

## National Assembly for Wales

### Carbon Dioxide Emissions in Wales December 2009

This research paper updates and replaces a previous research paper of the same title, in include data up to 2007.

It provides a short synopsis of climate change projections and the policy framework guiding action on carbon dioxide emissions. The paper examines carbon dioxide emissions at a national level, compares Welsh emissions with those of other countries internationally. Also included is information on the per capita carbon dioxide emissions for each local authority in Wales.

Comparisons cannot be made with data in the previous paper.

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# **National Assembly for Wales**

## **Carbon Dioxide Emissions in Wales**

December 2009

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Paper Number: 09/037

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## Executive Summary

This paper updates and replaces the research paper of the same title, published in February 2009, to include data up to 2007. Please note, comparisons with previous publications cannot be made due to changes in the sources and methodologies used.

There is compelling scientific evidence that the activities of humankind are responsible for changing the climate of the planet. Carbon dioxide is the most significant human caused greenhouse gas, accounting for over 85 per cent of the total UK greenhouse gas emissions in 2007.

In 2007, Wales emitted 39 million tonnes (Mt) of carbon dioxide, this accounted for a 9.5 per cent reduction in emissions below the 1990 base year, and a 7 per cent decrease since 2006. To reach the 2010 target of reducing carbon dioxide emissions by 20 per cent below the 1990 base year, emissions will need to be reduced by 10.5 percentage points in three years.

The largest emitter of carbon dioxide emissions in Wales was Port Talbot Steelworks, emitting 6.9 Mt of carbon dioxide in 2008.

Of the EU-27, the UN Framework Convention on Climate Change (UNFCCC) Annex 1 Parties and the UK devolved administrations (accounting for 46 countries), Wales was ranked as having the 17<sup>th</sup> largest reduction in emissions since the base year. The UK was ranked 20<sup>th</sup>. Of the same countries, Wales was ranked as having the 6<sup>th</sup> highest carbon dioxide emissions per capita, while the UK was ranked 17<sup>th</sup>.

Using 'end user' measurements, Neath Port Talbot had the highest carbon dioxide emissions in Wales in 2007, while Merthyr Tydfil had the lowest. Carbon dioxide emissions per capita were lowest in the South Wales Valleys, Mid-Wales and some parts of North Wales.



# Contents

<b>1. Climate Change</b>	<b>1</b>
1.1. Temperature changes	1
1.2. UK climate change projections	2
<b>2. Policies and Targets</b>	<b>4</b>
2.1. International policy	5
2.2. European policy	5
2.3. UK policy	6
2.4. Wales policy	6
<b>3. Measuring Carbon Dioxide Emissions</b>	<b>8</b>
3.1. National Emissions	8
3.2. Carbon dioxide emitters in Wales	10
3.3. International comparisons	11
3.3.1. Change in carbon dioxide emissions	11
3.3.2. Carbon dioxide emissions per capita	14
3.4. Local comparisons	16
<b>4. Useful links and further information</b>	<b>21</b>
<b>Annex Carbon dioxide emissions, by country</b>	<b>22</b>





# Carbon Dioxide Emissions in Wales

## 1. Climate Change

The earth's climate has been varying for millions of years, some natural variation is natural and expected. However, recent, rapid pollution loading is thought to have changed the composition of both the atmosphere and the oceans, leading to an increase in the amount of heat retained within the planetary circulation systems. There is compelling scientific evidence that the activities of humankind are responsible for changing the climate of the planet; this human-induced change is what is usually referred to as 'climate change'.

The United Nations Intergovernmental Panel on Climate Change (IPCC) [Working Group I](#) recently concluded in their Fourth Assessment that:

...most of the observed increase in global average temperature since the mid 20<sup>th</sup> century is very likely (>90 per cent probability of occurrence) to result from the observed increase in human caused greenhouse gases.<sup>1</sup>

Emissions of carbon dioxide are the most significant human caused greenhouse gas, accounting for over 85 per cent of the total UK greenhouse gas emissions in 2007<sup>2</sup>. The global mean atmospheric concentration of carbon dioxide (CO<sub>2</sub>) has increased from a pre-industrial concentration of about 280 parts per million (ppm) to 379 ppm by 2005<sup>3</sup>.

This paper concentrates on human caused carbon dioxide emissions, providing analysis of the recent changes in emissions in Wales and makes comparisons with global emissions and other UK countries.

It must also be noted that although the vast majority of scientific research supports the concept that the recent changes in the climate are as a result of human activity. It has also been suggested that some of the early 20<sup>th</sup> century warming was due to internal climate variability, or due to natural forcings such as solar activity<sup>4</sup>.

### *1.1. Temperature changes*

The Central England Temperature (CET) monthly series is the longest continuous temperature record, beginning in 1659. It is therefore a valuable source of information when considering the recent changes to the climate. Figure 1 shows the changes in CET from 1772 to 18 November 2009 relative to the average 1961-90 (the baseline period) temperatures, the red line is the equivalent to a 10 year

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<sup>1</sup> The Committee on Climate Change, [The Science of Climate Change](#) [accessed 15 December 2009]

<sup>2</sup> AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007](#), (page ix) (September 2009)

<sup>3</sup> Parliamentary Office of Science and Technology – Postnote (number 295), [Climate Change Science](#), November 2007

<sup>4</sup> Ibid page 3

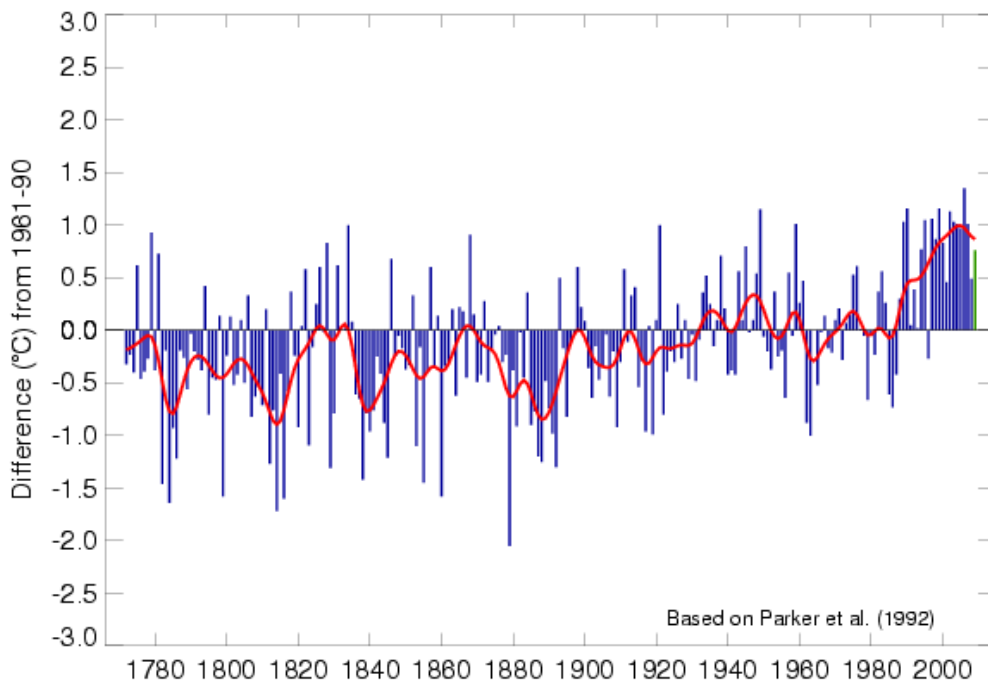
running average. From the data, Central England temperatures have risen by about a degree Celsius since 1980, with 2006 being the warmest on record<sup>5</sup>. In addition to the CET series, global temperature trends show an increase of nearly 0.8°C since the late 19<sup>th</sup> century and have risen at about 0.2°C per decade over the past 25 years<sup>6</sup>.

The UK Climate Projections paper on recent climate trends also draws attention to the fifteen warmest calendar years in the CET series, stating that:

Several of these high ranking years are too long ago to have had any significant contribution from man-made warming. This reflects the large natural variability of climate over a small area such as that of the CET.<sup>7</sup>

However, it also reflects that in 2006 a number of records in the CET monthly series were broken, for example; July 2006 was the warmest month since CET observations began and the 2006 Autumn was the warmest Autumn.

**Figure 1: Mean Central England temperature, 1772 to 18 November 2009, as a deviation from the mean 1961-1990 (baseline period).**



Source: Met Office, [Central England Temperature dataset](#)

## 1.2. UK climate change projections

Using historical climate trends scientists can create models to help predict future climates. The Met Office and the UK Climate Impacts Programme have developed the UK Climate Projections 2009 (UKCP09) based on the latest scientific understanding. Findings from the UKCP09 suggest that by the 2080's all areas in

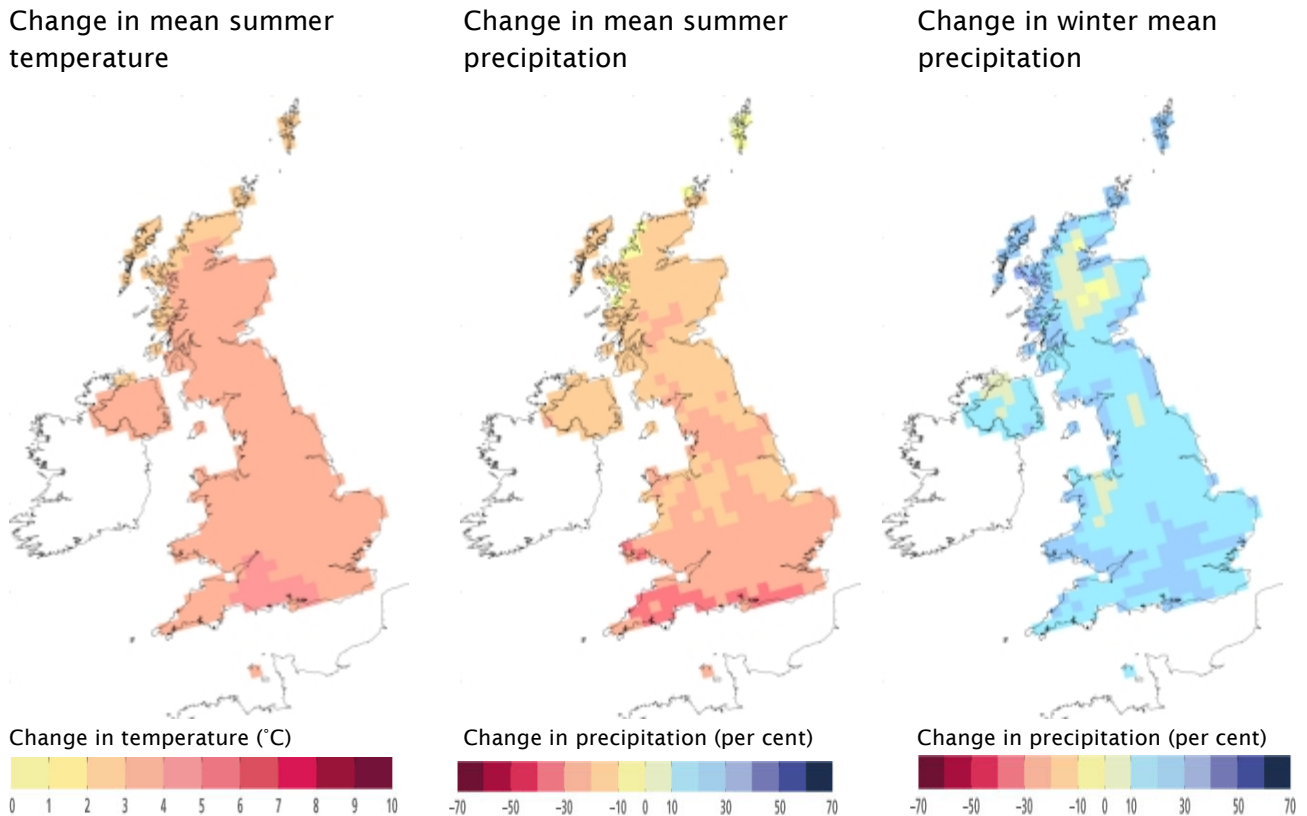
<sup>5</sup> UK Climate Projections, [The climate of the UK and recent trends](#) (page 9), January 2009

<sup>6</sup> *ibid* page 6

<sup>7</sup> *ibid* page 10

the UK will get warmer, with the greatest increases in the summer. It also suggests that there will be little change in the annual precipitation, but more of it will fall in the winter, resulting in drier summers. Figure 2 shows the estimated changes to summer temperatures, and winter and summer precipitation at a 50 per cent probability level (central estimate) for the UK by the 2080s as a result of medium emissions<sup>8</sup>.

**Figure 2: UK climate change projections, central estimate, 2080s**



Source: UK Climate Projections, [Key findings: UKCP09 maps for the UK](#)

The UK Climate Projections 2009 suggest that by using the medium emissions scenario and the central estimate, by the 2080's the climate in Wales<sup>9</sup> will have:

- increased in **winter mean temperature** by 2.8°C; it is very unlikely to be less than 1.6°C or more than 4.2°C;
- increased in **summer mean temperature** by 3.5°C; it is very unlikely to be less than 1.9°C or more than 5.8°C;
- changed in **winter mean precipitation** by 19 per cent; it is very unlikely to be less than 4 per cent or more than 42 per cent; and

<sup>8</sup> The UKCP09 uses medium emissions levels however, projections have also been calculated using different emissions scenarios. Further information is available on the [UK Climate Projections website](#). [accessed 15 December 2009]

<sup>9</sup> UK Climate Projections, [Key findings: Wales](#) [accessed 15 December 2009]

- changed in **summer mean precipitation** by -20 per cent; it is very unlikely to be less than -43 per cent and is very unlikely to be more than 5 per cent.

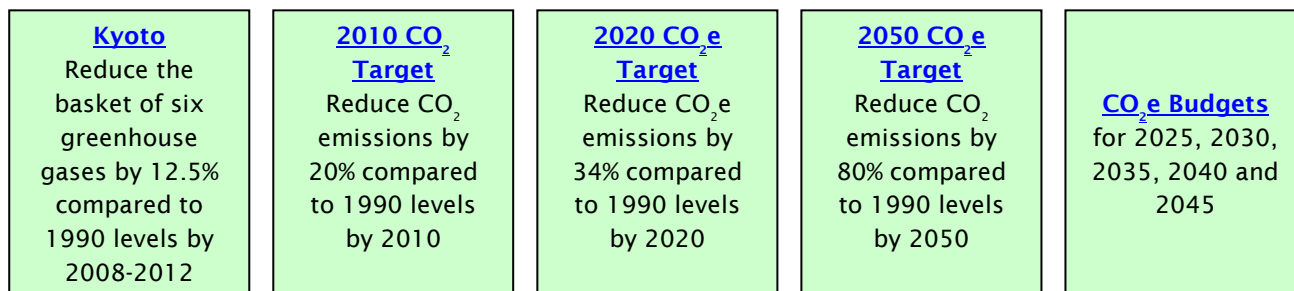
The Minister for the Environment, Sustainability and Housing, Jane Davidson made a statement on the climate change projections in relation to Wales on the 23 June 2009 stating:

In broad terms, that means that we are likely to see hotter, drier summers and warmer, wetter winters.<sup>10</sup>

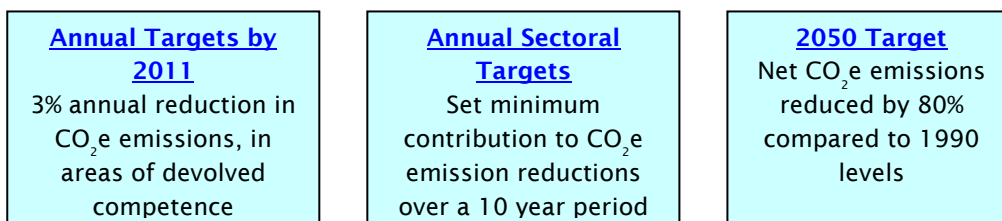
## 2. Policies and Targets

The following diagram provides an overview of the targets the UK Government and the Welsh Government have set to reduce the emissions of greenhouse gases, especially carbon dioxide, over the next century. To obtain further information on the targets click on the links (where available) within each box.

### UK Targets



### Wales Targets



### Scotland Targets

**2010:** Reduce CO<sub>2</sub> below 2009 by 2010  
**2011-2019:** Reduce CO<sub>2</sub>e emissions to be lower than preceding year  
**2020:** Net CO<sub>2</sub>e emissions reduced by 42% compared to baseline  
**2020-2050:** CO<sub>2</sub>e emissions to be 2-3% lower than preceding year  
**2050:** Net CO<sub>2</sub>e emissions reduced by 80% compared to baseline

### Northern Ireland Targets

**2025:** Reduce emissions of CO<sub>2</sub> by 30% on baseline levels  
**2025:** Reduce emissions of all GHGs (CO<sub>2</sub>e) by 25% on baseline levels

Source: AEA [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007](#), (page 2) September 2009

Note: CO<sub>2</sub>e is carbon dioxide equivalent emissions from greenhouse gases (GHGs).

<sup>10</sup> Welsh Government, Jane Davidson (Minister for Environment, Sustainability and Housing), [UK Climate Change Impact Programme 2009](#), Cabinet (oral) Statement, 23 June 2009

## 2.1. *International policy*

The UN Framework Convention on Climate Change (UNFCCC)<sup>11</sup> sets an overall framework for intergovernmental efforts to tackle climate change, with the objective of stabilising greenhouse gas emissions in the atmosphere and reduce the human impact on the climate system<sup>12</sup>. It recognises that the climate system is a shared resource whose stability can be affected by emissions of carbon dioxide and other greenhouse gases. The convention has been ratified by 194 countries<sup>13</sup> and entered into force on 21 March 1994.

The Kyoto Protocol<sup>14</sup> is the protocol to the UNFCCC which entered into force on 16 February 2005; 189 Parties and one regional organisation (the EU) have ratified the Protocol to date<sup>15</sup>. The Protocol's major feature is mandatory targets on greenhouse gas emissions. These targets range from -8 per cent to +10 per cent of 1990 (base year) emissions levels, 'with the view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012'. The European Union participated in both the UNFCCC and the Kyoto Protocol on behalf of its Member States, The EU countries have a target to reduce emissions by 8 per cent, the UK has agreed to reduce its emissions to at least 12.5 per cent lower than the base year levels<sup>16</sup>.

The World's nations met at the fifteenth conference of the UNFCCC in Copenhagen between 7 and 18 December 2009. The conference was hoped to achieve a global climate change agreement that would enter into force when the Kyoto Protocol expires in 2012<sup>17</sup>.

## 2.2. *European policy*

The [European Climate Change Programme](#) was launched in June 2000, with the goal of identifying and developing all the necessary elements of an EU strategy to implement the Kyoto Protocol. The EU has wide jurisdiction over environmental matters to influence climate change, the most relevant of which are:

- The EU has an objective of limiting global temperature increase to less than 2°C compared to pre-industrial levels, and pursues a 30 per cent reduction in emissions from developed countries in 2020. Until an international agreement is concluded, the EU's target is a 20 per cent reduction, including targets to

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<sup>11</sup> United Nations: [United Nations Framework Convention on Climate Change](#) [accessed 15 December 2009]

<sup>12</sup> AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007](#), (September 2009)

<sup>13</sup> The number of [countries](#) that have ratified the convention as of 16 October 2009 [accessed 15 December 2009]

<sup>14</sup> United Nations: [Kyoto Protocol to the United Nations Framework Convention on Climate Change \(p3\)](#), 1998

<sup>15</sup> The number of [Parties](#) to have ratified the protocol as of 6 November 2009 [accessed 15 December 2009]

<sup>16</sup> DECC, [The United Kingdom's initial report under the Kyoto Protocol \(p 7\)](#), November 2006

<sup>17</sup> Welsh Government, Jane Davidson (Minister for Environment, Sustainability and Housing), [Preparation for Copenhagen](#), Cabinet (Oral) Statement, 3 November 2009

improve energy efficiency by 20 per cent by 2020, and to increase the share of renewable energy to 20 per cent by 2020.

- Aviation will be included in the EU Emissions Trading Scheme from January 2012.

### 2.3. UK policy

The UK's first Climate Change Programme, in 2000, set a domestic goal to cut the UK's emissions of carbon dioxide by 20 per cent below 1990 levels by 2010<sup>18</sup>. In 2006, the UK Government announced that it was unlikely to meet this target<sup>19</sup>. In March 2006 the UK Government published its new Climate Change Programme<sup>20</sup> which set out its policies and priorities for action on climate change, both across the UK as a whole and internationally.

The *Climate Change Act 2008*<sup>21</sup> provides a legal framework to reduce future greenhouse gas emissions by 80 per cent compared to 1990 levels by 2050, with an interim target of at least 26 per cent by 2020. It established a system of '[carbon budgeting](#)' every five years, during which time greenhouse gas emissions must be within predetermined limits. In addition, the Act also established the [Committee on Climate Change](#), an independent body to advise the UK Government and report to Parliament.

### 2.4. Wales policy

The *One Wales* agreement between Labour and Plaid Cymru sets out a target for 3 per cent annual reductions in carbon equivalent emissions by 2011 'in areas of devolved competence'<sup>22</sup>.

The *Climate Change Strategy – High Level Policy Statement*<sup>23</sup> consultation document, published in January 2009, set out the proposed definitions of Wales' targets and the areas of intended focuses. It expands on the commitments set out in the *One Wales* document, providing further detail as to how the Welsh Government plans to reduce greenhouse gas emissions by 3 per cent in areas of devolved competencies. It also commits to the UK's long term target to reduce greenhouse gas emissions by at least 80 per cent by 2050. Additionally, the consultation document provides further details of the specific targets for the residential, public and transport sectors and their relative expected contribution to the 3 per cent target. In June 2009, the Welsh Government published its *Climate Change Strategy – Programme for Action*<sup>24</sup>

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<sup>18</sup> Department of Energy and Climate Change, [Climate Change: The UK Programme, Summary](#), November 2000

<sup>19</sup> BBC News, [UK to miss CO2 emissions target](#), 26 March 2006 [accessed 15 December 2009]

<sup>20</sup> Department of Energy and Climate Change, [UK Climate Change Programme](#), March 2006

<sup>21</sup> [Climate Change Act 2008](#) (chapter 27) [accessed 15 December 2009]

<sup>22</sup> Welsh Government: [One Wales: A progressive agenda for the government of Wales, \(p33\)](#) (27 June 2007)

<sup>23</sup> Welsh Government, [Climate change strategy – High level policy statement consultation](#), January 2009

<sup>24</sup> Welsh Government, [Climate change strategy – Programme of action consultation](#), June 2009

consultation, which sets out in more detail the actions the Welsh Government are proposing to deliver their climate change objectives.

The consultation periods for both publications have now closed. The Welsh Government aims to combine the results of both consultations to develop their final Climate Change Strategy by the end of 2009.

In a debate on climate change on 18 November 2009<sup>25</sup>, there was cross party agreement that the Welsh Government should set a target of reducing carbon dioxide emissions by 40 per cent below the 1990 base year by 2020.

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<sup>25</sup> [RoP p106-129](#), 18 November 2009 [accessed 15 December 2009]

### 3. Measuring Carbon Dioxide Emissions

There are two main approaches to calculating carbon dioxide emissions:

- **Production approach:** calculating emissions according to where emissions are produced. This is relatively easy to calculate and allocate to national accounts, however, it does not account for products that are made elsewhere and imported. This methodology is used by the [UNFCCC](#).
- **Consumption or end user approach:** calculating emissions according to where the product of those emissions is consumed. This accounts for all the emissions associated with the consumption of materials, goods and energy, rather than those associated with the geographical location of where production takes place. I.e. accounting for all carbon dioxide emissions for which Wales' residents are responsible, not those that simply arise from within Wales. "End user" data for each UK country has been published by AEA<sup>26</sup> and are included in section 3.4.

The difference between the two approaches gives an indication of the extent to which the products, produced in Wales, are remaining in Wales or being exported to other countries. In this paper, the national and international figures (in sections 3.1 and 3.3) use the production approach, while the local authority emissions data (section 3.4) uses the end user definition.

#### 3.1. National Emissions

This section compares the available data on carbon dioxide emissions in Wales, and other UK countries, with the targets outlined in the previous chapter. The majority of these targets relate to the reduction of UK carbon dioxide emissions; this section assumes that the Welsh Government is working towards the same targets.

Wales has performed inconsistently in reducing greenhouse gas emissions over the past 17 years. In 2007, total emissions of carbon dioxide were 39Mt, representing a 7.0 per cent decrease since 2006 and 9.5 per cent lower than the base year (1990)<sup>27</sup>, this is presented in table 1 and figure 3. In comparison with the other UK countries in 2007, Wales has reduced its emissions (below the 1990 base year) by 1 percentage point more than the UK average. Scotland has had the largest reduction in emissions, of 14.7 per cent.

To reach the 2010 target of reducing carbon dioxide emissions by 20 per cent below the 1990 base year, emissions in Wales will need to be reduced by 10.5 percentage points in three years.

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<sup>26</sup> AEA, [Local and Regional CO<sub>2</sub> Emissions Estimates for 2005-2007 for the UK](#), (November 2009)

<sup>27</sup> AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007](#), (September 2009)



**Due to updated emissions data and changes to methodologies it is not possible to compare these figures with previous Members' Research Service papers or previous AEA inventory publications.**

**Table 1: Carbon dioxide emissions<sup>(a)</sup> and percentage change from base year (1990), Wales and the UK<sup>(b)</sup>, 1990 to 2007 (Mt CO<sub>2</sub>)**

	Wales		England		Northern Ireland		Scotland		UK	
	Emissions (Mt)	% change from 1990	Emissions (Mt)	% change from 1990	Emissions (Mt)	% change from 1990	Emissions (Mt)	% change from 1990	Emissions (Mt)	% change from 1990
1990	43.1	..	467.4	..	17.4	..	50.5	..	591.5	..
1995	40.6	-5.8%	426.5	-8.8%	17.0	-2.0%	49.5	-1.9%	551.5	-6.8%
1998	42.8	-0.9%	423.9	-9.3%	16.4	-5.5%	49.8	-1.3%	551.8	-6.7%
1999	43.9	1.9%	415.5	-11.1%	16.7	-3.8%	46.4	-8.0%	541.3	-8.5%
2000	46.1	6.9%	419.5	-10.2%	16.6	-4.4%	49.4	-2.2%	549.5	-7.1%
2001	43.6	1.0%	432.7	-7.4%	16.9	-2.5%	49.4	-2.1%	561.2	-5.1%
2002	37.2	-13.7%	425.9	-8.9%	15.5	-10.8%	46.2	-8.5%	543.6	-8.1%
2003	38.5	-10.8%	436.5	-6.6%	15.6	-10.1%	46.5	-8.0%	554.9	-6.2%
2004	42.2	-2.2%	434.8	-7.0%	15.5	-10.7%	44.4	-12.2%	554.6	-6.2%
2005	40.5	-6.1%	434.1	-7.1%	16.4	-5.3%	43.4	-14.1%	551.8	-6.7%
2006	41.9	-2.7%	428.2	-8.4%	17.1	-1.7%	46.8	-7.2%	549.7	-7.1%
2007	39.0	-9.5%	426.9	-8.7%	15.8	-8.7%	43.1	-14.7%	541.2	-8.5%

Source: AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007](#), (September 2009)

.. not applicable

(a) Different methodologies have been used from previous AEA publications, therefore comparisons cannot be made with previous papers.

(b) Data includes Crown Dependencies but excludes Overseas Territories - emissions from Crown Dependencies are allocated to England.

Emissions from offshore sources are not allocated to any country, instead they are recorded in an 'unallocated' inventory category. Unallocated carbon dioxide emissions accounted for 3.0 per cent (16.4 Mt) of the UK's emissions in 2007, a 24.3 per cent increase from the base year.

Figure 3 shows the inconsistent trend of carbon dioxide emissions in Wales in comparison with the UK trend and the ideological trend lines to achieve the 2010 target of reducing carbon dioxide emissions by 20 per cent below the 1990 base year and the 2020 target of reducing emissions by 34 per cent (the most ambitious target set for 2020).

In Wales, the largest source of carbon dioxide emissions is the energy industry, accounting for 38 per cent of all emissions in 2007<sup>28</sup>. As a result of this, changes to the energy industry explain many of the fluctuations in carbon dioxide emissions shown in figure 3.

The most significant fluctuation of carbon dioxide emissions was between 2000 and 2002, the initial decline was as a result of the closure of the Llanwern blast furnace in 2001<sup>29</sup>. This was followed by the explosion at the Port Talbot blast furnace in

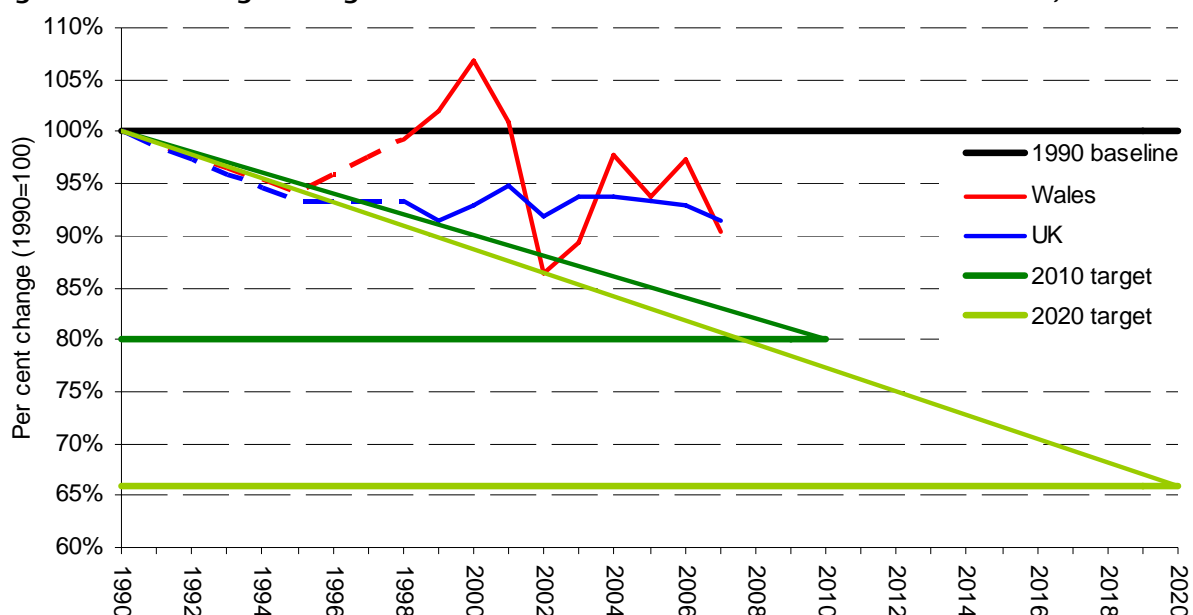
<sup>28</sup> AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007, Appendix 2.3](#) (table 7A) (September 2007) (Percentage has been calculated by Members' Research Service.)

<sup>29</sup> BBC News, [Llanwern steelworks 'set to close'](#), 7 January 2001 [accessed 15 December 2009]

November 2001<sup>30</sup>, which significantly reduced carbon dioxide emissions until it reopened in January 2003.

The most recent fluctuations between 2005 and 2007 can be explained from changes in the fuel mix of electricity generation in Wales. Between 2005 and 2006 coal fired generation increased by over 30 per cent followed by a 40 per cent reduction between 2006 and 2007. These changes can be partly explained by the plant shut-down at Aberthaw to retro fit two units with Flue Gas Desulphurisation abatement<sup>31</sup>.

**Figure 3: Percentage change in carbon dioxide emissions from 1990 to 2007<sup>(a)</sup>, Wales and UK<sup>(b)</sup>**



Source: AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007](#), (September 2009)

(a) For figures prior to 1998, data is only available for 1990 and 1995, therefore the figures in between have been estimated

(b) Different methodologies have been used from previous AEA publications, therefore comparisons cannot be made with previous papers.

### 3.2. Carbon dioxide emitters in Wales

Electricity generation contributed around 28.9 per cent of total Welsh carbon dioxide emissions in 2007, which is slightly lower than the UK proportion of 32.7 per cent. Emissions from electricity generation in Wales have increased by 0.1 per cent compared with a fall of 13.2 per cent in UK emissions over 1990 to 2007<sup>32</sup>. The Environment Agency has provided the Members' Research Service with the top 11 carbon dioxide emitters in the EU Emissions Trading Scheme (EUETS) in Wales from 2005 to 2008.

Wales is a net exporter of electricity i.e. it exports more than it uses. There is no electricity grid transmission links between North and South Wales at the moment,

<sup>30</sup> BBC News, [Fatal blast investigation begin](#), 9 November 2001 [accessed 15 December 2009]

<sup>31</sup> AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007](#), (page 29) (September 2009)

<sup>32</sup> Ibid (page 29)

energy is mainly exported from North Wales whilst South Wales is a net importer of electricity.

**Table 2: Top 11 carbon dioxide emitters in the EUETS in Wales, 2005-2008 (Mt CO<sub>2</sub>)**

		2005	2006	2007	2008
Port Talbot Steelworks	Industry	6.1	6.6	7.1	6.9
Aberthaw Power Station	Electricity generation	5.3	7.3	4.2*	7.0
Connahs Quay Power Station	Electricity generation	3.4	3.2	3.4	3.3
Chevron Limited - Pembroke	Industry	2.3	2.3	2.5	2.2
Baglan Power Station	Electricity generation	1.1	1.1	1.4	0.7
Murco Petroleum Limited - Milford Haven	Industry	1.0	1.2	1.2	1.1
Uskmouth Power Station	Electricity generation	1.0	0.9	0.6	1.3
Deeside Power Station	Electricity generation	1.0	0.6	0.9	1.2
Shotton Combined Heat Power Station	Electricity generation	0.5	0.5	0.5	0.5
Barry Power Station	Electricity generation	0.3	0.2	0.4	0.5
Padeswood Works	Industry	0.3	0.6	0.6	0.5

Source: Environment Agency

\* reduction at Aberthaw was the result of a temporary reduction in capacity.

### 3.3. International comparisons

#### 3.3.1. Change in carbon dioxide emissions

Comparisons of carbon dioxide emissions with those of other countries can be interesting for reference purposes. As explained in [section 2.1](#), the Kyoto protocol includes individual targets of reducing greenhouse emissions by between -8 per cent and +10 per cent of 1990 emissions levels by 2008 / 2012. Figure 4 shows the percentage change of carbon dioxide emissions between the base year (1990) and 2007 of all the UNFCCC Annex 1<sup>33</sup> Parties<sup>34</sup>, the EU-27<sup>35</sup> and the four UK countries<sup>36</sup> (the Kyoto Protocol targets are denoted by two red lines).

Included in the graph are two figures for the UK: "UK (i)" includes all unallocated, Crown Dependencies<sup>37</sup> and Overseas Territories<sup>38</sup> which have joined the UK's instruments of ratification to the UNFCCC and the Kyoto Protocol, while "UK (ii)" does not include Overseas Territories and matches the figures in table 1.

Of the 46 countries<sup>39</sup>, 19 have increased their carbon dioxide emissions since 1990, while 25 have reduced their emissions. The largest increases were in Turkey and

<sup>33</sup> [Annex I Parties](#) include the industrialised countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States. [accessed 15 December 2009]

<sup>34</sup> The graph excludes Latvia even though it is part of the UNFCCC Annex 1 Parties as it had negative emissions in 1990 and 2007. CO<sub>2</sub> emissions in Latvia have declined from -2,217Gg to -23,411Gg, a decrease of 950 per cent.

<sup>35</sup> Data was not available from the UNFCCC for Cyprus.

<sup>36</sup> The UK countries are highlighted with an \* on the graph.

<sup>37</sup> Crown Dependencies of Jersey, Guernsey and the Isle of Man.

<sup>38</sup> Overseas Territories included are the Cayman Island, Falkland Islands, Bermuda, Montserrat and Gibraltar.

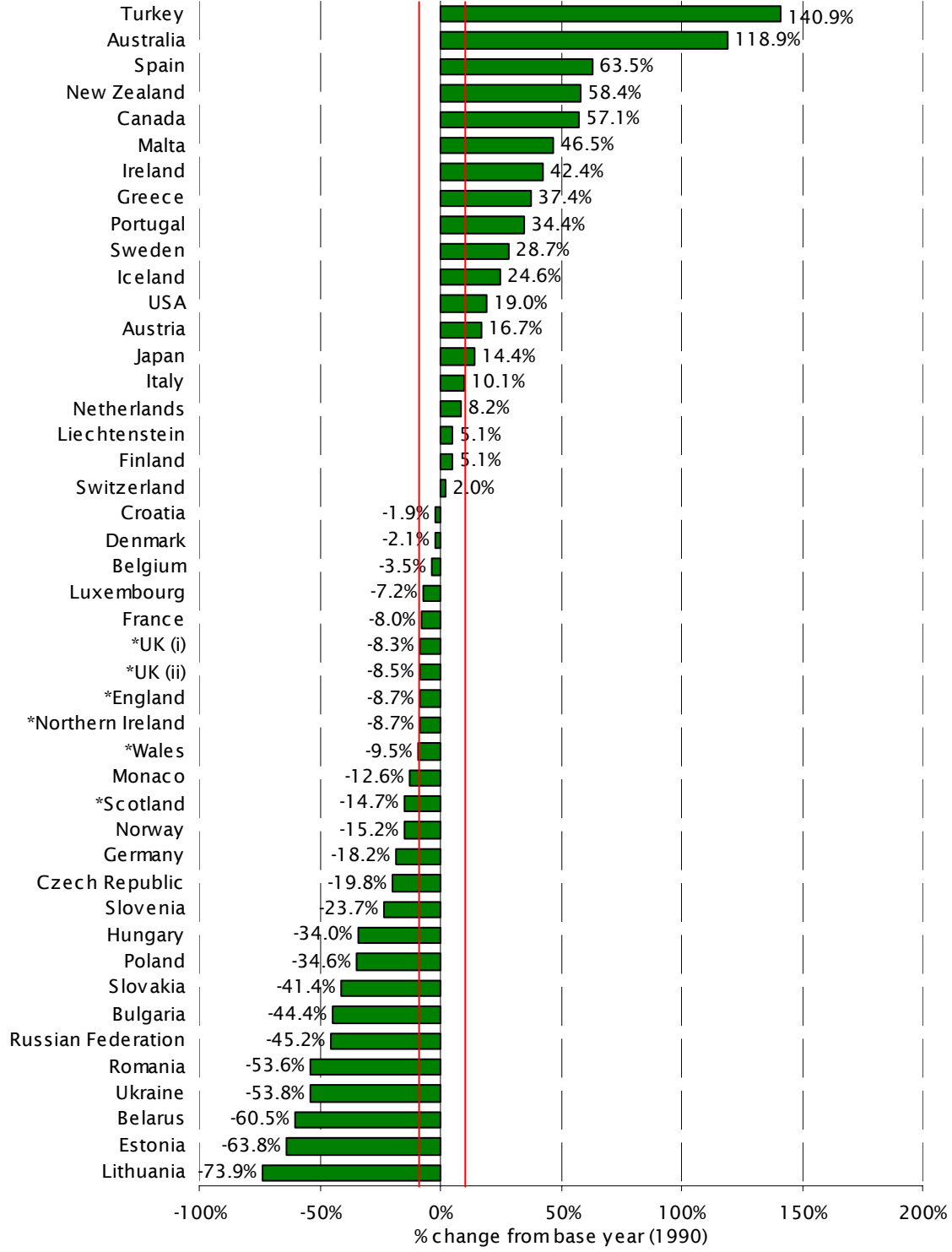
<sup>39</sup> Including all four UK countries and "UK (i)" emissions (not "UK (ii)").

Australia, both increasing by over 100 per cent. The largest decreases in emissions were in Lithuania, Estonia and Belarus, all declining by over 60 per cent.

In terms of the largest reductions of carbon dioxide emissions of the 46 countries included in figure 4, Wales is ranked 17<sup>th</sup>, Scotland 15<sup>th</sup>, Northern Ireland and England, were 18<sup>th</sup> and 19<sup>th</sup> respectively.

A full list of carbon dioxide emissions in 2007 for the Annex 1 Parties, EU-27 and UK countries is provided in the Annex.

**Figure 4: Percentage change from the base year (1990) of carbon dioxide emissions, by Country<sup>(a)</sup>, including LULUCF<sup>(b)</sup>, 2007 (Gg<sup>40</sup>)**



Source: UNFCCC [Greenhouse Gas Data](#) and AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007, Appendix 2](#) (September 2007)

\* denotes UK Countries

(a) The graph excludes Latvia even though it is part of the UNFCCC Annex 1 Parties, as it had negative emissions in 1990 and 2007. CO<sub>2</sub> emissions in Latvia have declined from -2,217Gg to -23,411Gg, a decrease of 950%.

(b) LULUCF – Land use, land use change and forestry

UK (i) Figure does not match those published in table 1, here the figure includes all unallocated, Crown Dependencies and Overseas Territories which have joined the UK’s instruments of ratification to the UNFCCC and the Kyoto Protocol

UK (ii) Only includes unallocated and Crown Dependencies and matches figures provided in table 1, (the figure for England includes Crown Dependencies, see table 1).

<sup>40</sup> One Gigagramme (Gg) equates to one thousand tonnes, or one kilotonnes (kt) (UK data is recorded in kt).

### 3.3.2. Carbon dioxide emissions per capita

Countries with large populations and large economies, tend to have the largest emissions. Due to this, focusing only on absolute emission levels only gives a partial understanding of global carbon dioxide emissions. Examining the carbon dioxide emissions per capita provides further explanation as to how emissions are distributed<sup>41</sup>. Carbon dioxide emissions per capita is the total amount of carbon dioxide emitted by a country, divided by the population of the country<sup>42</sup>.

Figure 4 presents the total carbon dioxide emissions (net emissions/removals) per capita for each of the EU-27, the UNFCCC Annex 1 Parties and the four UK countries<sup>43</sup>. Data for UK countries have been calculated using carbon dioxide emissions published in the AEA 2009 publication<sup>44</sup>, divided by the [mid-2007 population estimates](#) for each country.

The carbon dioxide emissions per capita shown in figure 5 have been **calculated by the Members' Research Service**, by dividing the carbon dioxide emissions for each country by their population. **Caution** should be used when **making comparisons** with other data sources as methodologies are likely to differ. In addition, **care** should be taken when **comparing the UK devolved administration** figures with **international figures** as the methods used to calculate the carbon dioxide emissions are also likely to vary slightly. Figures are not comparable with previous Members' Research Service *Carbon Dioxide Emissions in Wales* publications.

The carbon dioxide emissions per capita for the UK countries in 2007 were<sup>45</sup>:

- Wales 13.1 tonnes per capita
- Northern Ireland 9.0 tonnes per capita
- Scotland 8.4 tonnes per capita
- England 8.4 tonnes per capita

Of the 43 countries included in figure 5, Wales had the 6<sup>th</sup> highest carbon dioxide emissions per capita in 2007. Australia had the highest, while Lithuania had the lowest. The UK was ranked 17<sup>th</sup> highest.

Wales' per capita emissions decreased by 7.4 per cent; from 14.14 tonnes per capita to 13.09 tonnes per capita between 2006 and 2007.

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<sup>41</sup> World Resources Institute, [Navigating the numbers, Greenhouse gas data and international climate policy](#), 2005

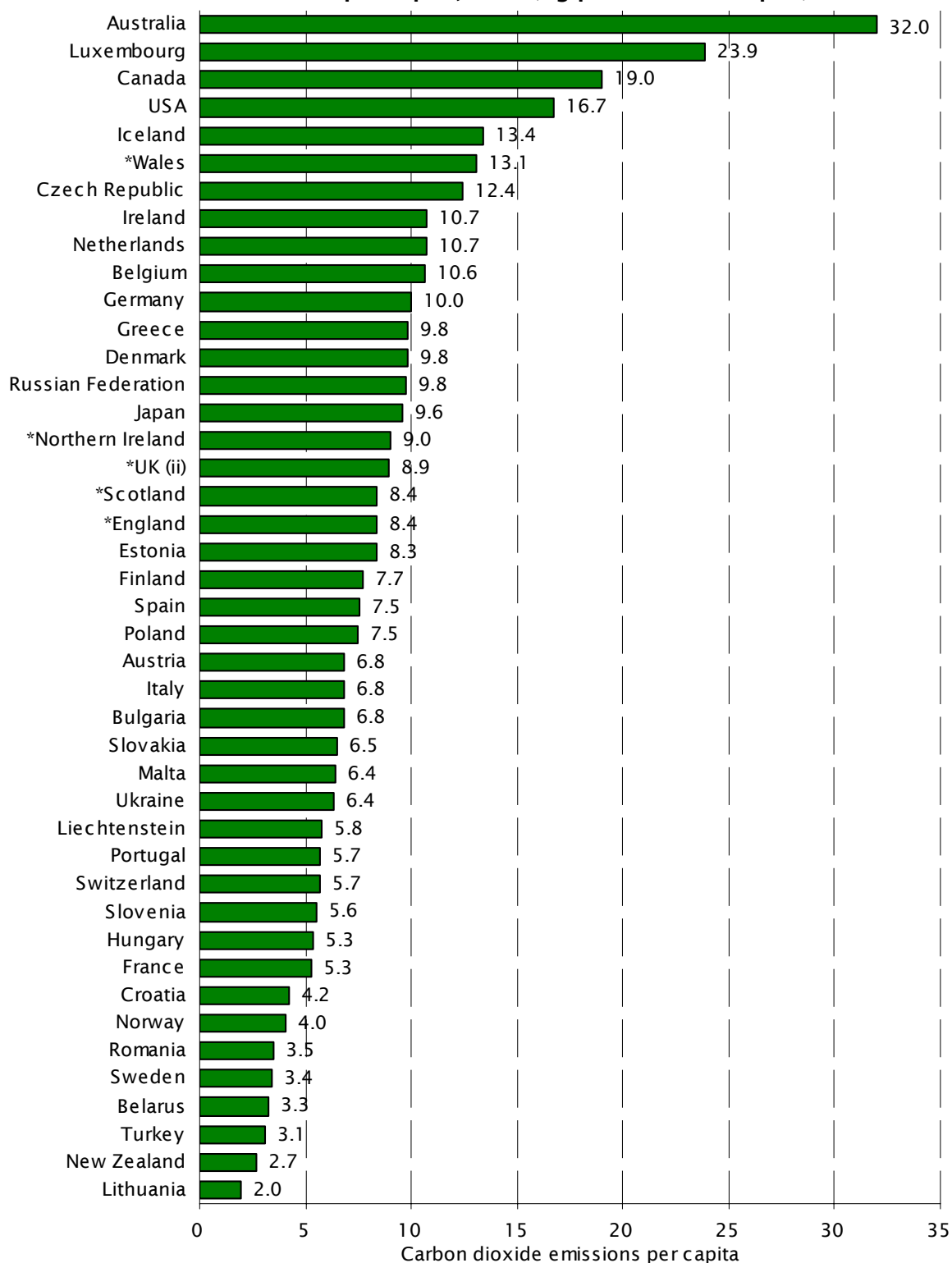
<sup>42</sup> DBERR, [Energy – its impact on the environment and society](#), Annex 5A, July 2006

<sup>43</sup> Data for Cyprus and Monaco are not available and due to the negative levels of carbon dioxide emissions in Latvia it has also been excluded (see footnote 21).

<sup>44</sup> AEA, [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007, Appendix 2](#) (September 2009)

<sup>45</sup> These figures are not comparable with previous publications as different methods have been used to calculate the figures.

Figure 5: Carbon dioxide emissions per capita, 2007 (Gg per thousand capita)<sup>(a)</sup>



Source: UNFCCC [Greenhouse Gas Data](#), UN [Demographic Year Book 2007](#) (table 5) AEA [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007, Appendix 2, Mid-2007 population estimates \(table 3\)](#) and Members' Research Service calculations

\* denotes UK Countries

(a) The graph excludes Latvia even though it is part of the UNFCCC Annex 1 Parties, as it had negative emissions in 1990 and 2007. CO<sub>2</sub> emissions in Latvia have declined from -2,217Gg to -23,411Gg, a decrease of 950 per cent.

Note: the figures provided in this table are not comparable with the data used in the previous edition of this paper.

UK (ii) UK data is emissions from UK and Crown Dependencies, but population data used is only for the UK (the figure for England includes Crown Dependencies, see table 1).

### 3.4. Local comparisons

The principal methodology for allocating emissions to local authorities allocates emissions on an “end user” basis. This means that emissions are distributed according to the point of energy consumption or the point of emission if non-energy related. Emissions from the production of goods are assigned to where the production takes place (i.e. emissions from exported goods are included).

The values arising from this methodology give an idea of geographical use, rather than production, it is useful in informing about emissions from use of energy in local authority areas. Detailed carbon dioxide emissions for 2007 by sector, and local authority are shown in table 3. Figure 6 shows the percentage change in total carbon dioxide emissions between 2005 and 2007, by local authority.

As a result of the ‘end user’ methodology used, the total emissions figure (33.0 Mt CO<sub>2</sub>) in table 3 does not match the inventoried all-Wales total (39.0 Mt CO<sub>2</sub> in table 1), which is based on the ‘production’ approach. The information is therefore more useful to compare between the local authorities in Wales, rather than a definitive value of emissions.

**Table 3: Carbon dioxide emissions by sector and local authority, 2007 (kt CO<sub>2</sub>)**

	Industry & Commercial	Domestic	Road Transport	LULUCF (b)	Total	Rank (of total emissions)
Isle of Anglesey	411	181	143	43	778	15
Gwynedd	295	302	295	-115	777	16
Conwy	209	288	290	-25	761	17
Denbighshire	221	239	208	-27	642	18
Flintshire	1,601	370	426	5	2,403	3
Wrexham	871	312	235	-7	1,411	9
Powys	410	336	355	-211	891	13
Ceredigion	217	178	166	-35	526	20
Pembrokeshire	568	294	246	84	1,192	11
Carmarthenshire	646	435	479	34	1,595	6
Swansea	565	535	420	18	1,538	7
Neath Port Talbot	7,716	336	325	-21	8,357	1
Bridgend	586	323	332	-17	1,224	10
Vale of Glamorgan	954	293	244	27	1,519	8
Cardiff	1,032	688	719	7	2,446	2
Rhondda Cynon Taff	577	556	498	-28	1,602	5
Merthyr Tydfil	140	139	97	-6	369	22
Caerphilly	397	406	270	-2	1,070	12
Blaenau Gwent	209	171	82	-4	458	21
Torfaen	283	205	148	2	637	19
Monmouthshire	282	221	379	5	887	14
Newport	1,130	333	491	4	1,959	4
<b>Wales</b>	<b>19,320</b>	<b>7,142</b>	<b>6,850</b>	<b>-269</b>	<b>33,043</b>	<b>..</b>

Source: DECC, [2007 local authority carbon dioxide emissions](#) (full dataset) and Members’ Research Service calculations  
 (a) Different methodologies have been used from previous AEA publications, therefore comparisons cannot be made with previous papers.

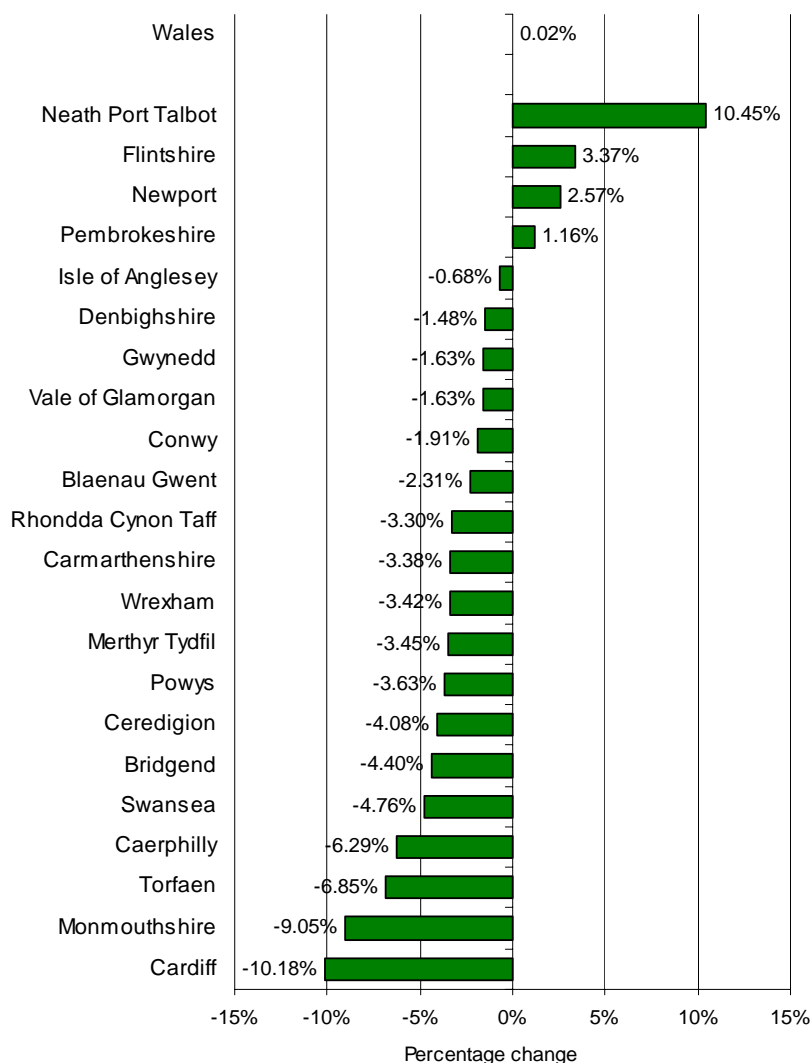
(b) LULUCF - Land use, land use change and forestry.



The following observations can be made from table 3 and figure 6:

- The highest carbon dioxide emissions and the largest increase in emissions in 2007 was in Neath Port Talbot (the main contributor to this is the Corus steelworks in Port Talbot);
- Industrial and commercial emissions accounted for 58 per cent of all carbon dioxide emissions in Wales, while land use, land use change and forestry (LULUCF) reduced emissions 1 per cent;
- Only four Welsh local authorities increased their carbon dioxide emissions between 2005 and 2007, while 18 reduced theirs. Cardiff reduced their emissions by the most (10.18 per cent); and
- Of the 434 local authorities in the UK, Neath Port Talbot had the third highest emissions in 2007. Merthyr Tydfil (with the lowest emissions in Wales) had the 25<sup>th</sup> lowest carbon dioxide emissions in the UK.

**Figure 6: Change in carbon dioxide emissions between 2005 and 2007, by local authority**



Source: DECC, [2007 local authority carbon dioxide emissions](#) (full dataset) and Members' Research Service calculations  
 (a) Different methodologies have been used from previous AEA publications, therefore comparisons cannot be made with previous papers.

Per capita emissions provide an indication of the level of emissions in comparison with the population size of a local authority. Table 4 provides carbon dioxide emissions per capita in 2007 by sector, while figure 7 highlights the geographical differences of the total emissions per capita. Per capita emissions as a result of domestic activity<sup>46</sup> provide an indication of energy efficiency at a local authority level.

The following observations can be made from table 4 and figure 7:

- The highest emissions per capita were in Neath Port Talbot (60.8 tonnes per capita), while Caerphilly had the lowest (6.2 tonnes per capita) (The main contributor to the high Neath Port Talbot figure is the Corus steelworks in Port Talbot).
- There is little difference between domestic carbon dioxide emissions across Wales, ranging from 2.1 to 2.6 tonnes per capita. Cardiff had the lowest domestic emissions, while the Isle of Anglesey had the highest.
- Emissions per capita from LULUCF highlight the areas with the most carbon dioxide is being removed from the atmosphere, generally through forest growth. In Wales, Powys had the highest levels of carbon dioxide being removed from the atmosphere.

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<sup>46</sup> Carbon dioxide emissions from domestic activity include domestic electricity, gas, oil and solid fuel use and emissions from domestic home and garden machinery.

**Table 4: Carbon dioxide emissions per capita<sup>(a)</sup>, by sector in Wales, 2007 (tonnes per capita)**

	Industry & Commercial	Domestic	Road Transport	LULUCF (b)	Total
Isle of Anglesey	6.0	2.6	2.1	0.6	11.3
Gwynedd	2.5	2.6	2.5	-1.0	6.6
Conwy	1.9	2.6	2.6	-0.2	6.8
Denbighshire	2.3	2.5	2.1	-0.3	6.6
Flintshire	10.6	2.5	2.8	0.0	16.0
Wrexham	6.6	2.4	1.8	-0.1	10.7
Powys	3.1	2.5	2.7	-1.6	6.8
Ceredigion	2.8	2.3	2.1	-0.5	6.8
Pembrokeshire	4.8	2.5	2.1	0.7	10.1
Carmarthenshire	3.6	2.4	2.7	0.2	8.9
Swansea	2.5	2.3	1.8	0.1	6.7
Neath Port Talbot	56.2	2.4	2.4	-0.2	60.8
Bridgend	4.4	2.4	2.5	-0.1	9.1
Vale of Glamorgan	7.7	2.4	2.0	0.2	12.2
Cardiff	3.2	2.1	2.2	0.0	7.6
Rhondda Cynon Taff	2.5	2.4	2.1	-0.1	6.9
Merthyr Tydfil	2.5	2.5	1.7	-0.1	6.6
Caerphilly	2.3	2.4	1.6	0.0	6.2
Blaenau Gwent	3.0	2.5	1.2	-0.1	6.6
Torfaen	3.1	2.2	1.6	0.0	7.0
Monmouthshire	3.2	2.5	4.3	0.1	10.1
Newport	8.1	2.4	3.5	0.0	14.0
<b>Wales</b>	<b>6.5</b>	<b>2.4</b>	<b>2.3</b>	<b>-0.1</b>	<b>11.1</b>

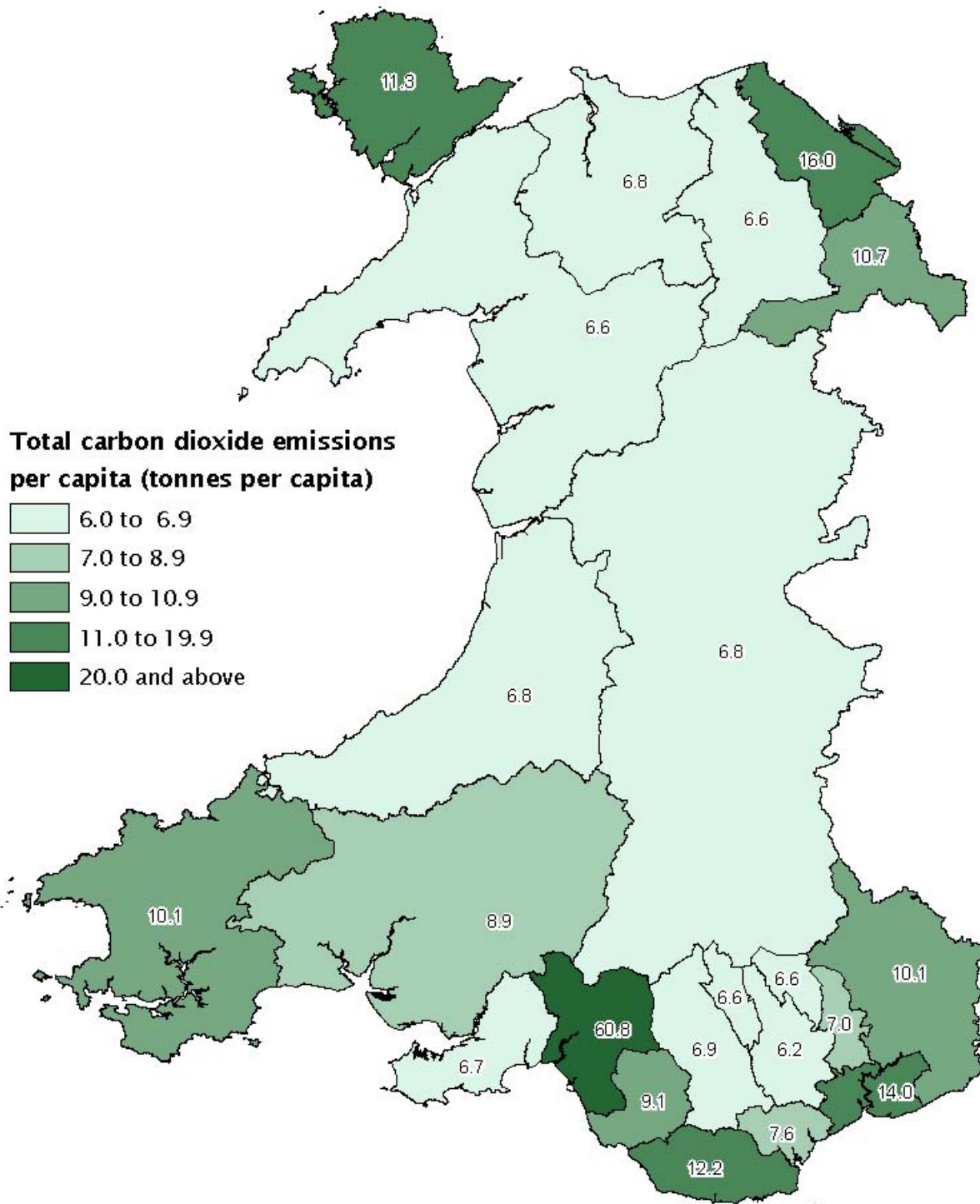
Source: DECC, [2007 local authority carbon dioxide emissions](#) (full dataset), Mid -2007 population estimates ([StatsWales \[table 3122\]](#)) and Members' Research Service calculations

(a) Per capita emissions have been calculated using StatsWales population so does not match exactly those used in the DECC paper (which used rounded population data).

(b) LULUCF - Land use, land use change and forestry

Note: Different methodologies have been used from previous AEA publications, therefore comparisons cannot be made with previous papers.

Figure 7: Carbon dioxide emissions per capita, by local authority, 2007



Source: DECC, 2007 local authority carbon dioxide emissions  
Mid-2007 population estimates (StatsWales)

Members' Research Service

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#### 4. Useful links and further information

The links below provide further information about the data sources in this paper and also contain links to further information about carbon dioxide emissions at an international, European, UK and Welsh level.

- [Climate Change Commissions for Wales](#)
- [Climate Change Statistics](#), published by DECC
- [The Department of Energy and Climate Change](#) (DECC)
- [European Climate Change Programme](#)
- [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990 to 2007](#), published by AEA
- [The Met Office Hadley Centre](#)
- [Tyndall Centre for Climate Change Research](#)
- The UK Government's [Committee on Climate Change](#)
- [UK Climate Projections](#)
- [UN Framework Convention on Climate Change](#)
- Welsh Government website on [Climate Change](#)

## Annex Carbon dioxide emissions, by country

	CO <sub>2</sub> emissions (Gg)		Mid-2007 population (thousands)	Percentage change from base year	CO <sub>2</sub> per capita (g per capita)
	1990 (base year)	2007			
England	467,392	426,911	51,092	-8.7%	8.4
Northern Ireland	17,352	15,842	1,759	-8.7%	9.0
Scotland	50,487	43,065	5,144	-14.7%	8.4
UK (i)	594,194	544,610	..	-8.3%	..
UK (ii)	591,521	541,189	60,975	-8.5%	8.9
Wales	43,129	39,011	2,980	-9.5%	13.1
Australia	308,287	674,932	21,072	118.9%	32.0
Austria	48,651	56,779	8,315	16.7%	6.8
Belarus	80,054	31,627	9,702	-60.5%	3.3
Belgium	117,204	113,071	10,623	-3.5%	10.6
Bulgaria	93,766	52,088	7,660	-44.4%	6.8
Canada	398,214	625,628	32,976	57.1%	19.0
Croatia	18,920	18,562	4,436	-1.9%	4.2
Czech Republic	159,639	128,031	10,334	-19.8%	12.4
Denmark	54,631	53,467	5,457	-2.1%	9.8
Estonia	30,910	11,188	1,342	-63.8%	8.3
Finland	38,653	40,614	5,289	5.1%	7.7
France	353,064	324,657	61,707	-8.0%	5.3
Germany	1,007,274	824,362	82,263	-18.2%	10.0
Greece	79,902	109,758	11,193	37.4%	9.8
Hungary	81,234	53,587	10,056	-34.0%	5.3
Iceland	3,340	4,163	311	24.6%	13.4
Ireland	32,635	46,480	4,339	42.4%	10.7
Italy	367,037	404,176	59,375	10.1%	6.8
Japan	1,068,837	1,222,419	127,772	14.4%	9.6
Latvia	-2,217	-23,411	2,276	956.0%	-10.3
Liechtenstein	195	205	35	5.1%	5.8
Lithuania	25,352	6,608	3,376	-73.9%	2.0
Luxembourg	12,344	11,453	480	-7.2%	23.9
Malta	1,791	2,624	409	46.5%	6.4
Monaco	105	92	..	-12.6%	..
Netherlands	161,909	175,194	16,382	8.2%	10.7
New Zealand	7,144	11,316	4,228	58.4%	2.7
Norway	22,488	19,067	4,709	-15.2%	4.0
Poland	436,670	285,390	38,116	-34.6%	7.5
Portugal	44,949	60,422	10,608	34.4%	5.7
Romania	160,875	74,654	21,538	-53.6%	3.5
Russian Federation	2,535,336	1,390,205	142,115	-45.2%	9.8
Slovakia	59,555	34,922	5,398	-41.4%	6.5
Slovenia	14,703	11,215	2,019	-23.7%	5.6
Spain	206,968	338,331	44,874	63.5%	7.5
Sweden	24,123	31,043	9,148	28.7%	3.4
Switzerland	42,144	42,982	7,551	2.0%	5.7
Turkey	94,724	228,201	73,875	140.9%	3.1
Ukraine	642,452	296,558	46,646	-53.8%	6.4
USA	4,235,263	5,040,842	301,621	19.0%	16.7

Source: UNFCCC [Greenhouse Gas Data](#), UN [Demographic Year Book 2007](#) (table 5), AEA [Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2007, Appendix 2](#) and [Mid-2007 population estimates \(table 3\)](#)



