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**UPDATED ENERGY AND  
CARBON EMISSIONS  
PROJECTIONS**

THE ENERGY WHITE PAPER

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# ENERGY WHITE PAPER

## UPDATED ENERGY AND CARBON EMISSIONS PROJECTIONS

### EXECUTIVE SUMMARY

This paper presents the latest DTI energy and carbon emissions projections to 2020. The work has been carried out in two stages. The first stage updates the baseline projections previously published in July 2006 to inform the Energy Review Report. The second stage provides a range of projections, reflecting high, central and low range assumptions around future fossil fuel prices and the estimated impact of the Energy White Paper proposals. In addition, these projections explore the impact of a carbon price<sup>1</sup> for the UK power sector covered by the EU Emissions Trading Scheme (EU ETS).

#### First stage: Baseline projections

The first stage projections, without the impact of the EU ETS and excluding the proposals in this White Paper, suggest that depending on the price of fossil fuels, the baseline projections of UK domestic carbon emissions are projected to be 149-151 million tonnes of carbon (MtC) in 2020. This is 3-5 MtC higher than the central baseline projections published with the Energy Review Report in July 2006. Part of the reason for this is that our projections now include a higher level of coal-fired electricity generation in 2020 than we projected last July, due to revised assumptions about the future level of fossil fuel prices and a reassessment of coal's future prospects.<sup>2</sup>

#### Second stage: White Paper projection

Carbon Emission projections including the White Paper proposals ( in contrast to the projections published with the Energy Review Report) also incorporate an EU ETS carbon price for UK sectors of €20/t CO<sub>2</sub> from 2010 and €25/t CO<sub>2</sub> from 2015-2020. These projections are based on central fossil fuel price assumptions and a range reflecting the low, central and high carbon savings estimated to be achieved through the White Paper proposals<sup>3</sup>. Including the estimated full impact of the EU ETS<sup>4</sup>, emissions are projected to be 119.2-128.8 MtC in 2020; equating to a 20-26% reduction on 1990 levels.

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<sup>1</sup> Except in the baseline projection, a carbon price of €20/tCO<sub>2</sub> from 2010 and €25/tCO<sub>2</sub> in 2015-2020 is assumed for the EU ETS sectors in the UK.

<sup>2</sup> The fossil fuel price assumptions used in these projections were subject to consultation in October 2006. Details of revisions to fuel price assumptions are given in Annex B

<sup>3</sup> The range of estimates of carbon savings reflect uncertainty about the timing and impact of the measures.

<sup>4</sup> The exact level of savings from the EU ETS beyond Phase II (2008-2012) will be decided in line with future national allocation plans. However, the White Paper presents an illustrative projection for savings from the EU ETS sectors in 2020, based on the assumption that the cap on emissions from the EU ETS sectors in the UK is equal to that agreed for Phase II. See Annex I for methodology.

Under the Kyoto Protocol, the UK has a goal to reduce Greenhouse Gas Emissions (GHGs) by 12.5% on 1990 levels by 2008-2012. The Kyoto goal is based on a basket of greenhouse gases (GHG) of which carbon emissions represent the largest share. The latest baseline projections show that the UK remains on track to exceed its Kyoto commitment.

Based on the carbon price we have assumed for the EU ETS sectors and assuming that the UK will achieve between high and low range of carbon savings for the White Paper proposals, the carbon emissions projections together with an estimated non-CO<sub>2</sub> GHG emissions projections<sup>5</sup> suggest that total UK GHG emissions will be between 147-159 million tonnes of carbon equivalent (MtCe) in 2020, i.e. 25-31% lower than 1990 levels. This projection of UK GHG emissions is inclusive of savings of carbon achieved domestically through a carbon price of €20/t CO<sub>2</sub> in 2010 and €25/t CO<sub>2</sub> in 2015-2020;<sup>6</sup> and is based on the central current non-carbon greenhouse gases projection and under central fossil fuel prices.

## **INTRODUCTION**

Emissions projections which informed the Energy Review Report were published in July 2006. The Energy Review projections have been updated to inform the Energy White Paper and summary results were included in Annex B of the White Paper<sup>7</sup>. The updated White Paper projections are presented here in more detail.

### **Reasons for updating the emissions projections**

Future fossil fuel prices are key assumptions in energy and emissions projections.

Fossil fuel price assumptions have been revised since the Energy Review projections following the consultation in October 2006. The revisions to the fossil fuel price assumptions show an increase in expected future fuel prices, consistent with other major projections (IEA and EIA) and reflecting market tightness and higher costs of production. The revision has also meant that the assumed relative price of fossil fuels have changed since the Energy Review projections. In the baseline scenario, and without a carbon price, the relative price of coal in the medium term is now more favourable compared with that in the July 2006 projections. This contributes, along with a reassessment of coal's future prospects, to an increase in coal capacity in the new baseline of up to 8GW by 2020. Details of current fuel price assumptions and comparison with earlier assumptions is shown in Annex B of this paper.

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<sup>5</sup> Provisional estimates of non-CO<sub>2</sub> greenhouse gas emissions provided by Defra to the EU in March 2007. These estimates are under review to take account of the CO<sub>2</sub> projections provided in this White Paper, and other information that has become available since the 2006 Climate Change Programme was published. Fully updated estimates should be available in the second half of 2007.

<sup>6</sup> These GHG projections do not take into account the estimated additional allowances purchased by EU ETS sectors from other Member States

<sup>7</sup> [www.dti.gov.uk/energy/whitepaper/page39534.html](http://www.dti.gov.uk/energy/whitepaper/page39534.html)

Other revisions to the projections have taken place since the July 2006 projections. These include updating the economic growth assumptions and incorporating Budget 2007 implications and inventory changes. Details are provided in Annex C. Other modeling and policy adjustments have also been made. These are explained later in the paper.

### **The fuel price scenario basis for the projections.**

The projections are based on three illustrative fuel price scenarios of low, central and high prices which reflect uncertainty over the outturn of future prices and are not detailed forecasts of future prices. The low prices scenario assumes a level oil price of 25\$ per bbl throughout the projection period (2010 – 2020), a central scenario assumes \$57/bbl in 2010, \$50/bbl in 2015 and \$52.5/bbl in 2020 and in the high price scenario where oil is \$70/bbl in 2010 increasing to \$80/bbl by 2020. Assumptions on other fossil fuels are shown in Annex B.

Excluding the impact of a carbon price and prior to the inclusion of White paper proposals provides the low, central and high baseline projections based on low, central and high fuel price assumptions for direct comparison with the Energy Review projections<sup>8</sup>.

Baseline projections and comparison with Energy Review projections are the basis for the next three sections of this paper. The subsequent sections (4 to 8) are based on the White Paper projections which include a carbon price and the White Paper proposals and are thus not directly comparable with the Energy Review projections.

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<sup>8</sup> There were four fuel price scenario projections in the Energy Review (low, high and two central fuel prices (favouring coal and favouring gas)).

## SECTION 1- Baseline projections results

### Baseline projections

Depending on the price of fossil fuels, and without the impact of the EU ETS and the proposals in this White Paper, UK domestic carbon emissions are projected to be 149-151 million tonnes of carbon (MtC) in 2020. This is 3-5 MtC higher than previous baseline projections published with the Energy Review Report in July 2006<sup>9</sup>. The main reason for this is that our projections now include a higher level of coal-fired electricity generation in 2020 than we projected last July, partly due to revised assumptions about the future level of fossil fuel prices. A more detailed breakdown of changes is provided later. Table 1 shows the latest baseline projections based on three fuel price scenarios.

**Table 1.1 Headline baseline projections (low, central and high fossil fuel price assumptions)**

MtC	2010	2015	2020
<b>Baseline low fossil fuel price assumptions<sup>1</sup></b>	146.9	150.7	149.2
<b>Baseline central fossil fuel price assumptions<sup>1</sup></b>	146.5	149.4	151.2
<b>Baseline high fossil fuel price assumption<sup>1</sup></b>	145.8	149.1	150.5

<sup>1</sup>Baseline projections exclude the impact of EU ETS and White Paper proposals.

More detailed results of emissions by sector in the low, central and high fossil fuel price scenario can be found in Annex A

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<sup>9</sup> The UK CO<sub>2</sub> emissions projections were published in February 2006 to inform the Climate Change Programme Review 2006 and updated to incorporate policies announced in the Climate Change Programme 2006. These projections (UEP26) informed the Energy Review in July 2006.

## **SECTION 2 – Baseline comparison with Energy Review July 2006 projections**

Although the level of fossil fuels in the various scenarios is not the same<sup>10</sup>, comparison of the headline carbon emissions projections published in the Energy Review Report in July 2006 (Table 2.1) with the current baseline emissions projections indicate that across all fuel price scenarios the projections are higher in the current baseline. Section 3 examines the reasons for this.

**Table 2.1** Energy Review Report projections published in July 2006 for the various fossil fuel price assumptions.

MtC	<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Energy Review low fossil fuel price assumption</b>	143.3	145.0	142.9
<b>Energy Review central (fav. coal) fossil fuel price assumption</b>	143.9	147.8	146.5
<b>Energy Review central (fav. gas) fossil fuel price assumption</b>	142.9	146.4	145.8
<b>Energy Review high fossil fuel price assumption</b>	142.5	145.9	146.9

Note: Energy Review projections exclude a carbon price.

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<sup>10</sup> Fossil fuel price assumptions comparisons are provided in Annex B ( Table B.1)

## SECTION 3 – Breakdown of changes in 2020 projected emissions

In this section the impact of the baseline changes are provided, based on examination of the sector changes in the central fuel price scenarios. The existing policies included in baseline are listed fully in Annex D.

**Table 3.1** illustrates the changes in the emissions by sector for the Energy Review central scenario (favouring coal) and the central baseline projection

MtC	Energy Review (July 2006) baseline		Updated central baseline		Changes	
	2010	2020	2010	2020	2010	2020
<b>Power stations</b>	44.1	46.5	45.3	49.0	1.2	2.5
<b>Refineries</b>	5.7	5.7	5.8	6.1	0.1	0.4
<b>Residential</b>	19.8	20.1	19.7	18.3	-0.1	-1.8
<b>Services</b>	5.9	6.9	6.2	6.6	0.3	-0.3
<b>Industry</b>	32.5	30.3	30.8	29.9	-1.7	-0.4
<b>Road Transport</b>	32.6	32.5	32.5	33.9	-0.1	1.3
<b>Off-road</b>	1.5	1.4	3.3	3.2	1.8	1.8
<b>Other Transport</b>	2.3	2.5	3.4	3.7	1.1	1.2
<b>LUC</b>	-0.5	0.7	-0.5	0.5	0.0	-0.1
<b>Total</b>	<b>143.9</b>	<b>146.5</b>	<b>146.5</b>	<b>151.2</b>	<b>2.6</b>	<b>4.7</b>

Note: The Energy Review July 2006 projection is the central favouring coal scenario. Both these projections assume no carbon price.

Table 3.2 shows the factors which have contributed to the changes in the emissions by sector.

- Oil prices, in the central scenario, are assumed to be \$57/bbl in 2010 (\$53/bbl in 2020) in current prices representing an increase of \$16/bbl and \$6/bbl in 2010 and 2020 respectively on the Energy Review July 2006 projection assumptions<sup>11</sup>. Therefore, under the assumption that the gas price rises with the oil price, current projected emissions in 2020 are higher than the Energy Review July 2006 projection, largely due to fuel switching - from gas to coal - in power generation (2 MtC in 2020)
- The impact of the revised growth forecast is most pronounced in industry (0.9MtC) and refining (0.4 MtC) in 2020.
- Emissions projections from flaring have been increased to reflect estimates derived in the context of finalising the ETS phase 2 NAP (0.6 MtC in 2020).

### Impact of policy proposals

- The longer-term impact of the Building Regulations 2005 (included in the Energy Review) has been included in this baseline saving in total carbon some 2.75 MtC in 2020.
- The successor to the VA to improve road vehicle fuel efficiency is excluded from this baseline (-1.8MtC in 2020) (The policy is re-instated as a policy proposal)

<sup>11</sup> The medium term fossil fuel price forecast has increased in line with IEA and EIA projections.



- inventory changes – see Table 3.2

**Table 3.2 presents the breakdown of changes within sectors (MtC)**

<b>Sector</b>	<b>Change</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Power stations</b>	Fuel switching	0.30	-1.35	1.97
	New Interconnectors	0	0.18	0.29
	CHP modeling revision	0.85	0.62	0.62
	Other	0.08	0.13	-0.24
	<b>Total power stations</b>	<b>1.24</b>	<b>-0.42</b>	<b>2.53</b>
<b>Refineries</b>	Modeling revision	0.13	0.32	0.44
	<b>Total refineries</b>	<b>0.1</b>	<b>0.3</b>	<b>0.4</b>
<b>Residential</b>	Incorporating additional savings from Building Reg 2005	-0.67	-1.34	-2.40
	Inventory change	0.63	0.63	0.63
	other	-0.05	-0.06	-0.07
	<b>Total residential</b>	<b>-0.1</b>	<b>-0.8</b>	<b>-1.8</b>
<b>Services</b>	Policy saving transfer to transport sector	0.2	0.2	0.2
	Revised growth	0.13	-0.03	-0.45
	Inventory change	0.01	0.01	0.01
	other	-0.05	-0.06	-0.06
	<b>Total services</b>	<b>0.3</b>	<b>0.1</b>	<b>-0.3</b>
<b>Industry</b>	Fuel price effect	-0.08	-0.04	0.15
	Inventory change	-1.97	-1.81	-1.77
	Flaring/ waste changes	-0.11	0.51	0.48
	CHP revision	-0.19	-0.14	-0.14
	CCA re-estimation	-0.10	-0.10	-0.10
	Revised growth	0.63	0.48	0.89
	other	0.09	0.38	0.12
	<b>Total industry</b>	<b>-1.7</b>	<b>-0.7</b>	<b>-0.4</b>
<b>Road transport</b>	Fuel price effect	-0.26	-0.27	-0.14
	Inventory change	-0.33	-0.30	-0.29
	Policy saving transferred	-0.20	-0.20	-0.20
	Policy adjustment (remove VA extension)	0.15	0.79	1.82
	Bio-fuel re-estimation	0.39	0.12	0.02
	other	0.12	0.08	0.10
	<b>Total road transport</b>	<b>-0.1</b>	<b>0.2</b>	<b>1.3</b>
<b>Off-road</b>	Inventory change	1.80	1.77	1.77
	other	0.02	0.03	0.02
	<b>Total off road</b>	<b>1.8</b>	<b>1.8</b>	<b>1.8</b>
<b>Other transport</b>	Increases to rail and shipping	0.99	1.05	1.10
	Inventory changes	0.09	0.10	0.11
	<b>Total other transport</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>
<b>Land Use Change (LUC)</b>	adjustment	-0.02	-0.08	-0.12
<b>Total all changes</b>		<b>2.58</b>	<b>1.63</b>	<b>4.65</b>

### Inventory changes.

The UK greenhouse gas inventory is updated annually to meet legal requirements for reporting to the United Nations Framework Convention on Climate Change and the European Union. The annual reports include new data and also revisions to historical estimates, which can occur because new underlying historical data may become available, and because new scientific information may enable better historical estimates to be made. In this case the time series is updated to ensure consistency. For record keeping purposes the inventory estimates and the underlying data are archived annually so that the basis of each year's estimate can be recovered if needed. The previous years' data are of course carried forward as input to the next update, but the archive is maintained. The Energy Review projections were on the “2003 inventory” basis. White Paper projections are on the most recent inventory basis and Table 3.3 – illustrates some of the main changes in updating the baseline emissions to the “2005 inventory” basis.

**Table 3.3 Brief description of sector impact of inventory changes**

	<b>Inventory change includes</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Residential</b>	includes peat, house & garden, non-aerosol household products	0.63	0.63	0.63
<b>Services</b>	includes agrochem	0.01	0.01	0.01
<b>Industry</b>	Transfer to off-road; includes energy recovery	-1.97	-1.81	-1.77
<b>Road Transport</b>	Improved data on lube oil emissions	-0.33	-0.30	-0.29
<b>Off-road</b>	Revised estimates of off-road fuel use	1.80	1.77	1.77
<b>Other Transport</b>	Revised estimates of aircraft support & military	0.09	0.10	0.11
<b>Total</b>		<b>0.23</b>	<b>0.30</b>	<b>0.46</b>

## SECTION 4- The impact of a carbon price for the EU ETS sectors and Energy White Paper measures

### The White Paper Projections

The White Paper projections are based on the same low, central and high fuel price assumptions as in the baseline but developed further to include an EU ETS carbon price<sup>12</sup>, consideration of purchased allowances for other EU Member States and the impact of the White Paper proposals. Including the White Paper proposals at a range of carbon saving estimates (as shown in Table 10.1 of the White Paper<sup>13</sup>) provides for a total of five scenario projections.

The White Paper projections are

- central prices, low WP policy estimates
- central prices, central WP policy estimates
- central prices, high WP policy estimates.
- low prices, central WP policy estimates
- high prices, central WP policy estimates

The White Paper projections (in contrast to the projections published with the Energy Review Report and the baseline in the previous sections) incorporate an EU ETS carbon price for UK sectors of €20/t CO<sub>2</sub> from 2010 and €25/t CO<sub>2</sub> from 2015-2020<sup>14</sup>.

The exact level of savings from the EU ETS beyond Phase II (2008-2012) will be decided in line with future national allocation plans. However, in the White Paper an illustrative projection for savings from the EU ETS sectors in 2020 is presented, based on the assumption that the cap on emissions in 2020 is equal to that under Phase II 2008-2012. Based on our latest baseline projections this will deliver 13.7 MtC savings in 2020. DTI projections show that in order to meet this level of effort, the EU ETS sectors in the UK will be required to purchase emissions allowances from other Member States. The methodology for calculating the estimated allowance is explained in Annex I.

Table 4.1 details the headline aggregate Energy White Paper projections. These are based on central fossil fuel price assumptions. The range reflects the low, central and high carbon savings estimated to be achieved through the White Paper proposals<sup>15</sup> (as described in Table 10.1 in Chapter 10). These estimates also include the estimated full impact of the EU ETS, including the impact of a carbon price and the additional effort from purchasing emissions allowances from other Member States.<sup>16</sup>

<sup>12</sup> In these projections, the carbon price impact is assumed to be limited to the power sector

<sup>13</sup> [www.dti.gov.uk/energy/whitepaper/page39534.html](http://www.dti.gov.uk/energy/whitepaper/page39534.html)

<sup>14</sup> €20/tCO<sub>2</sub> is broadly consistent with the current forward price of EU Allowances for Phase II (2008-2012) of the EU ETS (See: [www.nordpool.com](http://www.nordpool.com) carbon contracts for 21.05.07). The path of the carbon price beyond the end of Phase II is highly uncertain.

<sup>15</sup> The range of estimates of carbon savings reflect uncertainty about the timing and impact of the measures.

<sup>16</sup> Annex G.

**Table 4.1 Headline Energy White Paper projections (central fuel prices)**

MtC	1990	2005	2010	2020
<b>Baseline</b>	161.5	151.1	146.5	151.2
<b>Emissions projection including full impact of EU ETS and assuming low impact of White paper measures</b>	161.5	151.1	136.1	128.8
<b>Emissions projection including full impact EU ETS and assuming central impact of White Paper measures</b>	161.5	151.1	135.7	126.5
<b>Emissions projection including full impact of EU ETS and assuming high impact of White Paper measures</b>	161.5	151.1	135.2	119.2

Table 4.1 shows that, along with the impact of the EU ETS and depending on the level of savings from the White Paper proposals, UK carbon emissions are projected to be 119.2-128.8 MtC in 2020; equating to a 20-26% reduction on 1990 levels. This is illustrated in Figure 4.1.<sup>17</sup>

**Figure 4.1 Headline Energy White Paper projections**

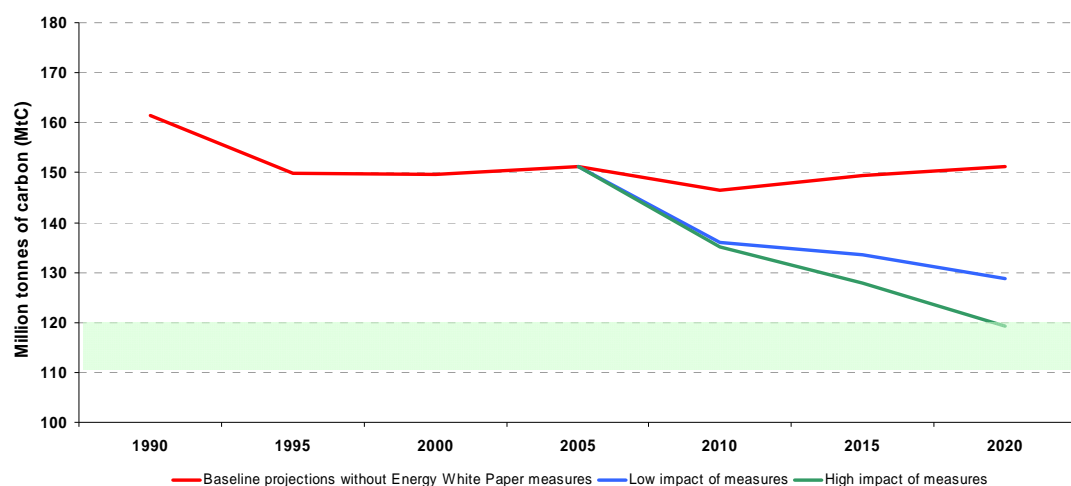


Table 4.2 provides more detail on sectoral projections compared to the baseline projections, under central fuel prices. The range reflects the low, central and high estimated carbon savings. The table also separates domestic carbon emissions, and emissions inclusive of allowances purchased from other Member States.

<sup>17</sup> The Climate Change Bill sets out a new legal framework for the UK to achieve, through international and domestic action, a 26-32% reduction in emissions on 1990 levels by 2020.

**Table 4.2 Sector emissions<sup>18</sup> under the central, high and low policy scenarios (MtC)**

		<b>CENTRAL FOSSIL FUEL PRICES</b>								
		<b>WP proposals assuming low carbon saving</b>			<b>WP proposals assuming central carbon saving</b>			<b>WP proposals assuming high carbon saving</b>		
	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Power Stations</b>	47.0	44.2	40.7	38.8	43.5	39.2	36.4	42.8	37.8	32.9
<b>Refineries</b>	5.0	5.8	6.0	6.1	5.8	6.0	6.1	5.8	6.0	6.1
<b>Residential</b>	23.1	19.7	18.0	15.6	19.7	17.7	15.0	19.6	17.4	14.4
<b>Services</b>	6.5	6.1	5.9	6.0	6.1	5.7	5.8	6.1	5.6	5.6
<b>Industry</b>	30.8	30.8	30.6	29.7	30.8	30.5	29.6	30.8	30.5	29.6
<b>Road transport<sup>1</sup></b>	32.7	32.4	32.7	32.2	32.4	32.7	32.2	32.1	29.8	27.2
<b>Off-road</b>	3.5	3.3	3.2	3.2	3.3	3.2	3.2	3.3	3.2	3.2
<b>Other transport</b>	3.1	3.4	3.4	3.5	3.4	3.2	3.4	3.4	3.1	3.3
<b>LUC</b>	-0.6	-0.5	0.0	0.5	-0.5	0.0	0.5	-0.5	0.0	0.5
<b>Total<sup>2</sup></b>	<b>151.1</b>	<b>145.2</b>	<b>140.4</b>	<b>135.6</b>	<b>144.4</b>	<b>138.3</b>	<b>132.2</b>	<b>143.4</b>	<b>133.6</b>	<b>122.9</b>
<b>EU ETS allowances purchased from abroad<sup>3</sup></b>		<b>9.1</b>	<b>6.8</b>	<b>6.8</b>	<b>8.7</b>	<b>6.2</b>	<b>5.7</b>	<b>8.3</b>	<b>5.6</b>	<b>3.7</b>
<b>Total including full impact of EU ETS</b>	<b>151.1</b>	<b>136.1</b>	<b>133.6</b>	<b>128.9</b>	<b>135.7</b>	<b>132.2</b>	<b>126.5</b>	<b>135.2</b>	<b>128.0</b>	<b>119.2</b>

<sup>1</sup>DTI forecasts of road transport emissions are consistent with, but at the top end of DfT emissions forecasts because of the different modelling approaches used. For more details of the DTI projection see Annex G

<sup>2</sup>Estimated carbon emissions inclusive of impact of White Paper proposals and a carbon price – but excluding the additional effort required through purchase of allowances from other EU Member States.

<sup>3</sup>Estimated emissions allowances purchased from abroad (either Emissions Unit Allowances from other Member States in EU ETS; or through Kyoto flexibility mechanisms such as the Clean Development Mechanism An explanation of the calculation of these figures is given in Annex I.

<sup>18</sup> Table 4.2 presents emissions by source. For a full set of results by end user see Annex E.

**Table 4.3 Sector emissions under the low and high fossil fuel price scenario assuming central carbon saving from WP policies (MtC)**

	Low fossil fuel prices assuming central carbon saving from WP policies			High fossil fuel prices assuming central carbon saving from WP policies		
	2010	2015	2020	2010	2015	2020
<b>Power Stations</b>	43.6	40.5	36.5	45.0	43.5	43.3
<b>Refineries</b>	5.8	6.0	6.1	5.8	6.0	6.1
<b>Residential</b>	20.5	20.3	17.4	19.2	16.7	13.9
<b>Services</b>	6.1	5.7	5.8	6.1	5.7	5.8
<b>Industry</b>	30.9	31.0	30.4	30.5	30.0	29.1
<b>Road transport</b>	32.9	33.7	33.0	32.1	32.1	31.3
<b>Off-road</b>	3.3	3.3	3.3	3.3	3.2	3.2
<b>Other transport</b>	3.4	3.3	3.5	3.4	3.2	3.3
<b>LUC</b>	-0.5	0.0	0.5	-0.5	0.0	0.5
<b>Total<sup>1</sup></b>	<b>146.0</b>	<b>143.8</b>	<b>136.5</b>	<b>144.9</b>	<b>140.4</b>	<b>136.6</b>
<b>EU ETS allowances purchased from abroad<sup>2</sup></b>	<b>8.8</b>	<b>7.5</b>	<b>5.9</b>	<b>10.2</b>	<b>10.5</b>	<b>12.7</b>
<b>Total including full impact of EU ETS</b>	<b>137.2</b>	<b>136.3</b>	<b>130.7</b>	<b>134.7</b>	<b>129.9</b>	<b>123.9</b>

<sup>1</sup>Estimated carbon emissions inclusive of impact of White Paper proposals and a carbon price – but excluding the additional effort required through purchase of allowances from abroad.

<sup>2</sup>Estimated emissions allowances purchased from abroad (either Emissions Unit Allowances from other Member States in EU ETS; or through Kyoto flexibility mechanisms such as the Clean Development Mechanism. An explanation of the calculation of these figures is given in Annex I.

## Progress against goals

### Greenhouse Gases and the Kyoto goal

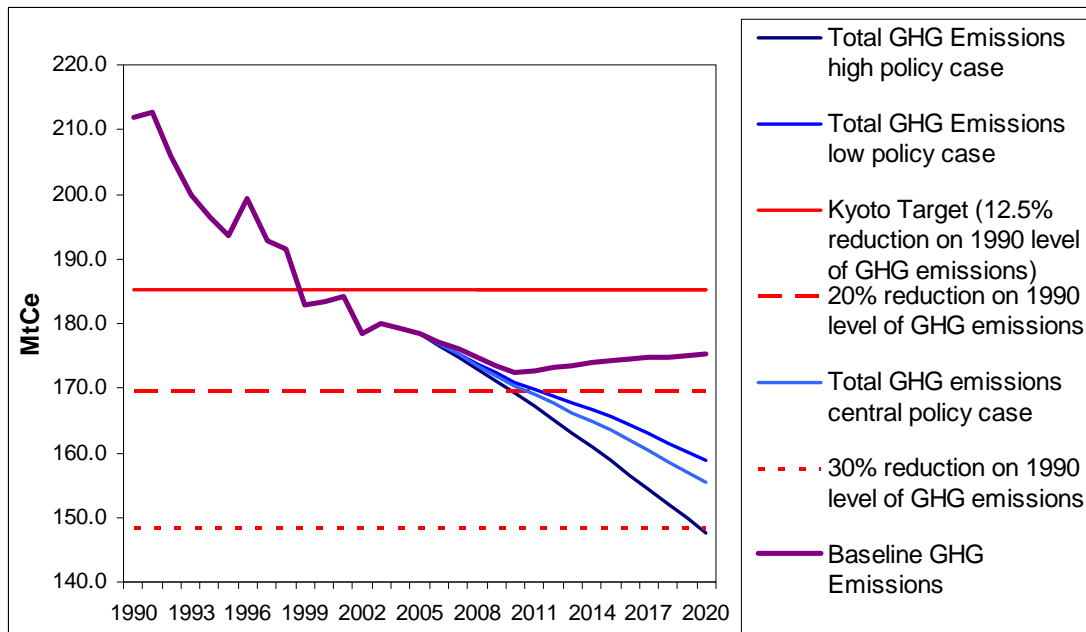
Under the Kyoto Protocol, the UK has a goal to reduce Greenhouse Gas Emissions (GHGs) by 12.5% on 1990 levels by 2008-2012. The Kyoto goal is based on a basket of greenhouse gases (GHG) of which carbon emissions represent the largest share. The latest baseline projections show that the UK remains on track to exceed its Kyoto commitment.

Based on the carbon price we have assumed for the EU ETS sectors and assuming that the UK will achieve between high and low range of carbon savings for the White Paper proposals, the carbon emissions projections together with an estimated non-CO<sub>2</sub> GHG emissions projections<sup>19</sup> suggest

<sup>19</sup> Provisional estimates of non-CO<sub>2</sub> greenhouse gas emissions provided by Defra to the EU in March 2007. These estimates are under review to take account of the CO<sub>2</sub> projections provided in this White Paper, and other information that has become available since the 2006

that total UK GHG emissions will be between 147-159 million tonnes of carbon equivalent (MtCe) in 2020, i.e. 25-30% lower than 1990 levels. This projection of UK GHG emissions is inclusive of savings of carbon achieved domestically through a carbon price of €20/t CO<sub>2</sub> in 2010 and €25/t CO<sub>2</sub> in 2020;<sup>20</sup> and is based on the central current non-carbon greenhouse gases projection and under central fossil fuel prices.

**Figure 4.2 Total Greenhouse Gas emissions (1990-2020)**



#### Draft Climate Change bill goal

The draft Climate Change Bill creates a new legal framework for the UK achieving, through domestic and international action at least a 60% reduction in emissions by 2050, and 26-32% by 2020, against a 1990 baseline. Table F1 in Annex F sets out these White Paper proposals projections against the draft Climate Change Bill goal. This progress is also assessed against our updated baseline.

Climate Change Programme was published. Fully updated estimates should be available in the second half of 2007.

<sup>20</sup> These GHG projections do not take into account the estimated additional allowances purchased by EU ETS sectors from other Member States

## SECTION 5 – Final energy demand results

### Energy demand by final user

The results are arranged on the basis of energy demand by final user and across all sectors and illustrate the estimated impact of the White Paper proposals in energy terms. Table 5.1 and 5.2 are based on central fuel price assumptions and White Paper proposals central estimates. Table 5.3 presents energy demand by final user for all five White Paper scenarios and Table 5.4 provides final energy demand by fuel aggregated across sectors.

**Table 5.1<sup>3</sup> Energy demanded by final user<sup>1</sup>, updated baseline with central fossil fuel prices (Mtoe)**

	Residential	Transport <sup>2</sup>	Industry	Services	Total updated baseline <sup>2</sup>
<b>1990</b>	40.8	41.7 (48.6)	38.7	19.2	<b>140.4 (147.3)</b>
<b>1995</b>	42.7	42.3 (50.2)	36.3	21.2	<b>142.5 (150.4)</b>
<b>2000</b>	46.8	44.3 (55.6)	35.2	21.5	<b>147.8 (159.1)</b>
<b>2005</b>	47.0	46.2 (59.2)	33.1	20.2	<b>146.5 (159.5)</b>
<b>2010</b>	41.7	49.1 (61.9)	33.9	19.5	<b>144.1 (157.0)</b>
<b>2015</b>	41.7	50.7 (65.5)	35.2	20.0	<b>147.5 (162.4)</b>
<b>2020</b>	41.3	51.5 (68.2)	37.0	20.4	<b>150.1 (166.9)</b>

**Table 5.2<sup>3</sup> Energy demanded by final user<sup>1</sup> for central fossil fuel prices and central WP policy estimates compared to updated baseline (Mtoe)**

	Residential	Transport <sup>2</sup>	Industry	Services	Total with central WP policy <sup>2</sup>	Total energy saved by WP proposals
<b>1990</b>	40.8	41.7 (48.6)	38.7	19.2	<b>140.4 (147.3)</b>	
<b>1995</b>	42.7	42.3 (50.2)	36.3	21.2	<b>142.5 (150.4)</b>	
<b>2000</b>	46.8	44.3 (55.6)	35.2	21.5	<b>147.8 (159.1)</b>	
<b>2005</b>	47.0	46.2 (59.2)	33.1	20.2	<b>146.5 (159.5)</b>	
<b>2010</b>	41.3	48.9 (61.7)	33.8	19.2	<b>143.3 (156.0)</b>	<b>0.8 Mtoe</b>
<b>2015</b>	38.2	49.7 (64.6)	34.8	18.5	<b>141.2 (156.1)</b>	<b>6.3 Mtoe</b>
<b>2020</b>	33.7	49.2 (65.9)	36.3	17.9	<b>137.0 (153.8)</b>	<b>13.1 Mtoe</b>

<sup>1</sup> on energy supplied basis, excludes non-energy uses, excludes fuel used for transformation in Iron & Steel sector

<sup>2</sup> Figures in brackets include fuel used in international aviation. For UK emissions accounting, international aviation fuel is excluded.

<sup>3</sup> Addendum, January 2008: tables 5.1 and 5.2 have been amended since original publication in May 2007. The presentation of the "Transport" and the "Totals" categories has been modified to distinguish more clearly between values excluding and including international aviation figures.



**Table 5.3 Energy demanded by final user for all WP policy estimates and fuel price scenarios (Mtoe)**

	Mtoe	2010	2015	2020
<b>Industry</b>	Central prices low WP policy impact	33.8	34.9	36.4
	Central prices central WP policy impact	33.8	34.8	36.3
	Central prices high WP policy impact	33.8	34.7	36.1
	Low prices central WP policy impact	34.1	35.7	37.6
	High prices central WP policy impact	33.9	34.6	36.4
<b>Residential</b>	Central prices low WP policy impact	41.5	39.2	35.3
	Central prices central WP policy impact	41.3	38.2	33.7
	Central prices high WP policy impact	41.2	37.4	32.0
	Low prices central WP policy impact	43.0	42.9	38.0
	High prices central WP policy impact	40.4	36.5	31.7
<b>Services</b>	Central prices low WP policy impact	19.3	18.9	18.6
	Central prices central WP policy impact	19.2	18.5	17.9
	Central prices high WP policy impact	19.1	18.1	17.1
	Low prices central WP policy impact	19.2	18.5	17.9
	High prices central WP policy impact	19.2	18.5	17.9
<b>Transport domestic<sup>4</sup></b>	Central prices low WP policy impact	48.9	49.7	49.2
	Central prices central WP policy impact	48.9	49.7	49.2
	Central prices high WP policy impact	48.6	47.7	44.4
	Low prices central WP policy impact	49.7	51.2	50.6
	High prices central WP policy impact	48.6	48.8	48.0
<b>TOTAL<sup>4</sup></b>	Central prices low WP policy impact	143.6	142.7	139.5
	Central prices central WP policy impact	143.3	141.2	137.0
	Central prices high WP policy impact	142.6	137.9	129.6
	Low prices central WP policy impact	145.9	148.3	143.9
	High prices central WP policy impact	142.1	138.4	134.0

<sup>4</sup> excludes international aviation

Tables 5.4 and 5.5 illustrate the comparative demand by fuel for the updated baseline in the central case and the central policy impact estimate with central fossil fuel prices. The total energy saved by White Paper proposals is estimated to be of 13.1 Mtoe by 2020

**Table 5.4 Final energy demanded by fuel in the updated baseline (central fossil fuel prices)**

Mtoe	Gas	Electricity	Solid fuel	Oil	Renewables	Total updated baseline <sup>4</sup>
<b>2010</b>	52.4	29.7	2.0	57.2	2.8	<b>144.1</b>
<b>2015</b>	53.4	31.1	1.8	58.3	2.9	<b>147.5</b>
<b>2020</b>	53.7	33.1	1.7	58.8	3.0	<b>150.1</b>

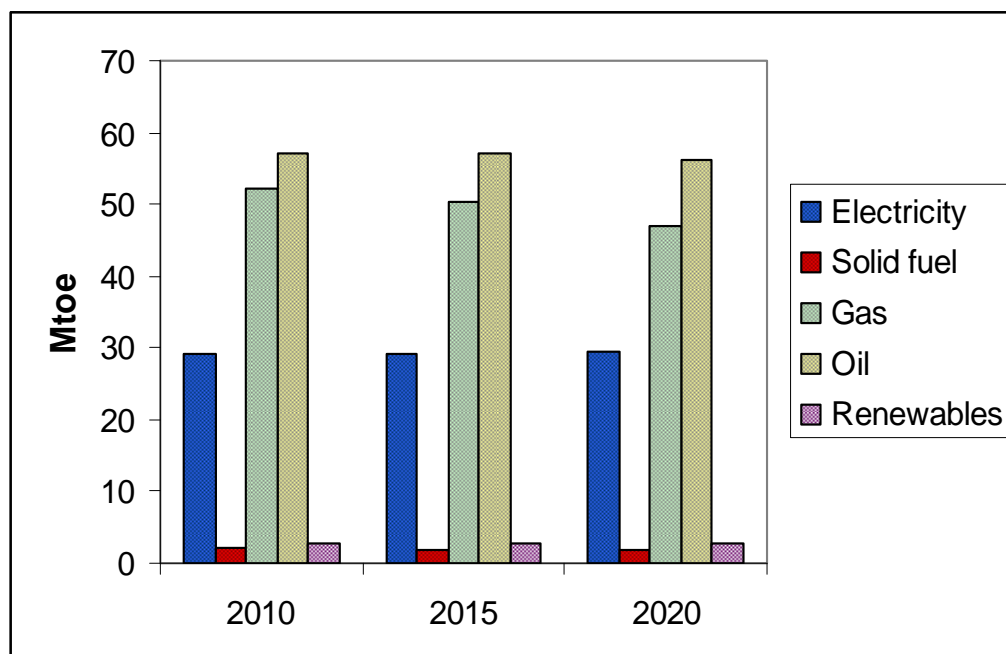
<sup>4</sup> excludes international aviation

**Table 5.5 Final energy demanded by fuel with central fossil fuel prices and central WP policy estimates (illustrated in Figure 5.1)**

Mtoe	Gas	Electricity	Solid fuel	Oil	Renewables	Total WP central policy <sup>4</sup>	Total updated baseline <sup>4</sup>	Total energy saved by WP proposals
<b>2010</b>	52.2	29.2	2.0	57.1	2.8	<b>143.3</b>	<b>144.1</b>	<b>0.8 Mtoe</b>
<b>2015</b>	50.2	29.2	1.8	57.2	2.9	<b>141.2</b>	<b>147.5</b>	<b>6.3 Mtoe</b>
<b>2020</b>	47.0	29.4	1.7	56.1	2.9	<b>137.0</b>	<b>150.1</b>	<b>13.1 Mtoe</b>

<sup>4</sup> excludes international aviation

**Figure 5.1 Projected Total Final Energy Demand**



## SECTION 6 – Electricity generation<sup>21</sup>

Electricity demand is reduced substantially in the longer term by the White Paper proposals at all level of savings (low, central and high estimates of policy saving) reducing the need for new capacity. The main impact of emissions trading is to switch generation into lower carbon intensive forms of generation (from coal to gas) but also by changing the balance of new capacity additions away from coal towards gas.

The key assumptions on plant closures, construction and operations, environmental and efficiencies are

- Between 2005 and 2010 around 2.5GW of existing capacity is assumed to close of which 1.5GW of this is assumed to be nuclear and 0.5GW coal capacity.
- In the longer term, coal fired capacity reacts to the LCPD and general ageing of the fleet. Although energy price assumptions tend to argue in favour of extended coal lifetimes, environmental limits put pressure in the opposite direction.
- Plant operations are constrained by relevant environmental limits. Except where FGD equipment is available, a coal plant, opted out under the Large Combustion Plant Directive (LCPD) arrangements, is assumed to operate on low sulphur coal. New coal plants are assumed to be fitted with SO<sub>2</sub> and NO<sub>x</sub> clean up equipment.
- It is assumed that nearly all coal stations remaining on the system during the latter half of this decade will have some form of over-fire air system fitted, or will achieve equivalent emission reductions.
- Construction activity has slowed in recent years. The main sources of growth in capacity being the renewables sector and new Combined Cycle Gas Turbine (CCGT) plants whose construction began a number of years previously.
- In the central energy price case, between 2016 and 2020, the projections assume new higher efficiency coal stations with the ability to collect and store carbon dioxide will be built
- Renewables capacity is assumed to rise in accord with the Government's commitment to ensuring that the contribution of renewables over time to the generation mix rises over time. The assumption behind this increase is based on modelling conducted by Oxera for the Energy White Paper.<sup>22</sup>

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<sup>21</sup> The coverage of this sector is major power producers – as defined in the Digest of UK Energy Statistics - plus all other renewable generators. The activities of other generators of electricity are included within the industrial or commercial sectors.

<sup>22</sup> Oxera *Reform of the Renewables Obligation – what is the likely impact of changes?* (2007) [www.dti.gov.uk/energy/whitepaper/page39534.html](http://www.dti.gov.uk/energy/whitepaper/page39534.html)

- It is assumed there are continued incentives to achieve the highest possible operational efficiency<sup>23</sup> of coal-fired and CCGT power stations and thereby to reduce the underlying level of emissions, both to reduce CO<sub>2</sub> emissions and also reflecting a period of transition from the current acid gas control regime to that pertaining under the Large Combustion Plant Directive (LCPD).
- Across the range of scenarios examined, the average coal plant efficiency in 2010 is assumed to be 35% and for existing CCGTs an average of between 46% and 47% is achieved. For new CCGTs constructed by 2010, an efficiency of close to 53% is assumed.

Table 6.1 shows the projected electricity supply by fuel, assuming WP proposals at their low, central and high estimates based on central fuel prices and a carbon price.

**Table 6.1 Electricity supply by fuel for WP low, central, high policy estimates and central fossil fuel prices, including a carbon price<sup>24</sup>** (updated baseline generation figures and generation figures for other policy cases can be found in Annex H)

TWh	WP proposals assuming low carbon saving		WP proposals assuming central carbon saving		WP proposals assuming high carbon saving	
	2010	2020	2010	2020	2010	2020
<b>Coal</b>	113	67	113	71	113	77
<b>Oil</b>	2	1	2	1	2	1
<b>Gas</b>	136	223	129	195	123	156
<b>Nuclear</b>	68	25	68	25	68	33
<b>Renewables<sup>1</sup></b>	29	46	33	57	36	67
<b>Imports</b>	11	16	11	16	11	16
<b>Storage</b>	3	3	3	3	3	3
<b>Total</b>	<b>362</b>	<b>381</b>	<b>359</b>	<b>367</b>	<b>357</b>	<b>352</b>

<sup>1</sup> renewables includes waste and cover both eligible and non-eligible sources

- The total supply required declines as the policy impact on overall demand increases. This typically results in a reduction in required new plant construction and is most clearly reflected in the level of generation from gas. Generation from coal declines only a little from ex-policy levels in 2010, but a more significant fall is evident in later years, reflecting a reduction in the amount of new coal capacity constructed, in addition to the impact of the CO<sub>2</sub> price on the balance between gas and coal generation.

<sup>23</sup> Efficiency is based on the higher heating value and is after deducting own use. Such figures are a little lower than those published in DUKES, which are based on a slightly different definition.

<sup>24</sup> The figures in this table relate to gross supply to the grid, plus imports of electricity. See also footnote 23 relating to the coverage of the sector. DUKES Table 5.6 is the key source of actual data for the sector.

- The Government is consulting on the proposal of allowing new nuclear power stations. Because this issue is subject to consultation, we have only allowed the model to build new nuclear power stations in the high case, to show the potential impact of the proposal, for purely illustrative purposes. On this basis, a small nuclear build of 1GW is projected in 2020.
  
- The policy measures in the central policy case act to reduce electricity demand by some almost 50 TWh in 2020, in broad terms, representing a cut in demand of over 10%.
  
- Renewable generation increases substantially from current levels in all cases, more so in the high policy case<sup>25</sup>.
  
- Imports of electricity are assumed to increase as a result of the addition of new capacity through the next ten years. Similarly, the availability of new interconnection capacity allows for increased export levels in future. The contribution to overall electricity supply from other sources – not included directly in this sector - increases by relatively little between 2005 and 2010 but by almost 3TWh/yr between 2010 and 2015. The contribution of other suppliers acts to reduce the supply required from the mainstream power sector.

Other results are detailed in Annex H which also includes plant capacity projections.

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<sup>25</sup>More detail on the renewable assessment can be found in <http://www.dti.gov.uk/energy/sources/renewables/policy/obligation/ro-and-energy-review/page27959.html>

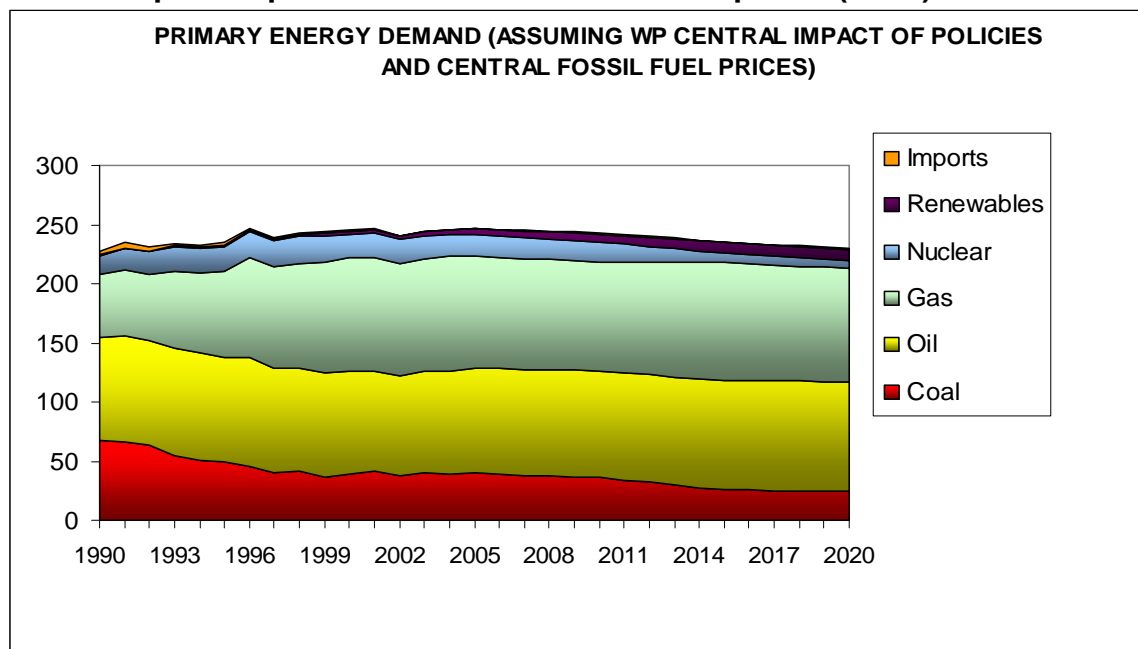
## SECTION 7- Primary energy demand results

### Primary energy demand

Primary demand for energy includes all inland consumption of primary fuels for energy and non energy use<sup>26</sup>.

Figure 7.1 illustrates how the demand for coal has steadily diminished since 1990 and is projected to reach an estimated use of 24.2 Mtoe by 2020. The demand for oil has experienced a stable pattern from 1990 with demand for oil reaching 93 Mtoe by 2020. Gas demand is projected to reach 95.7 Mtoe in 2020, little changed overall from 2005 levels. Nuclear is estimated to diminish in the future reflecting the currently expected profile of plant closures. Renewable demand reaches 10 Mtoe by 2020.

**Figure 7.1 Historic and projected primary energy demand assuming WP central impact of policies and central fossil fuel prices (Mtoe)**



<sup>26</sup> See <http://www.dti.gov.uk/energy/statistics/publications/dukes/page29812.html>

**Table 7.1 Primary energy demand by fuel, comparison between updated central baseline and central WP policy estimates with central fossil fuel prices**

Mtoe		Central fossil fuel prices and central WP policy estimates		updated central baseline		Changes	
		2005	2010	2020	2010	2020	2010
<b>Coal</b>	40.0	35.8	24.2	37.7	35.2	-1.9	-11.0
<b>Oil</b>	89.1	88.0	90.8	88.1	93.5	-0.1	-2.7
<b>Gas</b>	94.3	92.5	95.7	92.5	101.8	0.0	-6.0
<b>Nuclear</b>	18.4	16.9	6.2	16.9	6.2	0.0	0.0
<b>Renewables</b>	4.6	8.9	12.1	8.9	10.8	0.0	1.4
<b>Imports</b>	0.6	0.7	0.5	0.7	0.5	0.0	0.0
<b>Total</b>	<b>246.9</b>	<b>242.8</b>	<b>229.5</b>	<b>244.9</b>	<b>247.8</b>	<b>-2.0</b>	<b>-18.4</b>

Mtoe	Central fossil fuels prices and low WP policy estimates		Central fossil fuel prices and central WP policy estimates		Central fossil fuels prices and high WP policy estimates		Low fossil fuel prices and central WP policy estimates		High fossil fuel prices and central policy estimates	
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
<b>Coal</b>	35.8	23.3	35.8	24.2	35.8	25.8	35.5	23.1	38.4	35.7
<b>Oil</b>	88.0	90.8	88.0	90.8	87.6	84.1	89.4	94.1	87.3	88.3
<b>Gas</b>	93.8	101.6	92.5	95.7	91.3	88.1	94.8	103.2	89.4	84.4
<b>Nuclear</b>	16.9	6.2	16.9	6.2	16.9	8.1	16.9	6.2	16.9	6.2
<b>Renewables</b>	8.1	10.1	8.9	12.1	9.7	15.3	8.5	9.9	9.5	12.5
<b>Imports</b>	0.7	0.5	0.7	0.5	0.7	0.5	0.7	0.5	0.7	0.5
<b>Total</b>	<b>243.3</b>	<b>232.4</b>	<b>242.8</b>	<b>229.5</b>	<b>242.0</b>	<b>221.8</b>	<b>245.7</b>	<b>237.1</b>	<b>242.2</b>	<b>227.7</b>

In the central energy price case, policy acts to reduce the overall level of primary energy demand. The main effects occur in the final demand sectors where policy directly impacts on the level of energy use and also in power generation, where fuel switching is important. In the central energy price case, central policy reduces projected demand by around 7.5% in 2020.

## SECTION 8 - Projection uncertainty

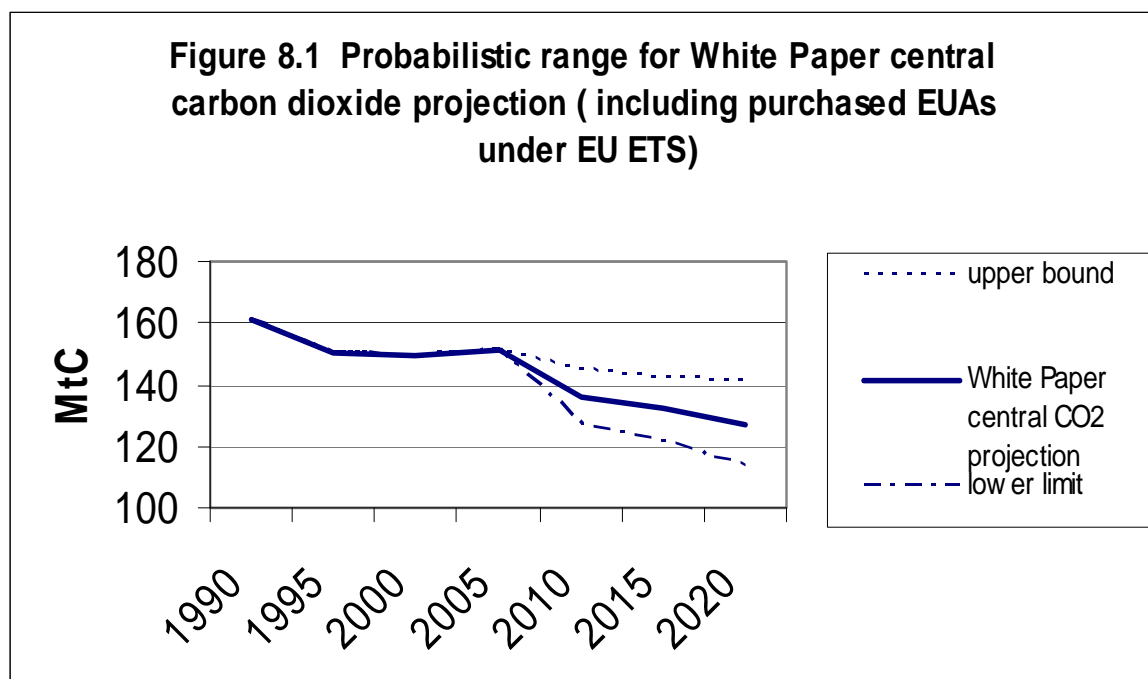
Analysis of projection uncertainty.

Projections into the future will be inherently uncertain. Uncertainty arises from a number of sources which include macroeconomic uncertainty (future economic growth and international fuel prices uncertainty), modelling uncertainty (the ability to project future energy market behaviour based on past trends) or policy based uncertainty (the ability to assess policy impact).

To illustrate some of the broad sources of uncertainty contributing to overall levels of uncertainty in the White Paper projections, and progress towards our Kyoto commitment, the following uncertainties have been explored

- Parameter ( modelling) uncertainty
- Fuel price
- Policy ( existing and White Paper measures)
- EU ETS
- Land use change projections
- Non-CO<sub>2</sub> projections ( where projections include other greenhouse gases<sup>27</sup> projections)

A White Paper projection of carbon emissions including the impact of the White Paper proposals and the EU ETS are illustrated in Figure 8.1 showing a probabilistic range around the central carbon emission projection of plus or minus 13.5 MtC in 2020 ( 9MtC in 2010).



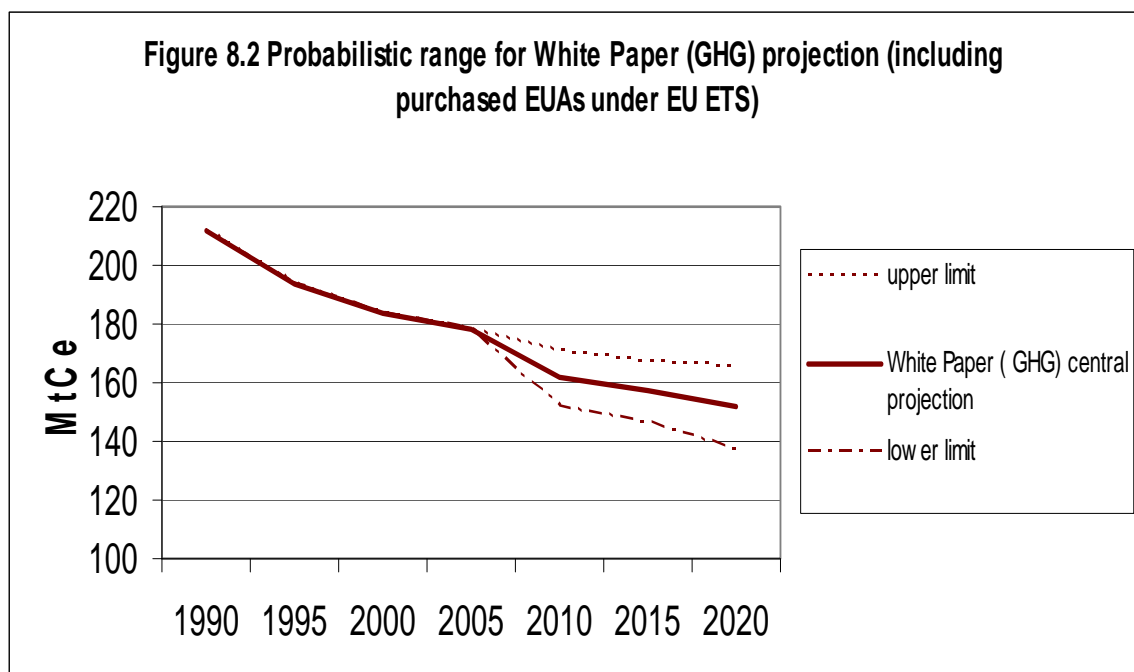
<sup>27</sup> The five non- CO<sub>2</sub> greenhouse gases covered by the Kyoto Protocol are methane, nitrous oxide, HFCs, PFCs and SF<sub>6</sub>.



The largest component of this uncertainty is parameter or modelling uncertainty ( 40% in 2020), total policy uncertainty for existing and proposed measures is estimated to be some 28%, fuel price contributes 21%, the impact of EU ETS<sup>28</sup> some 10%, and land use change (LULUCF) some 3%.

Extending this analysis to the projection of the total carbon plus other greenhouse gases provides a range of uncertainty of some plus or minus 14MtC, illustrated in figure 8.2, of which modelling of non-CO2 GHS projection contributes some 4%.

This suggests that in 2010 UK emissions of greenhouse gases will be between 19% and 28% below 1990 levels, with the central scenario about 24% below. This range takes into account macroeconomic, policy and modelling uncertainties and therefore our Kyoto goal is likely to be met on the basis of current policy.



<sup>28</sup> Based on illustrative levels of effort for the high, central and low price scenarios.

## Annex A

**Table A1- Emissions by source in the low, central and high fossil fuel price scenario**

MtC	Updated baseline low fossil fuel prices		Updated baseline central fossil fuel prices		Updated baseline high fossil fuel prices	
	2010	2020	2010	2020	2010	2020
<b>Power Stations</b>	44.2	42.8	45.3	49.0	45.8	51.2
<b>Refineries</b>	5.8	6.1	5.8	6.1	5.8	6.1
<b>Residential</b>	20.6	20.7	19.7	18.3	19.2	17.2
<b>Services</b>	6.2	6.6	6.2	6.6	6.2	6.6
<b>Industry</b>	30.8	30.7	30.8	29.9	30.4	29.1
<b>Road transport</b>	33.0	34.8	32.5	33.9	32.2	32.9
<b>Off-road</b>	3.3	3.3	3.3	3.2	3.3	3.2
<b>Other transport</b>	3.4	3.8	3.4	3.7	3.4	3.6
<b>LUC</b>	-0.5	0.5	-0.5	0.5	-0.5	0.5
<b>Total</b>	<b>146.9</b>	<b>149.2</b>	<b>146.5</b>	<b>151.2</b>	<b>145.8</b>	<b>150.5</b>

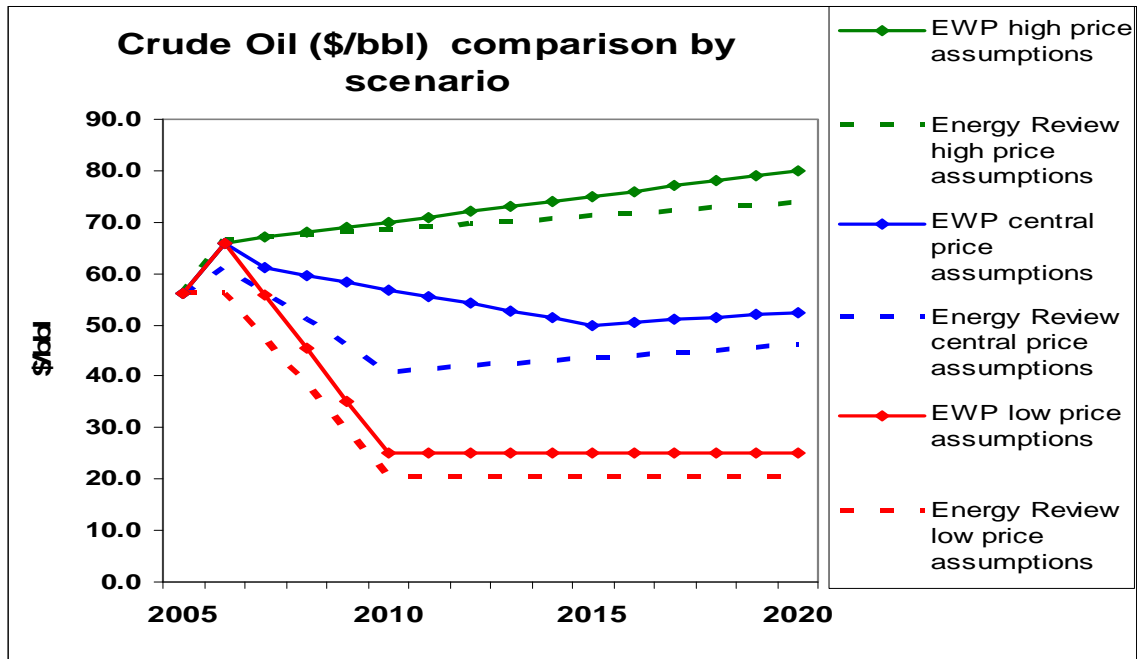
## Annex B- Fossil fuel price assumptions

**Table B1 Central fossil fuel price assumptions, Energy White Paper 2007 and Energy Review Report 2006**

2006 prices	Crude oil \$/bbl		Natural gas NBP p/therm		ARA coal £/tonne	
	Energy White Paper	Energy Review (July 2006)	Energy White Paper	Energy Review (July 2006)	Energy White Paper	Energy Review (July 2006)
<b>2010</b>	57	41	42	34	30	28
<b>2015</b>	50	43	38	36	31	27
<b>2020</b>	53	46	40	37	32	26

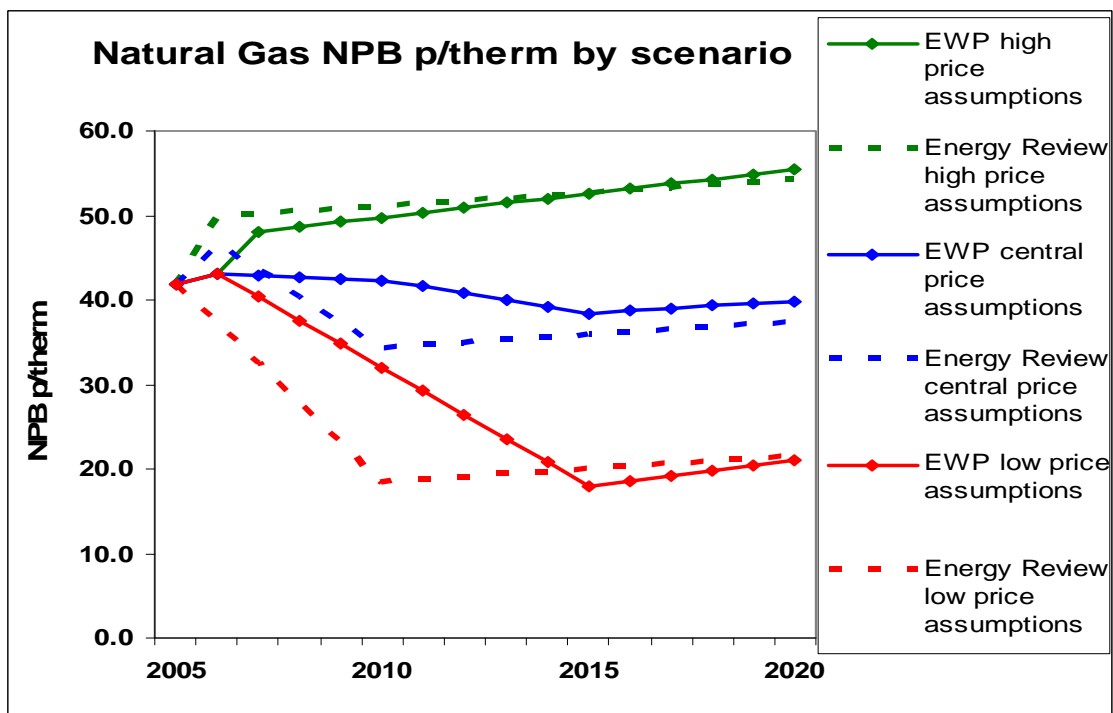
**In the central price scenario** the oil price assumptions are higher than those published in July 2006. The upward revisions are consistent with changes made by the International Energy Agency (IEA) and the US Energy Information Administration (EIA), and reflect the continuing market tightness and higher costs of production. It is assumed that oil prices ease post 2006 as new production capacity comes on-stream and demand growth moderates, leading to an increase in spare production capacity. However, as oil is increasingly produced from more expensive sources and we assume spare capacity remains relatively tight, prices are assumed to remain higher than the historic average. Prices gradually rise from 2015, but forecast shows a fall from 2010 to 2020, consistent with the trends assumed by the IEA and EIA, oil prices gradually rise from 2015, reflecting an expected increase in the market share of a small number of major producing countries - strengthening their ability to support prices through coordinated production and investment decisions - together with rising marginal production costs elsewhere. Oil is now assumed to be 57 \$/bbl in 2010 and 53 \$/bbl in 2020 (2006 prices).

Figure B1 illustrates changes in the oil price projections in the low, central and high case scenarios (\$/bbl)



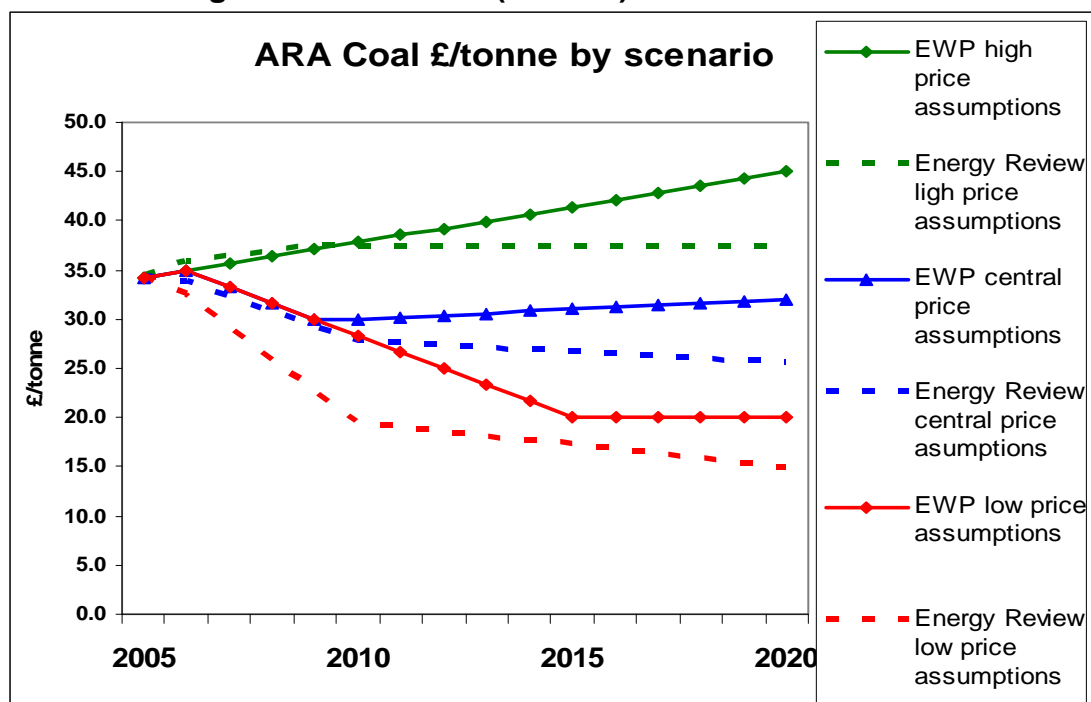
The gas price in Europe is assumed to remain oil linked and UK gas prices are assumed to be similar to continental prices plus the transport cost differential. Gas is assumed to be 42 p/therm in 2010, and 40p/therm in 2020.

Figure B2 illustrates changes in the gas price projections in the low, central and high case scenario (p/therm)



Coal prices are assumed to fall in the short-term due to additional investment in coal production and transport capacity, as a result of recent high prices. However, post 2010 coal prices are assumed to grow in line with oil and gas prices due to the opportunities for substituting between the different fossil fuels. Coal is assumed to be £30/tonne in 2010 and £32/tonne in 2020.

**Figure B3 illustrates the change in coal price projections in the low, central and high case scenarios (£/tonne)**



The high, central and low prices assumptions are illustrative scenarios developed by DTI analysts and are used to reflect uncertainty over the outturn of future prices in the modeling. They are not detailed forecasts or predictions of future prices.

**In the high price scenario** the oil price is assumed to be 70\$/bbl in 2010 increasing to 80\$/bbl by 2020, a gas price of 50p/therm to 55p/therm and a coal price of £38/tonne to £45/tonne respectively.

**In the low price scenario** the oil price is assumed to be stable at 25 \$/bbl in 2010 and 2020. The gas price is assumed to be 32 p/therm by 2010 and 21p/therm by 2020. A coal price of 28 £/tonne in 2010 and 20£/tonne in 2020 is projected.

Tables A2 to A4 give a more detailed account of changes in fossil fuel price projections from July 2006 assumptions.

**Table B2- Changes in oil price projections**

<b>Crude Oil (\$/bbl) (2006 prices)</b>	<b>Energy White Paper low prices</b>	<b>Energy Review , July 2006 low prices</b>	<b>Energy White Paper central prices</b>	<b>Energy Review , July 2006 central prices</b>	<b>Energy White Paper, high prices</b>	<b>Energy Review, July 2006 high prices</b>
<b>2010</b>	25	20	57	41	70	69
<b>2015</b>	25	20	50	43	75	71
<b>2020</b>	25	20	53	46	80	74

**Table B3- Changes in gas price projections**

<b>Natural Gas p/therm (2006 prices)</b>	<b>Energy White Paper low prices</b>	<b>Energy Review , July 2006 low prices</b>	<b>Energy White Paper central prices</b>	<b>Energy Review , July 2006 central prices</b>	<b>Energy White Paper, high prices</b>	<b>Energy Review, July 2006 high prices</b>
<b>2010</b>	32	18	42	34	50	51
<b>2015</b>	18	20	38	36	53	53
<b>2020</b>	21	21	40	37	55	54

**Table B4- Changes in coal price projections**

<b>ARA coal £/tonne (2006 prices)</b>	<b>Energy White Paper low prices</b>	<b>Energy Review , July 2006 low prices</b>	<b>Energy White Paper central prices</b>	<b>Energy Review , July 2006 central prices</b>	<b>Energy White Paper, high prices</b>	<b>Energy Review, July 2006 high prices</b>
<b>2010</b>	28	19	30	28	38	37
<b>2015</b>	20	17	31	27	41	37
<b>2020</b>	20	15	32	26	45	37

## Annex C – Economic Growth Assumptions

Near and medium-term economic growth assumptions are consistent with HM Treasury announcements in the most recent Budgets or Pre Budget Reports. Longer term GDP growth assumptions are based upon (but not exclusively) the on the HM Treasury neutral growth assumptions and longer term manufacturing growth is a DTI modeling assumption.

**Table C1 Economic growth assumptions: GDP and manufacturing (percent per annum).**

Percent per annum growth	2006	2007	2008	2009	2010	2011	2012	2013-20
<b>GDP White Paper projection</b>	2.75	3.0	2.75	2.75	2.5	2.5	2.0	2.0
<b>GDP Energy Review Projections</b>	2.25	3.0	3.0	2.5	2.5	2.5	2.5	2.5
<b>Manufacturing White Paper projection</b>	1.5	1.875	2.0	2.0	1.125	1.125	1.125	1.125
<b>Manufacturing Energy Review Projections</b>	0.75	2.0	2.0	1.125	1.125	1.125	1.125	1.125

**Table C2- illustrates projected industrial growth indices by sector**

	<b>Food, drink &amp; tobacco</b>	<b>Textiles, leather &amp; clothing</b>	<b>Pulp, paper printing &amp; publishing</b>	<b>Chemicals &amp; chemical products</b>	<b>Non-metallic minerals</b>
<b>2000</b>	100.0	100.0	100.0	100.0	100.0
<b>2005</b>	104.0	70.6	93.0	111.7	109.5
<b>2010</b>	<b>106.6</b>	<b>52.1</b>	<b>98.2</b>	<b>131.7</b>	<b>119.8</b>
<b>2015</b>	110.4	42.8	101.3	152.6	125.8
<b>2020</b>	114.0	34.9	104.0	175.9	131.8

	<b>Non-ferrous metals<sup>1</sup></b>	<b>Engineering &amp; vehicles</b>	<b>Construction and other industry</b>	<b>Iron and Steel<sup>1</sup></b>
<b>2000</b>	100.0	100.0	100.0	100.0
<b>2005</b>	87.4	93.1	109.9	118.8
<b>2010</b>	123.7	105.9	123.1	126.2
<b>2015</b>	125.4	113.3	131.8	130.2
<b>2020</b>	125.9	121.2	141.1	133.6

<sup>1</sup>whole sector growth includes a measure of physical output

## Annex D – Climate Change Policies in the baseline

**Table D1- provides the sector breakdown of carbon savings from existing policies (MtC)**

		2010	2015	2020
<b>Business</b>	CT support for Energy efficiency in SME	0.1	0.1	0.1
	Energy saving opportunities in SMEs	0.1	0.1	0.1
	UK ETS	0.3	0.3	0.3
	Building regulations (re-evaluated)	0.5	1.1	1.6
	Carbon Trust	1.1	1.1	1.1
	Climate Change Agreement	2.9	2.9	2.9
	Subsidy to biomass	0.1	0.1	0.1
	<b>Total business</b>	<b>5.0</b>	<b>5.7</b>	<b>6.1</b>
<b>Transport</b>	RTFO (re-evaluated)	1.2	1.5	1.6
	Voluntary Agreement package (excluding VA extension beyond 2009)	2.3	3.1	3.6
	10 Year Plan	0.8	0.8	0.8
	Sustainable Development (Scotland and Wales)	0.1	0.1	0.1
	Local Authorities policies	0.2	0.2	0.2
		<b>Total transport</b>	<b>4.7</b>	<b>5.7</b>
<b>Residential</b>	Energy Performance of Buildings Directive	0.2	0.2	0.2
	Package of measures (e.g. energy efficiency in buildings)	0.1	0.1	0.1
	EEC1 (2002-2005) (re-evaluated)	0.3	0.3	0.3
	EEC2 (2005-2008) (re-evaluated)	0.5	0.5	0.5
	CERT (2008-2011) (re-evaluated)	1.1	1.1	1.1
	Building Regulations (re-evaluated)	1.5	2.3	3.3
	Warm front and fuel poverty programmes	0.4	0.4	0.4
	Energy efficient products	0.4	0.4	0.4
	<b>Total residential</b>	<b>4.5</b>	<b>5.3</b>	<b>6.2</b>
<b>Agriculture</b>	Food crop strategy	0.1	0.1	0.1
	Woodland grant scheme (England)	0.2	0.2	0.2
	Woodlands planting since 1990 (Scotland)	0.5	0.5	0.5
	<b>Total agriculture sector</b>	<b>0.8</b>	<b>0.8</b>	<b>0.8</b>
<b>Public sector</b>	Revolving loan	0.1	0.1	0.1
	Devolved Administration	0.3	0.3	0.3
	Activities including CT	0.2	0.2	0.2
	<b>Total public sector</b>	<b>0.6</b>	<b>0.6</b>	<b>0.6</b>
<b>TOTAL EXCLUDING EU ETS</b>		<b>16</b>	<b>18</b>	<b>20</b>

Other measures included within the WP baseline are the Climate Change Levy with projected savings of 1.1 MtC by 2020, the Fuel Duty Escalator (an estimated 1.9 MtC by 2020) and the Renewables Obligation with estimated savings of 3.9 MtC by 2020. Thus, excluding the impact of EU ETS the estimated total saving of existing measures is some 27 MtC<sup>29</sup>

<sup>29</sup> Savings represented in this table are based on estimates against counterfactual future projections that differ from those implied by DTI emissions baseline which represent a continuation of historic trends. Therefore the addition of total savings as shown in the table to the emissions projection may overstate the overall level of emissions had the policies not



Table D2 provides the sector breakdown of carbon savings from WP policies (MtC) in the central case<sup>30</sup>

		2010	2015	2020
<b>Energy supply</b>	CCS demonstration project	0.0	0.0	0.5
	Changes to Renewables Obligation	0.2	0.7	0.8
	<b>Total Energy Supply</b>	<b>0.2</b>	<b>0.7</b>	<b>1.3</b>
<b>Business</b>	Carbon reduction Commitment	0.0	0.4	0.8
	Products policy	0.2	0.5	0.9
	Energy Performance of Buildings Directive	0.0	0.2	0.3
	Business Smart Metering	0.1	0.2	0.2
	<b>Total business</b>	<b>0.3</b>	<b>1.3</b>	<b>2.3</b>
<b>Transport</b>	Future Voluntary Agreements	0.1	0.7	1.7
	Domestic aviation included in EU ETS	0.0	0.3	0.3
	<b>Total transport</b>	<b>0.1</b>	<b>1.0</b>	<b>2.0</b>
<b>Residential</b>	Better billing	0.0	0.1	0.1
	Real time displays and Smart metering	0.1	0.2	0.1
	Product policy	0.2	0.5	0.9
	Supplier obligation	0.0	1.8	3.5
	DCLG- Zero carbon homes	0.0	0.0	1.2
	Energy Performance of Buildings Directive	0.0	0.2	0.4
	<b>Total residential</b>	<b>0.3</b>	<b>2.7</b>	<b>6.2</b>
<b>Public sector</b>	Carbon Reduction Commitment	0.0	0.1	0.2
	Carbon neutral government	0.0	0.1	0.2
	Products policy	0.0	0.1	0.2
	EPBD- Energy Performance Buildings Directive	0.0	0.2	0.3
	<b>Total public sector</b>	<b>0.0</b>	<b>0.5</b>	<b>0.9</b>
TOTAL EXCLUDING EU ETS		1	6	13
EU ETS illustrative level of effort		10	12	14
<b>TOTAL</b>		<b>11</b>	<b>18</b>	<b>27</b>

been in place. The overall carbon saving from existing policies which may be added to the White Paper emissions projection is some 25MtC.

<sup>30</sup> These measures correspond to those listed in Chapter 10, Table 10.1 of the White Paper

**Table D3 provides the sector breakdown of carbon savings from WP policies (MtC) in the low and high case for 2020<sup>31</sup>**

		Low policy impact	High policy impact
		2020	2020
<b>Energy supply</b>	CCS demonstration project	0.3	1.0
	Changes to Renewables Obligation	0.4	1.1
	<b>Total Energy Supply</b>	<b>0.6</b>	<b>2.1</b>
<b>Business</b>	Carbon Reduction Commitment	0.8	0.8
	Products policy	0.5	1.4
	Energy Performance of Buildings Directive	0.2	0.5
	Business Smart Metering	0.1	0.2
	<b>Total business</b>	<b>1.6</b>	<b>3.0</b>
<b>Transport</b>	Future Voluntary Agreements	1.7	5.4
	Domestic aviation included in EU ETS	0.2	0.4
	<b>Total transport</b>	<b>1.9</b>	<b>5.8</b>
<b>Residential</b>	Better billing	0.0	0.1
	Real time displays and Smart metering	0.0	0.5
	Product policy	0.4	1.3
	Supplier obligation	3.0	4.0
	DCLG- Zero carbon homes	1.1	1.2
	Energy Performance of Buildings Directive	0.2	0.6
	<b>Total residential</b>	<b>4.8</b>	<b>7.7</b>
<b>Public sector</b>	Carbon Reduction Commitment	0.2	0.2
	Carbon neutral government	0.2	0.2
	Products policy	0.1	0.3
	EPBD- Energy performance Buildings Directive	0.2	0.5
	<b>Total public sector</b>	<b>0.7</b>	<b>1.1</b>
<b>TOTAL EXCLUDING EU ETS</b>		<b>10</b>	<b>20</b>
EU ETS illustrative level of effort		<b>8</b>	<b>16</b>
<b>TOTAL</b>		<b>18</b>	<b>36</b>

<sup>31</sup> These measures correspond to those listed in Chapter 10, Table 10.1 of the White Paper

## Annex E- End user emissions by sector.

Table E1 End User emissions of central fuel price scenario with low, central and high carbon savings of White Paper proposals

MtC		CENTRAL FOSSIL FUEL PRICES								
		WP proposals assuming low carbon saving			WP proposals assuming central carbon saving			WP proposals assuming high carbon saving		
	2005	2010	2015	2020	2010	2015	2020	2010	2015	2020
<b>Business</b>	52.2	49.6	47.8	48.6	49.2	47.0	47.2	48.9	46.3	45.3
<b>Industrial processes</b>	3.9	3.9	4.2	4.5	3.9	4.2	4.5	3.9	4.2	4.5
<b>Transport</b>	43.5	44.6	44.3	43.2	44.6	44.2	43.0	44.3	41.1	37.7
<b>Residential</b>	40.5	35.9	33.3	29.0	35.6	32.2	27.3	35.2	31.2	25.2
<b>Public</b>	5.9	5.5	5.2	4.8	5.4	5.1	4.7	5.4	5.0	4.5
<b>Agriculture</b>	1.9	1.7	1.6	1.5	1.7	1.5	1.4	1.6	1.5	1.4
<b>LUC</b>	-0.6	-0.5	0.0	0.5	-0.5	0.0	0.5	-0.5	0.0	0.5
<b>Waste Management</b>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<b>Exports</b>	3.6 <sup>1</sup>	3.5	3.0	2.5	3.5	3.0	2.5	3.5	3.0	2.6
<b>Marine bunkers</b>	0.0	1.0	1.0	0.9	1.0	1.0	0.9	1.0	1.0	1.0
<b>Total<sup>2</sup></b>	<b>151.1</b>	<b>145.2</b>	<b>140.4</b>	<b>135.6</b>	<b>144.4</b>	<b>138.3</b>	<b>132.2</b>	<b>143.4</b>	<b>133.6</b>	<b>122.9</b>
<b>EU ETS allowances purchased from abroad<sup>3</sup></b>		<b>9.1</b>	<b>6.8</b>	<b>6.8</b>	<b>8.7</b>	<b>6.2</b>	<b>5.7</b>	<b>8.3</b>	<b>5.6</b>	<b>3.7</b>
<b>Total including full impact of EU ETS</b>	<b>151.1</b>	<b>136.1</b>	<b>133.6</b>	<b>128.9</b>	<b>135.7</b>	<b>132.2</b>	<b>126.5</b>	<b>135.2</b>	<b>128.0</b>	<b>119.2</b>

<sup>1</sup> includes marine bunkers

<sup>2</sup> Estimated carbon emissions inclusive of impact of White Paper proposals and a carbon price – but excluding the additional effort required through purchase of allowances from abroad.

<sup>3</sup> Estimated emissions allowances purchased from abroad (either Emissions Unit Allowances from other Member States in EU ETS; or through Kyoto flexibility mechanisms such as the Clean Development Mechanism an explanation of the calculation of these figures is given in Annex I.

**Table E2 End User emissions of low and high fuel price scenarios with central carbon savings of White Paper proposals.**

	Low fossil fuel prices assuming WP central carbon savings			High fossil fuel prices assuming WP central carbon savings		
	2010	2015	2020	2010	2015	2020
<b>Business</b>	49.2	47.9	47.7	50.1	49.1	51.1
<b>Industrial processes</b>	3.9	4.2	4.5	3.9	4.2	4.5
<b>Transport</b>	45.2	45.5	44.2	44.3	43.5	42.2
<b>Residential</b>	36.6	35.4	30.0	35.4	32.4	28.1
<b>Public</b>	5.4	5.2	4.7	5.5	5.4	5.0
<b>Agriculture</b>	1.6	1.6	1.4	1.7	1.6	1.5
<b>LUC</b>	-0.5	0.0	0.5	-0.5	0.0	0.5
<b>Waste Management</b>	0.1	0.1	0.1	0.1	0.1	0.1
<b>Exports</b>	3.4	2.9	2.5	3.5	3.0	2.6
<b>Marine bunkers</b>	1.0	1.0	0.9	1.0	1.0	1.0
<b>Total<sup>1</sup></b>	<b>146.0</b>	<b>143.8</b>	<b>136.5</b>	<b>144.9</b>	<b>140.4</b>	<b>136.6</b>
<b>EU ETS allowances<sup>2</sup></b>	<b>8.8</b>	<b>7.5</b>	<b>5.9</b>	<b>10.2</b>	<b>10.5</b>	<b>12.7</b>
<b>Total including full impact of EU ETS</b>	<b>137.2</b>	<b>136.3</b>	<b>130.7</b>	<b>134.7</b>	<b>129.9</b>	<b>123.9</b>

<sup>1</sup>Estimated carbon emissions inclusive of impact of White Paper proposals and a carbon price – but excluding the additional effort required through purchase of allowances from abroad.

<sup>2</sup>Estimated emissions allowances purchased from abroad (either Emissions Unit Allowances from other Member States in EU ETS; or through Kyoto flexibility mechanisms such as the Clean Development Mechanism an explanation of the calculation of these figures is given in Annex I.

## Annex F- Progress towards Climate Change goal

The draft Climate Change Bill creates a legal framework for the UK to achieve through international and domestic action at least a 60% reduction in emissions by 2050 and 26-32% by 2020 against a 1990 baseline.

The updated baseline emissions in the central case for 2020 show a 31.7-41.4 carbon gap if measured against the draft Climate Change Bill goal. If the central WP policy impact is taken into account the carbon gap is reduced to 9.3-19 MtC. The range associated with WP policies suggests that in the case where WP policies achieve a high impact the Climate change goal is achieved with a 26.2% reduction of emissions from the 1990 baseline by 2020.

**Table F1 shows projections against Climate Change goals**

MtC Updated baseline projections	WP baseline low fossil fuel prices	WP baseline central fossil fuel prices		WP baseline high fossil fuel prices	
<b>1990</b>	161.5	161.5		161.5	
<b>2010</b>	146.9	146.5		145.8	
<b>2015</b>	150.7	149.4		149.1	
<b>2020</b>	149.2	151.2		150.5	
<b>2020 Reduction from 1990</b>	-7.6%	-6.4%		-6.8%	
<b>Climate Change Bill goal</b>	<b>109.8-119.5 MtC</b>	<b>109.8-119.5 MtC</b>		<b>109.8-119.5 MtC</b>	
<b>Carbon gap in 2020</b>	29.7-39.4 MtC	31.7-41.4 MtC		31.0-40.7 MtC	
MtC WP policy projections	Central prices low policy impact	Central prices central policy impact	Central prices high policy impact	Low prices central policy impact	High prices central policy impact
<b>1990</b>	161.5	161.5	161.5	161.5	161.5
<b>2010</b>	145.2	144.4	143.4	146.0	144.9
<b>2010 with full impact of EU ETS</b>	136.1	135.7	135.2	137.2	134.7
<b>2020</b>	135.6	132.2	122.9	136.5	136.6
<b>2020 with full impact of EU ETS</b>	128.9	126.5	119. 2	130.7	123.9
<b>2020 Reduction from 1990<sup>32</sup></b>	-20.2%	-21.7%	-26.2%	-19.1%	-23.3%
<b>Climate Change Bill goal</b>	<b>109.8-119.5 MtC</b>	<b>109.8-119.5 MtC</b>	<b>109.8-119.5 MtC</b>	<b>109.8-119.5 MtC</b>	<b>109.8-119.5 MtC</b>
<b>Carbon gap in 2020</b>	<b>9.4/19.1 MtC</b>	<b>7.0/16.7 MtC</b>	<b>-0.3/9.4 MtC</b>	<b>11.2/20.9 MtC</b>	<b>4.4/14.1 MtC</b>

<sup>32</sup> Including full impact of EU ETS

## Annex G- Road Transport

This annex provides the background detail to the changes to the Road Transport projection and the impact of the White Paper proposals.

The Energy Review projection of Road Transport included measures included in the UK Climate Change Programme published in 2006<sup>33</sup>. One measure proposed in the CCP06 measures was a future voluntary agreement (VA) with car manufacturers to reduce CO<sub>2</sub> emissions from new cars. The road transport emissions projection published in July 2006 included this extension. However, for the purposes of establishing a White paper baseline this assumption was revised.

**Table G1 shows the breakdown of the changes between the road transport emissions projection published in July 2006 (and as part of the Energy review Report) and the White Paper projection.**

	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>	
Energy Review projection	33.4 estimated	32.60	33.18	32.54	includes bio-fuel (1.6MtC) and further VA
Updated baseline	32.7 Provisional actual	32.47	33.40	33.85	Revised estimates of bio-fuel
		<b>-0.13</b>	<b>0.22</b>	<b>1.31</b>	<b>Overall change</b>
Reasons for change					
		-0.26	-0.27	-0.14	Fuel price change effect
		-0.33	-0.30	-0.29	Inventory change-better data on lube oil
		-0.20	-0.20	-0.20	Policy saving transfer from public sector
		0.15	0.79	1.82	Removal of VA extension
		0.39	0.12	0.02	Revision to bio-fuel saving estimates
		0.12	0.08	0.10	Other changes

<sup>33</sup> Defra UK Climate Change. Programme 2006  
<http://www.defra.gov.uk/environment/climatechange/uk/ukccp/pdf/ukccp06-all.pdf>

Baseline policies included are set out in Table G.2.

**Table G2- Policies included in the baseline**

MtC	2010	2015	2020
<b>Initial VA package</b>	2.3	3.13	3.58
<b>Bio-fuels</b>	1.21	1.48	1.58
<b>Wider transport measures</b>	0.84	0.84	0.84
<b>Sustainable development</b>	0.1	0.1	0.1
<b>Policy transferred from public sector</b>	0.2	0.2	0.2
<b>Total baseline policy</b>	4.65	5.75	6.30

#### Impact of White Paper proposals

Road transport White Paper proposals for a successor to the Voluntary Agreements with manufacturers to improve new car efficiency and, for illustrative purposes, further increase in the proportion of bio-fuels replacing fossil road fuels are set out in the White Paper ( Chapter 10, Table 10.1)

The high and low White Paper proposals for a successor to EU voluntary agreements on new fuel car efficiency represent illustrative estimates reflecting annual improvements in new car fuel efficiency of between 1.5% - 3.6%<sup>34</sup>

DTI indicative estimates, based on DfT assumptions, of the impact of these proposals are shown in Table G.3

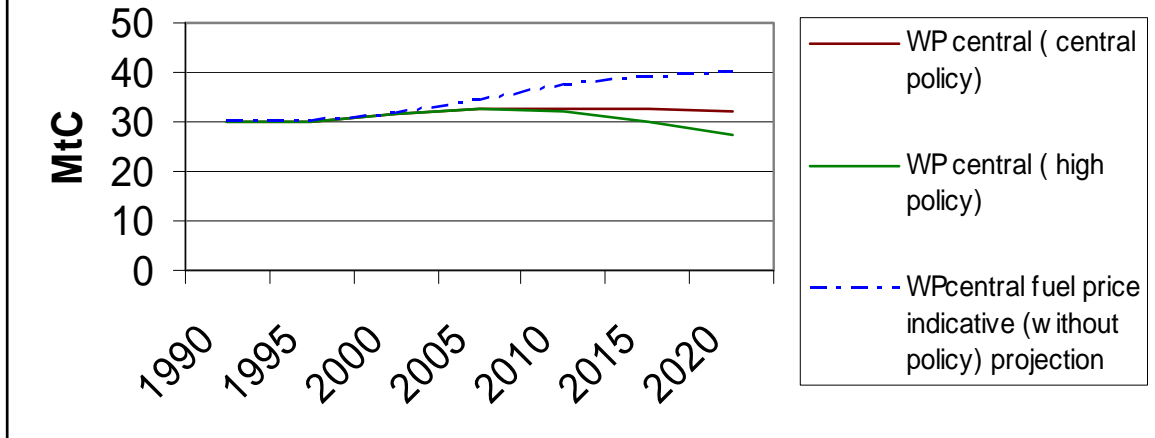
**Table G3 Indicative estimates of carbon savings from White paper proposals**

MtC	2010	2015	2020
<b>Further VA (1.5%)</b>	0.09	0.71	1.70
<b>Further VA (3.6%)</b>	0.36	2.27	5.43
<b>Increase of bio-fuels from 5% to 10%</b>	0.01	1.32	1.18

Figure G.1 illustrates the Road Transport central fuel price emissions projections, with and without policy, including the white Paper proposals at high and central policy estimates.

<sup>34</sup> Actual efficiency improvements will depend on the level of target set at EU level and application in the UK.

**Figure G.1 White Paper Road Transport emissions projections ( central fuel price ) with and without existing and proposed policy ( high and central saving)**





## Annex H- Electricity generation and capacity

### Generating capacity and new capacity build<sup>35</sup>

Table H1 illustrates the projected electricity supply by fuel for the updated baseline with low, central and high fossil fuel prices

TWh	Updated baseline low fossil fuel prices		Updated baseline central fossil fuel prices		Updated baseline high fossil fuel prices	
	2010	2020	2010	2020	2010	2020
<b>Coal</b>	112	65	121	119	124	138
<b>Oil</b>	2	1	2	1	2	1
<b>Gas</b>	140	264	129	202	124	182
<b>Nuclear</b>	68	25	68	25	68	25
<b>Renewables<sup>1</sup></b>	30	41	31	48	32	50
<b>Imports</b>	11	16	11	16	11	16
<b>Storage</b>	3	3	3	3	3	3
<b>Total</b>	<b>366</b>	<b>415</b>	<b>365</b>	<b>415</b>	<b>364</b>	<b>416</b>

Table H2 illustrates the projected electricity supply by fuel with central WP policy impact and low and high fossil fuel prices

TWh	Central WP policy impact low fossil fuel prices		Central WP policy impact high fossil fuel prices	
	2010	2020	2010	2020
<b>Coal</b>	112	63	124	121
<b>Oil</b>	2	1	2	1
<b>Gas</b>	134	217	119	149
<b>Nuclear</b>	68	25	68	25
<b>Renewables<sup>1</sup></b>	31	44	35	60
<b>Imports</b>	11	16	11	16
<b>Storage</b>	3	3	3	3
<b>Total</b>	<b>361</b>	<b>368</b>	<b>362</b>	<b>375</b>

<sup>35</sup> Under the requirements of the LCPD, opted-out plant must close by end of 2015. Coal capacity of end-year would typically be a few GW lower than the figures shown, which are intended to represent annual average capacity. The exact timing of closures is very uncertain.

**Table H3 illustrates generating capacity projections for the updated baseline for the low central and high fossil fuel prices**

GW	Updated baseline low fossil fuel prices			Updated baseline central fossil fuel prices			Updated baseline high fossil fuel prices		
	2010	2015	2020	2010	2015	2020	2010	2015	2020
coal	27	22	16	27	26	24	27	29	30
oil	4	2	1	4	2	1	4	2	1
gas	31	39	52	31	34	43	31	33	36
nuclear	11	5	4	11	5	4	11	5	4
renewables	5	7	7	5	8	9	5	8	9
Imports	3	5	5	3	5	5	3	5	5
Pumped storage	3	3	3	3	3	3	3	3	3
<b>total</b>	<b>83</b>	<b>83</b>	<b>87</b>	<b>83</b>	<b>82</b>	<b>87</b>	<b>83</b>	<b>85</b>	<b>87</b>

**Table H4 illustrates generating capacity projection for the low, central and high WP policy cases under central fossil fuel prices**

GW	CENTRAL FOSSIL FUEL PRICES								
	WP proposals assuming low carbon saving			WP proposals assuming central carbon saving			WP proposals assuming high carbon saving		
	2010	2015	2020	2010	2015	2020	2010	2015	2020
coal	27	24	18	27	24	19	27	24	20
oil	4	2	1	4	2	1	4	2	1
gas	31	33	41	31	33	37	31	32	33
nuclear	11	5	4	11	5	4	11	5	5
renewables	6	8	8	6	9	10	6	10	11
Imports	3	5	5	3	5	5	3	5	5
Pumped storage	3	3	3	3	3	3	3	3	3
<b>total</b>	<b>83</b>	<b>80</b>	<b>80</b>	<b>83</b>	<b>80</b>	<b>77</b>	<b>83</b>	<b>81</b>	<b>77</b>

**Table H5 illustrates generating capacity projections for the high and low fossil fuel prices under WP proposals assuming central carbon savings**

GW	WP proposals assuming central carbon saving and low fossil fuel prices			WP proposals assuming central carbon saving and high fossil fuel prices		
	2010	2015	2020	2010	2015	2020
coal	27	22	15	27	25	24
oil	4	2	1	4	2	1
gas	31	33	42	31	33	34
nuclear	11	5	4	11	5	4
renewables	6	8	8	6	9	10
Imports	3	5	5	3	5	5
Pumped storage	3	3	3	3	3	3
<b>total</b>	<b>83</b>	<b>78</b>	<b>78</b>	<b>83</b>	<b>82</b>	<b>80</b>

**Table H6 illustrates new capacity build projections for the updated baseline for the low central and high fossil fuel prices**

	Updated baseline low fossil fuel prices			Updated baseline central fossil fuel prices			Updated baseline high fossil fuel prices		
	2006-2010	2011-2015	2016-2020	2006-2010	2011-2015	2016-2020	2006-2010	2011-2015	2016-2020
<b>GW</b>									
coal	0	0	0	0	4	4	0	7	8
oil	0	0	0	0	0	0	0	0	0
gas	5	9	14	5	4	10	5	3	4
nuclear	0	0	0	0	0	0	0	0	0
renewables	2	2	1	2	2	1	2	2	1
other	1	2	0	1	2	0	1	2	0
<b>total</b>	<b>7</b>	<b>13</b>	<b>14</b>	<b>7</b>	<b>13</b>	<b>15</b>	<b>7</b>	<b>15</b>	<b>13</b>

**Table H7 illustrates new capacity build projections for low, central and high WP policy cases with central fossil fuel prices**

	CENTRAL FOSSIL FUEL PRICES								
	WP proposals assuming low carbon saving			WP proposals assuming central carbon saving			WP proposals assuming high carbon saving		
	2006-2010	2011-2015	2016-2020	2006-2010	2011-2015	2016-2020	2006-2010	2011-2015	2016-2020
<b>GW</b>									
coal	0	2	2	0	2	3	0	2	4
oil	0	0	0	0	0	0	0	0	0
gas	5	3	10	5	3	6	5	2	2
nuclear	0	0	0	0	0	0	0	0	1
renewables	2	3	0	2	3	1	3	4	1
other	1	2	0	1	2	0	1	2	0
<b>total</b>	<b>7</b>	<b>10</b>	<b>12</b>	<b>7</b>	<b>10</b>	<b>9</b>	<b>8</b>	<b>10</b>	<b>8</b>

**Table H8 illustrates new capacity build projections for the central WP policy case with high and low fossil fuel prices**

	WP proposals assuming central carbon saving and low fossil fuel prices			WP proposals assuming central carbon saving and high fossil fuel prices		
	2006-2010	2011-2015	2016-2020	2006-2010	2011-2015	2016-2020
<b>GW</b>						
coal	0	0	1	0	3	5
oil	0	0	0	0	0	0
gas	5	3	10	5	3	3
nuclear	0	0	0	0	0	0
renewables	2	2	0	3	3	1
other	1	2	0	1	2	0
<b>total</b>	<b>7</b>	<b>8</b>	<b>12</b>	<b>8</b>	<b>11</b>	<b>8</b>

## Annex I- EU ETS savings effort in 2020

Carbon abatement in 2020.

The exact level of savings from the EU ETS beyond Phase II (2008-2012) will be decided in line with future national allocation plans. However, the White Paper presents an illustrative projection for savings from the EU ETS in 2020 based on the assumption that the cap on emissions from EU ETS sectors in the UK in 2020 is equal to that agreed for Phase II. On the basis of our latest baseline emissions projections, this would achieve carbon savings of 13.7MtC in 2020. Our projections also show that in order to meet this level of effort, the EU ETS sectors in the UK will be required to purchase emissions allowances from other Member States.

The basis for the estimation of allowances purchased from other Member States under the EU ETS is set out in the Table I1. The table illustrates the estimated domestic carbon savings achieved through power sector emissions, central fossil fuel prices, carbon price of €25/tonne CO<sub>2</sub> for low, central and high carbon savings from White Paper proposals and an estimate of allowances purchased from other Member States under the EU ETS.

**Table I1 Methodology in the estimation of purchased allowances**

MtC	NAP emissions (Energy Review July 2006)		Revised baseline emissions (White Paper central price baseline)	White paper emissions ( central ff prices ) with low, central and high estimates of proposed measures)		
	2010	2020		Low policy	Central policy	High policy
	2010	2020	2020	2020	2020	2020
Emissions from the power sector	43.3	46.5	<b>49.0</b>	37.8	35.5	33.5
Phase II cap for power sector	<b>35.3</b>					
Illustrative level of effort for 2020	8		<b>13.7</b> (49.0-35.3)			
Projected effort in 2020				11.2 (49.0-37.8)	13.6 (49.0-35.5)	15.5 (49.0-33.5)
Reduction achieved through WP policy				3.3	4.6	6.1
UK domestic carbon savings achieved through ETS price				8.0 (11.2-3.3)	8.9 (13.6-4.6)	9.5 (15.5-6.1)
EU ETS estimated purchased allowances				<b>5.8 (13.7-8.0)</b>	<b>4.8 (13.7-8.9)</b>	<b>4.3 (13.7-9.5)</b>

The estimated purchase of allowances from abroad is based on the difference between the illustrative level of effort required in 2020 and the projected carbon savings that is assumed from the power sector under the assumed carbon prices within the UK for each scenario. Of this some is due directly to policy measures (lower electricity demand) and the residual due to domestic abatement (other than the WP measures).

In this central fuel price illustration, the level of effort (13.7 MtC) is indicated by the difference between the updated projection of the level of emissions in 2020 ( 49MtC) and the absolute level of emissions under the Phase II cap in 2010 35.3MtC i.e. July 2006 baseline projection in 2010 less 8MtC (Phase II effort).

## Annex J: Security of Supply

By reducing demand for gas and oil, UK's exposure to security of supply risks, including the risks associated with imported energy, is reduced. While the interactions of producers and consumers in energy markets will determine future levels of oil and gas demand, it is possible to evaluate the impact of our policies in terms of reduced demand for fossil fuels or increased UK oil and gas production and therefore reduced need for energy imports.

### Projections of imports of fossil fuels (baseline excluding White Paper measures)

According to latest projections, under the baseline without the impact of the EU ETS and excluding the proposals in this White Paper, demand for fossil fuels will increase slightly between now and 2020 – from 223Mtoe to around 233Mtoe respectively (see table J1).

**Table J1 – Demand for fossil fuels - central fossil fuel price assumptions (million tonnes of oil equivalent)**

	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Oil</b>	89	90	93	96
<b>Gas</b>	94	92	101	102
<b>Coal</b>	40	38	34	35
<b>Total</b>	<b>223</b>	<b>220</b>	<b>229</b>	<b>233</b>

While the UK has benefited from indigenous reserves of oil and gas for many years, as the North Sea matures, we will become increasingly dependent on imported energy<sup>36</sup>. Coal reserves are also expected to continue to decline over the next two decades, therefore adding to our overall demand for energy imports.<sup>37</sup>

**Table J2 - UK production of fossil fuels – central projections (Mtoe)**

	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Oil</b>	93	81	52	32
<b>Gas</b>	81	60	36	22
<b>Coal</b>	14	15	12	9
<b>Total</b>	<b>188</b>	<b>156</b>	<b>100</b>	<b>64</b>

By 2020, based on central fossil fuel price assumptions, and based on expected oil and gas production, we could therefore expect to be dependent

<sup>36</sup> Note that the production figures beyond 2012 and up to 2020 are mainly illustrative to show an estimate of the level of imports requirements needed. For published figures to 2012, see [http://www.og.dti.gov.uk/information/bb\\_updates/chapters/Section4\\_17.htm](http://www.og.dti.gov.uk/information/bb_updates/chapters/Section4_17.htm). The figures shown in this annex refer to the central projections.

<sup>37</sup> JESS - Long-Term Security of Energy Supply - December 2006 Report. See <http://www.dti.gov.uk/files/file35989.pdf>

for up to two-thirds of our oil consumption and up to 80% of gas consumption. By 2020 imports could be meeting up to 75% of UK coal demand (see table J3).

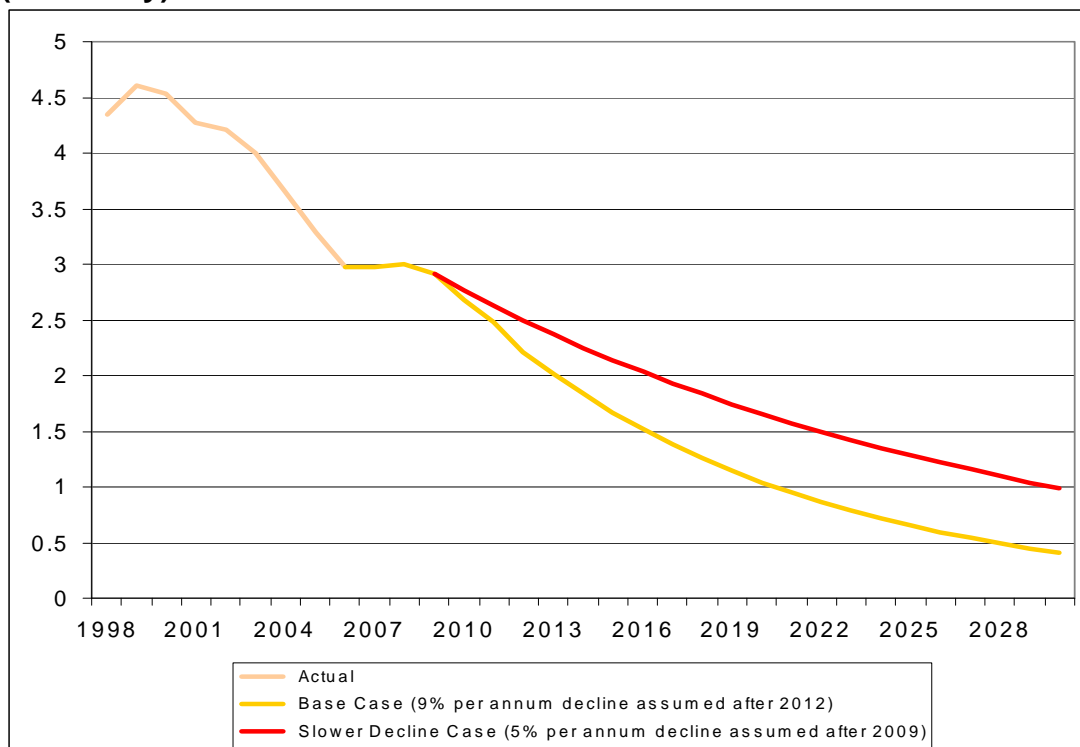
**Table J3 – Fossil fuels import requirements (Mtoe)**

	2005	2010	2015	2020
Oil	-4	10	42	64
Gas	13	32	65	79
Coal	26	23	23	26
<b>Total</b>	<b>35</b>	<b>65</b>	<b>130</b>	<b>169</b>

### Actual and possible future UKCS oil and gas production

Our proposals to improve the framework for investment in the UK Continental Shelf (UKCS) aim to maintain the competitiveness of the UKCS as it becomes increasingly mature, in order to maximise economic recovery. If a high level of investment were maintained, this could potentially deliver substantially higher oil and gas production – up to an extra 0.6 million barrels of oil equivalent (boe) a day from 2020 to 2030. About half or slightly more of this extra production would be oil and the remainder would be gas (see figure J1 below).

**Figure J1 – Actual and possible future UKCS oil and gas production (mboe/day)**



## Impact of a carbon price and Energy White Paper measures on demand and imports projections

The measures outlined in the Energy White Paper 2007 will reduce gas consumption directly by reducing demand for gas i.e. in heating our homes; but also indirectly by reducing demand for electricity so reducing the need for new gas-fired power stations.

We estimate that our energy efficiency measures included in the Energy White Paper 2007 will lead to savings in the consumption of gas, of between 5 to 8 billion cubic meters (bcm) by 2020. We also estimate that these measures will reduce electricity consumption by between 29TWh to 55TWh, which is equivalent to between 7% to 13% of projected demand. Table J4 below illustrates the impact of our energy efficiency measures for electricity and different fuels expressed in TeraWatt hours<sup>38</sup>.

**Table J4 – Impact of energy efficiency measures (TWh)**

<b>Low policy case</b>	<b>TWh</b>	<b>TWh</b>	<b>TWh</b>	<b>High policy case</b>	<b>TWh</b>	<b>TWh</b>	<b>TWh</b>
	<b>2010</b>	<b>2015</b>	<b>2020</b>		<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Electricity</b>	1.9	12.8	29.5	<b>Electricity</b>	6.7	27.6	55.3
<b>Gas</b>	1.3	28.4	61.4	<b>Gas</b>	3.2	45.0	92.8
<b>Oil</b>	0.0	2.6	5.3	<b>Oil</b>	0.1	3.4	6.7
<b>Solid fuels</b>	0.0	0.1	0.2	<b>Solid fuels</b>	0.0	0.1	0.2
<b>Total</b>	<b>3.2</b>	<b>43.9</b>	<b>96.5</b>	<b>Total</b>	<b>9.9</b>	<b>76.1</b>	<b>155.1</b>

In total, therefore, our measures could lead to up to 15 billion cubic metres of gas savings in 2020, equivalent to gas demand being 13% lower than it would otherwise be (table J5 shows demand for fossil fuels under the central policy case but also under the high policy case to show the upper end range of the impact). This would reduce our projected gas imports by up to around 17% compared to our baseline projections for import requirement.<sup>39</sup>

<sup>38</sup> Including the impact on electricity demand of all measures in the White Paper (e.g. supply measures, such as the changes to the RO or the EU ETS, in addition to the efficiency measures estimated in table J4) could bring the savings up to 15% reduction in projected electricity demand by 2020.

<sup>39</sup> Here we assume a one-for-one relationship between reductions in gas demand, and reductions in gas imports.



**Table J5 - Demand for fossil fuels (including a carbon price and the measures in the Energy White Paper) - central fossil price, central and high policy case assumptions (Mtoe)**

<b>Demand for fossil fuels - central price assumptions - High policy</b>				
	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Oil</b>	89	90	90	88
<b>Gas</b>	94	91	97	88
<b>Coal</b>	40	36	26	26
<b>Total</b>	<b>223</b>	<b>217</b>	<b>213</b>	<b>202</b>
<b>Demand for fossil fuels - central price assumptions - Central policy</b>				
	<b>2005</b>	<b>2010</b>	<b>2015</b>	<b>2020</b>
<b>Oil</b>	89	90	92	93
<b>Gas</b>	94	92	100	96
<b>Coal</b>	40	36	26	24
<b>Total</b>	<b>223</b>	<b>219</b>	<b>218</b>	<b>213</b>

Overall, therefore we estimate that the expected reduction in gas demand as a consequence of the energy efficiency measures when combined with the possible increase in domestic gas production, could bring our gas import dependence down to around 60% of projected gas demand in 2020, compared to around 80% if we did not implement our measures.