National Assembly for **Wales**
Cynulliad Cenedlaethol **Cymru**

Carbon Dioxide Emissions in Wales

Abstract
This research paper updates and replaces a previous research paper of the same title, to include data up to 2005.

It provides a short synopsis of climate change, and looks at 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, and provides information on per capita carbon dioxide emissions for each local authority in Wales.

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Cynulliad Cenedlaethol Cymru
National Assembly for Wales

Carbon Dioxide Emissions in Wales

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Cynulliad Cenedlaethol Cymru
National Assembly for Wales

Executive Summary

This paper updates and replaces a research paper of the same title, published in July 2007, to include data up to 2005.

There is compelling scientific evidence that the activities of humankind are responsible for changing the climate of the planet. Carbon dioxide is the most important human-produced greenhouse gas, and measures are being taken at various policy levels to reduce carbon dioxide emissions.

Despite the numerous policies acting to reduce emissions, carbon dioxide emissions in Wales have reduced by less than 4 per cent since 1990 – the year from which reductions are calculated under international obligations.

One interpretation of the Welsh Assembly Government's aim to 'contribute fully to meeting UK-wide targets' is a target to reduce Welsh carbon dioxide emissions by 20 per cent below 1990 levels by 2010. Welsh emissions in 2005 were nearly 16 per cent greater than the level needed to attain the target: to reach the target, emissions need to reduce by 4.8 per cent per year between 2006 and 2010.

In 2005, Wales was the 34th–lowest ranked country in the world in terms of generating value from carbon emissions – the only EU country that has a poorer record of carbon intensity is Estonia, in 33rd place. Excluding small island states, Wales had the 12th-highest carbon dioxide emissions per capita in the world in 2005.

Conwy and Ynys Môn have the highest per capita carbon dioxide emissions from domestic sources, while Cardiff has the lowest emissions per capita from domestic sources.

Cynulliad Cenedlaethol Cymru
National Assembly for Wales

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1 Climate Change

> "This is the biggest problem facing us globally this century. There is no bigger problem. The threat is quite simple; it's a threat to our civilisation"[1].
>
> *Professor Sir David King, Chief Scientific Adviser to the UK Government*, June 2004

The climate of planet earth has been varying for millions of years, and some variation is natural and expected. However, recent, rapid pollution loading has 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[2]; this human-induced change is what is usually referred to as 'climate change'.

Direct observations of climate change include the following[3]:

- Eleven of the last 12 years (1995-2006) rank among the 12 warmest years in the instrumental record of global surface temperature.
- Widespread changes in extreme temperatures have been observed over the last 50 years, with less frequent cold days, cold nights and frost, and more frequent hot days, hot nights and heat waves.
- The average temperature of the global ocean has increased to depths of at least 3000m. The ocean has been absorbing more than 80 per cent of the heat added to the climate system, causing sea water to expand, and contributing to sea level rise.
- Mountain glaciers and snow cover have declined across the globe, contributing to sea level rise. Ice sheets on Greenland and in Antarctica have lost mass, which is very likely to have contributed to sea level rise.
- Global sea level rose at a rate of 3.1mm per year between 1993 and 2003, which is substantially faster than the rate of 1.8mm per year between 1961 and 2003.

The Intergovernmental Panel on Climate Change (IPCC) notes that continued greenhouse gas emissions at or above current rates will cause further warming, inducing changes in the global climate system that will be larger than those observed during the 20th century (Figure 1)[4]. The great majority of organisms and ecosystems in Europe will have difficulties adapting to climate change[5], with more than 40 per cent of species around the world projected to become extinct if

[1] The Climate Group, *Viewpoint: Professor Sir David King*, 28 June 2004, http://theclimategroup.org/index.php/viewpoint/professor_sir_david_king/
[2] Oreskes N, 2004, The scientific consensus on climate change, *Science* 306 (5702), p. 1686, http://www.sciencemag.org/cgi/content/full/306/5702/1686
[3] Intergovernmental Panel on Climate Change, *IPCC Working Group 1: The physical basis for climate change, assessment report 4 final report, summary for policymakers*, February 2007, p. 5, http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf
[4] *ibid*, p. 13
[5] Intergovernmental Panel on Climate Change, *IPCC Working Group 2: Impacts, adaptation and vulnerability, fourth assessment report, summary for policymakers*, April 2007, p. 9, http://www.ipcc-wg2.org/

temperatures exceed 4°C above the 1980-1999 average[6]. At this level of temperature increase, it is thought that sea level rise will start to threaten major world cities, including New York, Shanghai, Tokyo and London[7]. Over a timescale of centuries, the Greenland and West Antarctic ice sheets are likely to at least partially melt. The complete melting of these sheets would lead to a contribution to sea level rise of about 7m and 5m respectively[8].

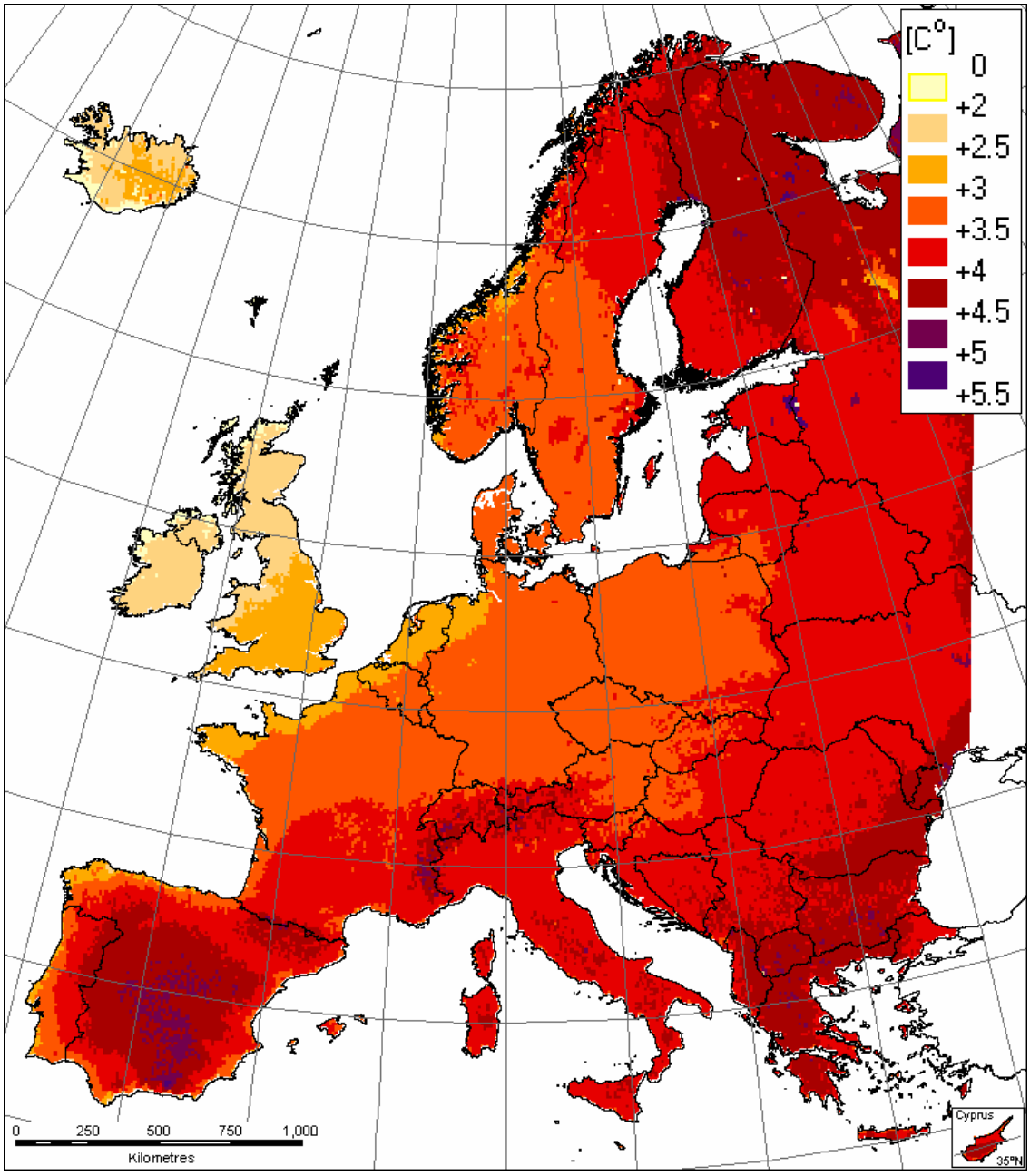

Figure 1 Projected change in mean annual temperature by the end of the 21st Century[9]

[6] *ibid*, p. 16
[7] Stern N, 2006, *Stern review: The economics of climate change*, p. v
http://www.hm-treasury.gov.uk./media/4/3/Executive_Summary.pdf
[8] Intergovernmental Panel on Climate Change, *IPCC Working Group 2: Impacts, adaptation and vulnerability, fourth assessment report, summary for policymakers*, April 2007, p. 15,
http://www.ipcc-wg2.org/
[9] Based on IPCC SRES scenario A2, taken from European Commission, *Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Adapting to climate change in Europe – options for EU action*,
http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0354en01.pdf

Figure 2 shows the annual average global mean near-surface temperature from 1850-2006, as a deviation from the average over the 1961-1990 baseline period[10].

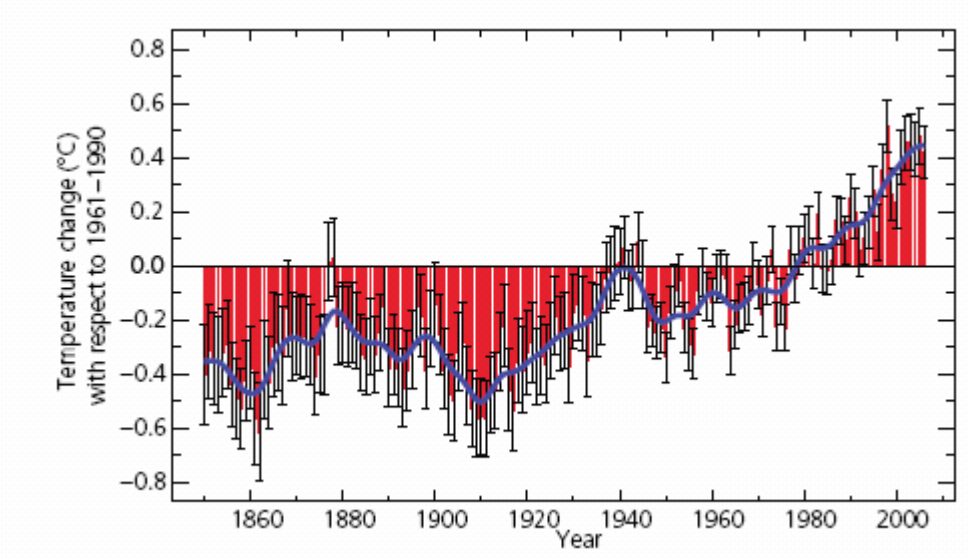

Figure 2 Average global temperatures from 1850 to 2006. The blue curve shows the data smoothed to emphasise decadal varations

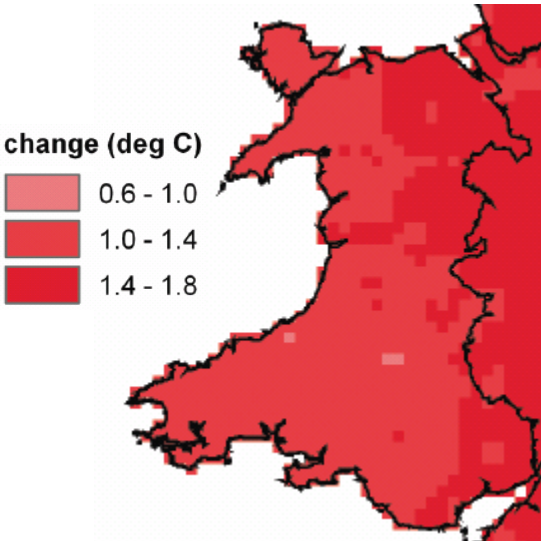

Figure 3 Change in annual average daily mean temperature (°C) between 1961 and 2006 based on a linear trend[17]

Recent observations show increasing global average air and ocean temperatures, widespread melting of snow and ice, and rising sea levels. According to the IPCC, warming of the climate system is "unequivocal"[11]. Based on a linear trend, the daily mean temperature in Wales is now 1.33 degrees higher than it was in 1961[12] (Figure 3), and Wales now has 22 less days of air frost than in 1961[13].

Mitigation efforts over the next two or three decades will have a large impact on opportunities to achieve lower stabilisation levels of atmospheric amounts of greenhouse gases[14], or, as Sir Nicholas Stern puts it: "the benefits of strong, early action [on climate change] considerably outweigh the costs"[15]. Provided that appropriate incentives to their adoption are applied, current and planned technology are seen as being sufficient to achieve stabilisation of greenhouse gases in the atmosphere[16].

[10] UK Climate Impacts Programme, *The climate of the United Kingdom and recent trends*, December 2007, p. 6, http://www.ukcip.org.uk/climate%5Fimpacts/publications/UKCIP08_Trends_text.pdf
[11] Intergovernmental Panel on Climate Change, *Climate change 2007: Synthesis report*, 17 November 2007, p. 1, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_topic1.pdf
[12] UK Climate Impacts Programme, *The climate of the United Kingdom and recent trends*, December 2007, p. 36, http://www.ukcip.org.uk/climate%5Fimpacts/publications/Trends5_meantemp_region.pdf
[13] *ibid*, p. 60, http://www.ukcip.org.uk/climate%5Fimpacts/publications/Trends16_airfrost.pdf
[14] Intergovernmental Panel on Climate Change, *IPCC Working Group 3: Mitigation of climate change, fourth assessment report, summary for policymakers*, May 2007, p. 15, http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf
[15] Stern N, 2006, *Stern review: The economics of climate change*, p. ii http://www.hm-treasury.gov.uk./media/4/3/Executive_Summary.pdf
[16] Intergovernmental Panel on Climate Change, *IPCC Working Group 3: Mitigation of climate change, fourth assessment report, summary for policymakers*, May 2007, p. 16, http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf

> "Climate change… is the greatest and widest-ranging market failure ever seen"[18].
>
> *Sir Nicholas Stern, Head of the UK Government Economics Service*, October 2006

According to Sir Nicholas Stern, a 'business as usual' approach to climate change will incur costs equivalent to a 20 per cent reduction in consumption per person, now and into the future[19], whereas achieving deep but attainable cuts in emissions would cost approximately 1 per cent of annual global GDP by 2050[20]. Although global economic losses from natural catastrophes in 2007 ($75 billion) were less than the record 2005 figure ($220 billion) that included the effects of hurricane Katrina, losses were 50 per cent greater than in 2006, and in line with a rising trend[21].

A report from the Tyndall Centre for Climate Change Research described two energy scenarios for the UK economy's transition from a high to a low-carbon system over a period up to 2050, and concluded the following:

> "If the Government's carbon dioxide targets are to actually have meaning, the Government must act now to curb dramatically the nation's carbon dioxide emissions. The message from this research is that stark. In waiting for technology or the EU ETS [Emissions Trading Scheme] to offer a smooth transition to a low-carbon future, we are deluding ourselves. It is an act either of negligence or irresponsibility for policymakers continually to refer to a 2050 target as the key driver in addressing climate change. The real challenge we face is in making the radical shift onto a low carbon pathway by 2010-12, and thereafter driving down carbon intensity at an unprecedented 9% per annum, for up to two decades"[22].

Carbon dioxide is the most important human-produced greenhouse gas[23]; the global atmospheric concentration of carbon dioxide has increased from a pre-industrial average of about 280 parts per million[24] (ppm) to a new record high of 381ppm in 2006[25]. The rate of growth in emissions in the 2000s is now 25 per cent greater than it was in the 1990s[26]. The atmospheric concentration of carbon dioxide in 2005 far exceeds the natural range over the past 650,000 years[27]. The primary source of the increased atmospheric concentration of carbon dioxide since the pre-industrial period is fossil fuel combustion[28].

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[17] UK Climate Impacts Programme, *The climate of the United Kingdom and recent trends*, p. 6, December 2007, http://www.ukcip.org.uk/climate%5Fimpacts/publications/Trends4_meantempchange61to06.pdf
[18] Stern N, 2006, *Stern review: The economics of climate change*, p. i http://www.hm-treasury.gov.uk/media/4/3/Executive_Summary.pdf
[19] *ibid*, p. x
[20] *ibid*, pp. xii-xiii
[21] Munich Re Group, *Press release: Natural catastrophe figures for 2007*, 27 December 2007, http://www.munichre.com/en/press/press_releases/2007/2007_12_27_press_release.aspx
[22] Tyndall Centre, *Living within a carbon budget*, July 2006, http://www.foe.co.uk/resource/reports/living_carbon_budget.pdf
[23] Intergovernmental Panel on Climate Change, *IPCC Working Group 1: The physical basis for climate change, assessment report 4 final report, summary for policymakers*, February 2007, p. 2, http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf
[24] *ibid*
[25] World Meteorological Organisation, *Greenhouse gas bulletin*, 23 November 2007, http://www.wmo.int/pages/prog/arep/gaw/ghg/documents/ghg-bulletin-3.pdf
[26] *ibid*
[27] Intergovernmental Panel on Climate Change, *IPCC Working Group 1: The physical basis for climate change, assessment report 4 final report, summary for policymakers*, February 2007, p. 2, http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf
[28] *ibid*

2 The Policy Background

> "The urgency of the situation means tough decisions need to be taken now to provide disincentives to carbon emissions"[29].
>
> *Martin Rees, President of the Royal Society*, May 2007

2.1 International policy

2.1.1 The United Nations Framework Convention on Climate Change

The UN Framework Convention on Climate Change[30] (UNFCCC) sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. 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 191 countries[31], and entered into force on 21 March 1994. Under the Convention, governments:

- Gather and share information on greenhouse gas emissions, national policies, and best practices
- Launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries
- Cooperate in preparing for adaptation to the impacts of climate change

2.1.2 The Kyoto Protocol

The Kyoto Protocol[32] is the main international instrument for tackling climate change. 176 Parties to the Protocol have ratified it to date[33]. The Kyoto Protocol entered into force on 16 February 2005.

The Protocol's major feature is mandatory targets on greenhouse gas emissions for those of the world's leading economies (Annex I Parties[34]) that have ratified it. These targets range from -8 per cent to +10 per cent of 1990 emissions levels, "with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008

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[29] Martin Rees, The Royal Society press release, *A time for global action on global warming*, 16 May 2007, http://www.royalsoc.ac.uk/news.asp?id=6639
[30] United Nations Framework Convention on Climate Change, www.unfccc.int
[31] The countries that have not ratified are Andorra, Iraq, and Somalia (http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php)
[32] United Nations, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf
[33] The countries that have not ratified are Afghanistan, Andorra, Brunei Darussalam, Central African Republic, Chad, Comoros, Iraq, Kazakhstan, Saint Kitts and Nevis, San Marino, Sao Tome and Principe, Somalia, Tajikistan, Timor-Leste, Tonga, Turkey, United States of America, and Zimbabwe (http://unfccc.int/kyoto_protocol/background/status_of_ratification/items/2613.php)
[34] The Annex I Parties are the EU-15, Australia, Belarus, Bulgaria, Canada, Croatia, Czech Republic, Estonia, Hungary, Iceland, Japan, Latvia, Liechtenstein, Lithuania, Monaco, New Zealand, Norway, Poland, Romania, Russian Federation, Slovakia, Slovenia, Switzerland, Turkey, Ukraine, and United States of America. Of these, the United States of America is alone in not ratifying the Protocol, and it is therefore not bound by the Protocol's requirements (http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php)

to 2012". The EU-15 countries have a target to reduce emissions by 8 per cent, and this has been distributed between its member states such that emissions will need to range between a reduction of 28 per cent in Luxembourg, and an increase of up to 27 per cent in Portugal. The UK has agreed to reduce its emissions to at least 12.5 per cent lower than base year levels[35].

The Protocol offers flexibility in how countries may meet their targets. For example, they may partially compensate for their emissions by increasing carbon 'sinks' such as forests, which absorb carbon dioxide as they grow. They may also pay for projects in other countries that result in cuts in greenhouse gas emissions, through a 'Clean Development Mechanism'[36].

In December 2007, agreement was reached on launching negotiations towards a strengthened international climate change programme[37]. The decision includes an agenda for the main issues to be negotiated up to 2009 – the date by which a new deal needs to be in place in order to provide continuity with the first phase of the Kyoto Protocol. The main issues are[38]:

- Action for adapting to the negative consequences of climate change, such as droughts and floods
- Ways to reduce greenhouse gas emissions
- Ways to deploy climate-friendly technologies widely
- Financing adaptation and mitigation measures

2.2 European policy

The European Union participated in both the UNFCCC and the Kyoto Protocol on behalf of its Member States. A European Council Decision[39] in 2002 approved the Protocol on behalf of the Community.

The European Commission launched the European Climate Change Programme (ECCP) in June 2000. Its aim was to help identify the most environmentally- and cost-effective policies and measures that could be taken at the European level to cut greenhouse gas emissions. The second ECCP was launched in October 2005[40]. It consists of several working groups, which examine issues including aviation, carbon capture and storage, adaptation, and the EU Emission Trading Scheme.

The EU has developed numerous policies and measures related to climate change. Examples are given in Annex A. The most relevant issues arising from the policies are highlighted below:

- Adaptation to climate change should be integrated into the implementation and modification of existing and forthcoming European legislation and policies.

[35] DEFRA, *The United Kingdom's initial report under the Kyoto Protocol*, November 2006, http://www.defra.gov.uk/environment/climatechange/uk/progress/pdf/uk-kyoto-1206.pdf
[36] UNFCCC, *Clean Development Mechanism*, http://cdm.unfccc.int/index.html
[37] UNFCCC, *UN breakthrough on climate change reached in Bali*, http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/20071215_bali_final_press_release.pdf
[38] *ibid*
[39] European Council, *Council Decision of 25 April 2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereafter*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002D0358:EN:HTML
[40] European Commission, *The European Climate Change Programme*,

- The EU's 7th Framework Programme for Research (2007-2013) places a strong emphasis on climate change.
- 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 by 2020. Until an international agreement is concluded, the EU's target is a 20 per cent reduction, including targets to 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.
- 5.75 per cent of transport fuels sold in Member States by 2010 should be biofuels (calculated on the basis of energy content). A Directive on the promotion of renewable energy is timetabled for publication on 23 January 2008, and is likely to include a sustainability scheme for biofuels.
- An emissions trading system (the EU Emissions Trading Scheme) limits carbon dioxide emissions from 11,500 large emitters in the Member States, by capping the emissions that are allowed, and allowing trading between emitters.
- Minimum energy efficiency standards must be met by all new buildings and large existing buildings undergoing major refurbishment.
- Member States must meet an indicative target of 21 per cent of EU electricity consumption being produced by renewable energy by 2010. Furthermore, 20 per cent of energy in Europe must be from renewable sources by 2020, and greenhouse gas emissions must be reduced by 20 per cent from 1990 levels by 2020.
- Member States must gradually reduce the amount of biodegradable waste landfilled to 35 per cent of the 1995 level by 2020 (biodegradable waste produces methane, a potent greenhouse gas).

2.3 UK policy

In 1997, the UK committed itself to a domestic target of reducing carbon dioxide emissions by 20 per cent below 1990 levels by 2010[41]. The Climate Change Bill[42], introduced into the House of Lords in November 2007, provides a legal framework to manage future greenhouse gas emissions:

- Compared to a 1990 baseline, it sets mandatory greenhouse gas reduction targets (a reduction of 26-32 per cent by 2020 and a reduction of 60 per cent by 2050)
- Carbon budgetary periods of five years will be set, during which time greenhouse gas emissions must be within predetermined limits
- A Committee on Climate Change will be incorporated, which will advise the UK Government and, on request, other national governments in the UK, on aspects of climate change
- Trading schemes may be established in any of the UK countries

A research paper prepared by Members' Research Service examines the Bill in more detail[43].

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http://ec.europa.eu/environment/climat/eccpii.htm
[41] DEFRA, *Progress towards national and international targets*, http://www.defra.gov.uk/environment/climatechange/uk/progress/index.htm
[42] UK Parliament, *Climate Change Bill [HL]*, http://www.publications.parliament.uk/pa/ld200708/ldbills/009/2008009.pdf
[43] National Assembly for Wales, *Climate Change Bill*, November 2007, http://www.cynulliadcymru.org/07-101.pdf

In March 2006, the UK Government published its Climate Change Programme[44], which sets out the policies and priorities for action on climate change, both across the United Kingdom as a whole, and internationally. The Programme covers adaptation to climate change, and emission reductions – in the domestic sector, in energy supply, business, transport, land use management, and in the public sector. The document also includes a section about Wales-specific factors (pp. 163-168).

2.4 Welsh policy

The One Wales agreement between Labour and Plaid Cymru[45] stipulates a number of commitments related to climate change:

- The establishment of a Climate Change Commission for Wales, which will assist with the development of new policies and the creation of consensus on climate change
- A target for 3 per cent annual reductions in carbon emissions by 2011 "in areas of devolved competence"
- A commitment to carbon neutrality for public buildings
- Supporting indigenous woodlands, including planting a tree for all new babies and adopted children

The Climate Change Commission held its first meeting in December 2007[46].

The Welsh Assembly Government's Environment Strategy[47] and Action Plan[48] contain specific commitments to tackling climate change. 'Addressing climate change' is one of the five key environmental themes of the Strategy, and the headline target is to cut greenhouse gas emissions by 20 per cent between a 2000 baseline of 46.5 Megatonnes of carbon dioxide[49], and 2020. It also aims to 'contribute fully to meeting UK-wide targets'[50].

In February 2007, the former Minister for Environment, Planning and Countryside announced the Welsh Assembly Government's aspiration for all new buildings to be zero carbon by May 2011[51].

The Energy Wales Route Map consultation[52] contains the following commitments:

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[44] HM Government, *Climate Change: The UK Programme 2006*, March 2006, http://www.defra.gov.uk/environment/climatechange/uk/ukccp/pdf/ukccp06-all.pdf
[45] Labour and Plaid Cymru, *One Wales: A progressive agenda for the government of Wales*, 27 June 2007, http://news.bbc.co.uk/1/shared/bsp/hi/pdfs/27_06_07_onewales.pdf
[46] Welsh Assembly Government, *Wales launches first Climate Change Commission in UK*, http://new.wales.gov.uk/news/presreleasearchive/1848941/?lang=en
[47] Welsh Assembly Government, *Environment Strategy for Wales*, May 2006, http://new.wales.gov.uk/topics/environmentcountryside/epq/Envstratforwales/About_the_strategy/?lang=en
[48] Welsh Assembly Government, *Environment Strategy for Wales: First Action Plan*, http://new.wales.gov.uk/topics/environmentcountryside/epq/Envstratforwales/About_the_strategy/?lang=en
[49] AEA Technology, 2007. *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2005*, http://www.airquality.co.uk/archive/reports/cat07/0709180907_DA_GHGI_report_2005.pdf
[50] Welsh Assembly Government, *Environment Strategy for Wales*, May 2006, p. 21, http://new.wales.gov.uk/topics/environmentcountryside/epq/Envstratforwales/About_the_strategy/?lang=en
[51] National Assembly for Wales, Record of Proceedings, 13 February 2007, http://www.cynulliadcymru.org/en/bus-home/bus-chamber/bus-chamber-second-assembly/bus-chamber-second-assembly-rop.htm?act=dis&id=48756&ds=2007/2
[52] Welsh Assembly Government, *Energy Wales: Route map to a clean, low-carbon and more competitive energy future for Wales*, 2005, http://new.wales.gov.uk/docrepos/40382/4038231141/40382112412/energyroutemape.pdf?lang=en

- Securing 4TWh per annum of renewable electricity production by 2010 and 7TWh by 2020
- Much greater energy efficiency in all sectors
- More electricity generation from cleaner, higher efficiency fossil-fuel plants
- Significant energy infrastructure improvements
- On a holistic basis, achieving measurable carbon dioxide emission reduction targets for 2020

In February 2007, the Welsh Assembly Government published a consultation[53] on a climate change adaptation action plan for Wales. The document highlights some of the changes anticipated as the Welsh climate changes, and illustrates steps that are being taken in response. A report on the consultation was published in August 2007[54]. A consultation on planning for climate change[55] has also closed.

[53] Welsh Assembly Government, *Responding to our changing climate: Consultation on a climate change adaptation action plan for Wales*, http://new.wales.gov.uk/topics/environmentcountryside/climate_change/whatarewedoing/adaptingtocc/?lang=en
[54] *ibid*
[55] Welsh Assembly Government, *Planning for climate change: Consultation document*, December 2006, http://new.wales.gov.uk/docrepos/40382/4038231121/403821/403821/403827/40382/1095043/Planning_for_Climate_Change1.pdf?lang=en

3 Carbon Dioxide Emissions in Wales

There are two broad approaches to calculating carbon dioxide emissions.

- Calculating carbon dioxide emissions according to where those emissions are produced is the 'production' approach. The advantage of using emission production figures is that they are relatively easy to calculate and allocate to national and subnational accounts – principally because this is the methodology used by the UN Framework Convention on Climate Change. The main disadvantage is that they do not account for products that are made elsewhere and imported to Wales, often in countries that have a less efficient production sector[56], nor for products made in Wales and exported.
- Calculating carbon dioxide emissions according to where the product of those emissions is consumed is the 'consumption' approach. The consumption approach is widely preferred because it accounts for all the emissions associated with the consumption of materials, goods, and energy, rather than those associated with the geographical and economical incidence of where production takes place. This would mean accounting for all the carbon dioxide emissions for which Wales' residents are responsible, rather than those that simply arise from within Wales' boundaries. However, empirical data for the consumption approach are incomplete[57].

The difference between the two approaches gives an indication of the extent to which Wales is bearing the burden of carbon dioxide emissions, the products of which (energy and material) are being used in other countries[58]. This paper uses the 'emissions production' definition in sections 3.1 and 3.2, but where consistent 'emissions consumption' data are available, as in section 3.3, we have used those figures.

3.1 The national picture

Wales has performed inconsistently in reducing greenhouse gas emissions over the past fifteen years, although emissions of carbon dioxide in 2005 (the most recent year for which data are available) were 3.7 per cent lower than they were in 1990[59]. The One Wales agreement between Labour and Plaid Cymru sets out a target for 3 per cent annual reductions in carbon emissions by 2011 "in areas of devolved competence".

In 1997, the UK committed itself to a domestic target of reducing carbon dioxide emissions by 20 per cent below 1990 levels by 2010[60]. One aim of the Welsh Assembly Government's Environment Strategy is to 'contribute fully to meeting UK-wide targets'. An interpretation of this aim is that the Welsh Assembly Government has a target to reduce Welsh carbon dioxide emissions by 20 per cent below 1990 levels by 2010. A path of the 'desired emissions' can be

[56] Helm and Smale, 2007. *Too good to be true? The UK's climate change record*, December 2007, http://www.dieterhelm.co.uk/publications/Carbon_record_2007.pdf
[57] *Ibid*
[58] WWF-UK, *WWF-UK responses to the UK Climate Change Programme Review Consultation Paper*, http://www.wwf.org.uk/filelibrary/pdf/ccprconres_120505.pdf
[59] AEA Technology, 2007. *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2005*, http://www.airquality.co.uk/archive/reports/cat07/0709180907_DA_GHGI_report_2005.pdf
[60] DEFRA, *Progress towards national and international targets*, http://www.defra.gov.uk/environment/climatechange/uk/progress/index.htm

plotted showing the steadily decreasing emissions that would have been necessary since the UK commitment in 1997 in order to achieve a 20 per cent emission reduction by 2010 (Table 1).

Table 1 Carbon dioxide emissions for Wales between 1990 and 2005[61], difference from the 1990 baseline, and difference from the 'desired emissions' required to meet the 20 per cent reduction target by 2010

Year	Carbon dioxide emissions (Mt)[a]	Change since 1990 (percentage points)	Difference from desired emissions (per cent)[b]
1990	43.3	-	-
1995	40.7	-6.0	-
1998	42.9	-0.9	+3.8
1999	44.4	+2.5	+9.5
2000	46.5	+7.4	+17.0
2001	43.9	+1.4	+12.7
2002	37.5	-13.4	-1.8
2003	38.7	-10.6	+3.4
2004	42.4	-2.1	+15.5
2005	41.7	-3.7	+15.9

[a] AEA Technology, 2007. *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2005*, http://www.airquality.co.uk/archive/reports/cat07/0709180907_DA_GHGI_report_2005.pdf A different methodology has been used from the one used in previous years, so the data for all years have changed since the previous report
[b] Calculated by MRS

To meet the 2010 emissions target, Welsh emissions need to reduce by 4.8 per cent per year between 2006 and 2010[62]. This emission reduction path is shown in Figure 4, along with the actual carbon dioxide emissions up to 2005, and the 'desired emissions' path.

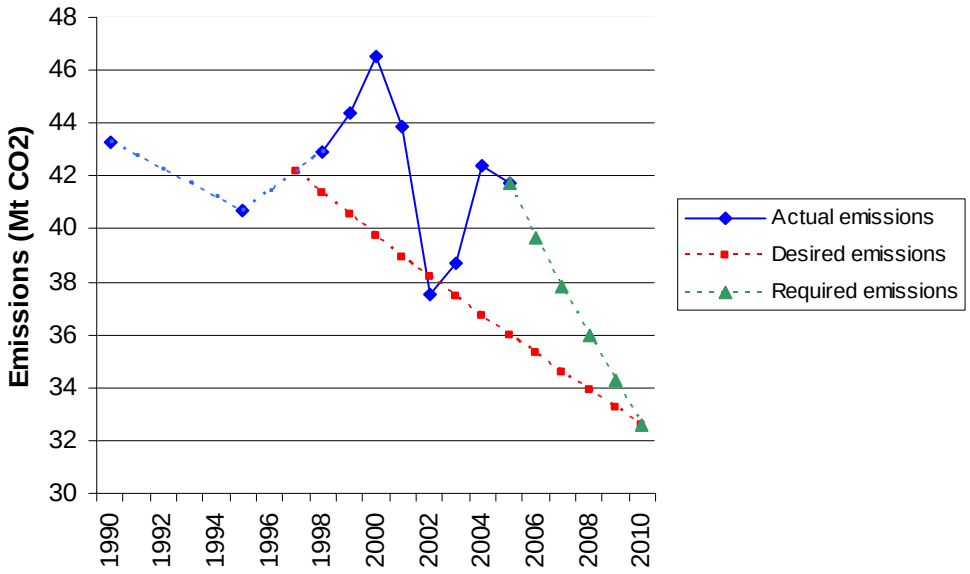

Figure 4 Carbon dioxide emissions for Wales: actual, desired, and required

Actual emissions: AEA Technology, 2007. *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2005*, http://www.airquality.co.uk/archive/reports/cat07/0709180907_DA_GHGI_report_2005.pdf

Desired and Required emissions calculated by Members' Research Service

[61] Information is only available for the years specified
[62] 2010 target emissions are 40.8 x 0.8 = 32.6Mt. Latest emission figures (2004) are 41.8Mt. Reduction required is therefore 9.2Mt, or 4.1 per cent per year. A steady percentage decrease relies on larger absolute decreases early in the time series.

3.2 International comparisons

Comparisons of carbon dioxide emissions with those of other countries can be interesting for reference purposes. Carbon dioxide emissions per capita is the total amount of carbon dioxide emitted by a country through human (production) activities[63], divided by the population of the country[64]. It is strongly affected by climate, transport demand, and use of fossil fuels[65]. Countries with a similar climate but with different per capita emissions will differ primarily as a result of the amount of fossil fuel combusted.

Carbon dioxide emissions per unit of GDP is a measure of carbon intensity, with a lower value indicating more efficient use of (carbon) resources in achieving economic output. An Oxbridge study[66] on CO_2-GDP relationships noted that emissions are "to an important degree" a function of policy and choice, which in turn determines the energy efficiency of economies.

The carbon dioxide emissions in 2005 of Wales and selected other countries are shown in Table 2. Countries have been chosen for one of the following reasons:

- They are interesting points of reference, for example, the Scandinavian countries, China and the USA
- They have similar carbon dioxide emissions to Wales
- They have similar carbon dioxide emissions per capita to Wales
- They have similar carbon dioxide emissions per unit GDP to Wales

In 2005, Wales was the 34th–lowest ranked country in the world in terms of generating value from carbon emissions – the only EU country that has a poorer record of carbon intensity is Estonia, in 33rd place. Northern Ireland would be 82nd, Scotland 103rd, and England 109th.

One factor affecting Wales' high carbon intensity is high-carbon electricity generation. Since no major energy company has its headquarters in Wales, the profit made from electricity generation is accrued elsewhere, while the carbon emissions are attributed to Wales. Furthermore, electricity prices in Wales are on average 10 per cent higher than they are in England[67], which reduces the disposable income that people in Wales are able to spend on revenue-generating activities. Energywatch considers that the UK Government should investigate this pricing structure because the historically acceptable reasons for higher charges in Wales are no longer valid[68].

[63] Defined by the US Energy Information Administration as the emissions arising from the 'consumption and flaring of fossil fuels'
[64] World Bank, *Carbon dioxide emissions (per capita) and consumption of ozone-depleting CFCs (ODP tons)*, http://ddp-ext.worldbank.org/ext/GMIS/gdmis.do?siteId=2&contentId=Content_t28&menuId=LNAV01HOME1
[65] DTI, *Energy – its impact on the environment and society*, Annex 5A, July 2006, http://www.dti.gov.uk/files/file32554.pdf
[66] Grubb *et al.*, 2004. *The relationship between carbon dioxide emissions and economic growth*, Oxbridge study on CO2-GDP relations, Phase I results, http://www.oxfordenergy.org/presentations/OxbridgeCO2_GDP_analysis.pdf
[67] National Assembly for Wales, *Written paper from energywatch Wales to the National Assembly for Wales Sustainability Committee*, 25 October 2007
[68] National Assembly for Wales, *Sustainability Committee*, 25 October 2007, [286],

Table 2 Carbon dioxide emissions for different countries in the year 2005

Country	Carbon dioxide emissions (Mt)	Carbon dioxide emissions per capita[69] (tonnes)	Carbon dioxide emissions per thousand US dollars PPP 2000[70] (tonnes)
Wales	**41.7**	**15.1**	**0.71**
England	436.6	9.3	0.33
Northern Ireland	15.1	9.4	0.42
Scotland	43.7	9.2	0.35
Denmark	51.0	9.4	0.32
Finland	52.3	10.0	0.36
Iceland	3.2	10.7	0.34
Norway	52.4	11.4	0.32
Sweden	58.8	6.5	0.23
Bangladesh	39.8	0.3	0.06
Ireland	44.1	11.0	0.33
Morocco	38.9	1.2	0.26
Puerto Rico	39.0	10.0	0.57
Trinidad and Tobago	38.2	35.5	1.41
Estonia	18.9	14.2	0.72
Netherlands	269.7	16.4	0.62
Saudi Arabia	412.4	15.6	1.11
Azerbaijan	37.0	4.6	0.69
Bulgaria	50.5	6.8	0.73
Iran	450.7	7.0	0.68
Macedonia	8.1	3.9	0.67
Romania	99.3	4.5	0.66
China	5,322.7	4.1	0.63
United States of America	5,957.0	20.1	0.54

Source: All information compiled from the US Energy Information Administration, http://www.eia.doe.gov/pub/international/iealf/tableh1co2.xls, http://www.eia.doe.gov/pub/international/iealf/tableh1cco2.xls, and http://www.eia.doe.gov/pub/international/iealf/tableh1pco2.xls, except for UK countries, for which additional information is taken from AEA Technology, 2007. *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2005*, http://www.airquality.co.uk/archive/reports/cat07/0709180907_DA_GHGI_report_2005.pdf

Cells shaded grey indicate values within 10 per cent of the Wales figure. Cells shaded green in the two end columns indicate values more than 10 per cent lower than those of Wales, and cells shaded amber in the two end columns indicate values more than 10 per cent higher than those of Wales.

Please note: due to a new calculation methodology, the figures are not comparable with those in the Members' Research Service paper covering emissions up to 2004.

[69] Per capita emissions for the UK countries was calculated using population estimates for 2005 from the following sources:
StatsWales, *Mid-year population estimates (2001 onwards), by local authority (single year of age, gender, Welsh LAs)*, http://www.statswales.wales.gov.uk/ReportFolders/ReportFolders.aspx
National Statistics, *UK population grows to more than 60 million*, 24 August 2006, http://www.statistics.gov.uk/pdfdir/pope0806.pdf
Northern Ireland Statistics and Research Agency, *Mid-year population estimates*, http://www.nisra.gov.uk/archive/demography/population/midyear/NI_Home_Pop_sya(1961-2006).xls
General Register Office for Scotland, *Mid-2005 population estimates Scotland: The population of Scotland*, http://www.gro-scotland.gov.uk/statistics/publications-and-data/population-estimates/mid-2005-population-estimates/pop-of-scotland.html
Each of the emissions figures was also increased by 7.06 per cent to account for the difference between the UK actual accounts (8.92 tonnes per capita) and the UK figure used by the US Energy Information Administration (9.55 tonnes per capita)

[70] See Annex B for details on the UK countries' carbon intensity

In terms of per capita emissions, of the 206 countries listed by the US Energy Information Administration, Wales would appear among the poorest-performing 20 countries. For comparison, Scotland, Northern Ireland and England would all rank outside the top 50. Excluding small island states[71], Wales had the 12th-highest carbon dioxide emissions per capita in the world in 2005[72].

Although the US Energy Information Administration claims to account for international shipping and aviation emissions in these calculations, one Danish media report suggests that Denmark should have per capita emissions in the top ten if its large shipping industry were included[73]. In a similar vein, if the UK's aviation and shipping emissions were attributed to the appropriate countries, Wales' per capita emissions would be reduced.

3.3 The local picture

There are two different methodologies for allocating emissions to local authorities. One uses emissions data for every 1km square in the UK by source of CO_2[74], while the other allocates emissions to the end user[75] – defined as a "re-allocation of all emissions from the production and distribution of energy to the users of that energy (electricity, refineries, oil and gas production, mining)". Since the values arising from this second methodology[76] give an idea of geographical use, rather than production, they are more useful in informing about emissions from use of energy in local authority areas. The carbon dioxide emissions for 2005, for each local authority, are shown in Table 3.

As a result of the methodology used, the total emissions figure calculated (34.8Mt CO_2) does not match the inventoried all-Wales total (41.7Mt CO_2). The information is therefore more useful to enable comparisons to be made between the local authorities in Wales, rather than as a definitive value of emissions.

Neath Port Talbot stands out because the steelworks based in Port Talbot emits a substantial proportion of Wales' emissions. Subtracting these emissions (6.1Mt CO_2) from the authority's accounts would leave Neath Port Talbot with 2,485 kilotonnes of emissions.

[71] Smaller than 1,400km^2: Bahrain, Faroe Islands, Gibraltar, Netherlands Antilles, Singapore, and US Virgin Islands.
[72] The countries with higher per capita emissions, in descending order of per capita emissions, were: Qatar, Trinidad and Tobago, United Arab Emirates, Kuwait, Luxembourg, Australia, USA, Canada, Brunei Darussalam, Netherlands, and Saudi Arabia.
[73] Politiken, *Danmark er EU's største klimasvin*, http://politiken.dk/politik/article441413.ece
[74] Data available from the National Atmospheric Emissions Inventory, http://www.naei.org.uk/data_warehouse.php
[75] DEFRA, *Local and regional CO_2 emissions estimates for 2005 for the UK*, http://www.defra.gov.uk/environment/statistics/globatmos/download/regionalrpt/local-regionalco2emissionsreport2005.pdf
[76] DEFRA, *Local and regional CO_2 emissions estimates for 2005*, http://www.defra.gov.uk/environment/statistics/globatmos/download/regionalrpt/local-regionalco2emissions2005.xls

Table 3 Carbon dioxide emissions for 2005 for Welsh local authorities, ranked in order of highest emitter

Local authority	Carbon dioxide emissions by category (kilotonnes)				
	Industry and commercial	Domestic	Road transport	Land use, land change and forestry	Total
Neath Port Talbot	7,914	357	371	-24	8,618
Cardiff	1,302	712	552	6	2,573
Flintshire	1,413	387	417	5	2,222
Newport	1,182	361	531	3	2,077
Carmarthenshire	799	454	528	8	1,788
Swansea	728	561	406	17	1,711
Rhondda Cynon Taf	683	579	403	-31	1,634
Wrexham	915	323	241	-7	1,473
Bridgend	825	336	277	-19	1,419
Vale of Glamorgan	828	309	250	26	1,412
Pembrokeshire	540	307	316	66	1,228
Powys	425	345	561	-219	1,112
Caerphilly	463	424	221	-4	1,103
Monmouthshire	398	231	439	-8	1,060
Gwynedd	338	309	405	-119	932
Conwy	237	299	336	-28	844
Denbighshire	253	249	253	-31	723
Torfaen	351	216	113	1	680
Ynys Môn	273	184	165	43	665
Ceredigion	243	185	245	-42	631
Blaenau Gwent	225	181	72	-5	473
Merthyr Tudful	160	144	116	-6	414
WALES	20,494	7,451	7,218	-370	34,793

Source: DEFRA, *Local and regional CO_2 emissions estimates for 2005*, http://www.defra.gov.uk/environment/statistics/globatmos/download/regionalrpt/local-regionalco2emissions2005.xls

Per capita emissions as a result of domestic activities[77] provide an indication of energy efficiency at a local authority level; these emissions figures for 2005 are calculated in Table 4, and shown in Figure 5. Note that these figures are not directly comparable with the figures for 2004, as a result of changes in DEFRA's accounting methodology.

[77] Domestic activities are defined as electricity and gas consumption, domestic oil and solid fuel, and, on a population-weighted basis, emissions from domestic house and garden machinery and from the use of petroleum waxes and detergents

Table 4 Per capita carbon dioxide emissions from domestic sources in Welsh local authorities, ranked in order of highest per capita emissions

Local authority	Domestic emissions (kilotonnes)	Population in mid-2005[78]	Per capita emissions from domestic sources (tonnes per capita)[79]
Conwy	299	111,000	2.69
Ynys Môn	184	69,000	2.68
Powys	345	130,000	2.65
Monmouthshire	231	88,000	2.63
Pembrokeshire	307	117,000	2.63
Gwynedd	309	118,000	2.62
Blaenau Gwent	181	69,000	2.61
Neath Port Talbot	357	137,000	2.61
Denbighshire	249	96,000	2.59
Merthyr Tudful	144	56,000	2.59
Newport	361	140,000	2.59
Flintshire	387	150,000	2.58
Carmarthenshire	454	177,000	2.56
Bridgend	336	132,000	2.55
Vale of Glamorgan	309	122,000	2.53
Rhondda Cynon Taf	579	233,000	2.48
Wrexham	323	130,000	2.48
Caerphilly	424	171,000	2.48
Swansea	561	226,000	2.48
Ceredigion	185	77,000	2.40
Torfaen	216	91,000	2.37
Cardiff	712	314,000	2.27
Wales	**7,451**	**2,954,000**	**2.52**

Source: Members' Research Service calculation based on Welsh Assembly Government and DEFRA statistics (see Table 3)

Several factors influence domestic energy consumption:

- Climate has an impact on heating; coastal, lowland, and southern counties benefit from a reduced heating requirement
- Inadequate access to information limits people's uptake of low-energy or low-carbon forms of energy (eg biomass heating, energy-efficient lighting)
- Poverty has an impact on heating because the cost of fuel has increased substantially over recent years, and even the more basic insulation techniques can cost hundreds of pounds
- Gas is a more carbon-efficient means of heating homes than electricity, coal or oil, so connectivity to the grid can reduce carbon emissions (people living in counties with poor connectivity will be more reliant on solid fuels, oil and electricity for heating)

[78] Population figures are mid-2005 estimates, rounded to the nearest thousand, from StatsWales: http://www.statswales.wales.gov.uk/ReportFolders/ReportFolders.aspx

[79] The actual per capita emissions reported here differ slightly from those that would be attained from a calculation using the figures in the table for Ynys Môn, Pembrokeshire, Blaenau Gwent, Merthyr Tudful, and Newport. This is because we have used exact figures for population, not the rounded values in the table

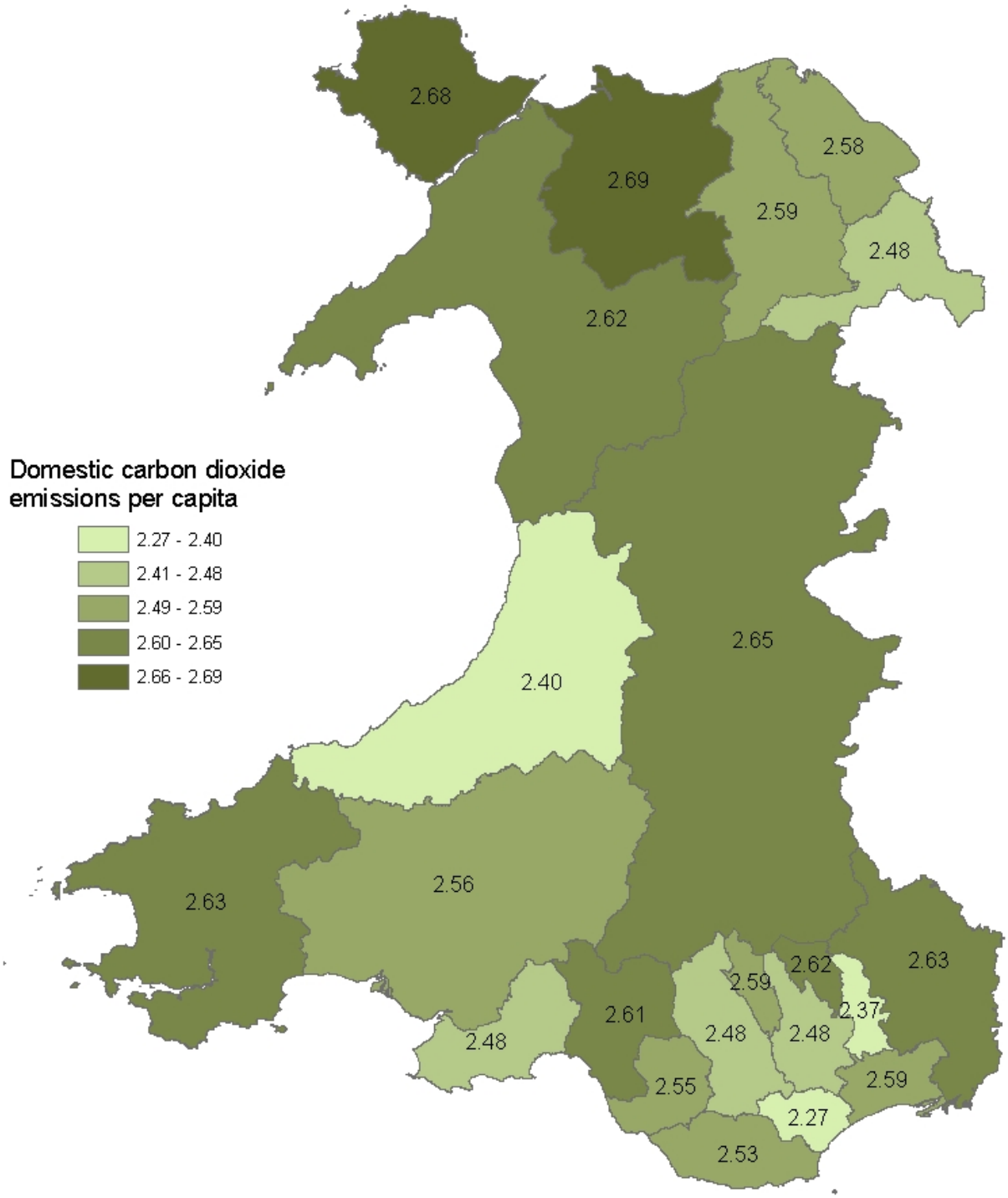

Figure 5 Per capita carbon dioxide emissions (in tonnes) from domestic sources in Wales in 2005

The domestic activities of the residents of Conwy and Ynys Môn emit 18 per cent more carbon dioxide, per capita, than the activities of the residents of Cardiff.

A total of 7 of the 22 local authorities are below the Wales average: Cardiff, Torfaen, Ceredigion, Swansea, Caerphilly, Wrexham, and Rhondda Cynon Taf.

Annex A European policies and measures related to climate change

- Green Paper COM(2007) 354[80] outlines the changes that European societies will need to make in order to adapt to the consequences of climate change.
- Communication COM(2007) 2 final[81] sets out the EU's objective of limiting global temperature increase to less than 2°C compared to pre-industrial levels, including targets to improve energy efficiency by 20 per cent by 2020, and to increase the share of renewable energy to 20 per cent by 2020.
- Proposal COM(2006) 818 final[82] proposes a means to include aviation in the EU Emission Trading Scheme (the Environment Council of 20 December 2007 approved the Proposal, and aviation will be included in the Scheme from January 2012)
- Green Paper COM(2006) 105[83] suggests six priority areas for implementing a European energy policy.
- Green Paper COM(2005) 265[84] introduces a variety of actions and measures to be taken by government, industry and consumers that will make efficiency savings of 20 per cent of current use by 2020.
- Decision 280/2004/EC[85] established a new mechanism for monitoring and reporting greenhouse gas emissions.
- Directive 2003/30/EC[86] requires that 5.75 per cent of transport fuels sold in Member States by 2010 should be biofuels. A Directive on the promotion of renewable energy is timetabled for publication on 23 January 2008, and is likely to include a sustainability scheme for biofuels.
- Directive 2003/87/EC[87] established an emission trading system (the EU Emission Trading Scheme) limiting carbon dioxide emissions from 11,500 large emitters in the Member States.
- Directive 2002/91/EC[88] sets minimum energy efficiency standards that must be met by all new buildings and large existing buildings undergoing major refurbishment.
- Directive 2001/77/EC[89] requires Member States to meet an indicative target of 21 per cent of EU electricity consumption being produced by renewable energy by 2010. Conclusion

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[80] European Commission, *Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Adapting to climate change in Europe – options for EU action*, http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0354en01.pdf

[81] European Commission, *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Limiting global climate change to 2 degrees Celsius The way ahead for 2020 and beyond*, January 2007, http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0002en01.pdf

[82] European Commission, *Proposal for a Directive of the European Parliament and of the Council… to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community*, 20 December 2006, http://eur-lex.europa.eu/LexUriServ/site/en/com/2006/com2006_0818en01.pdf

[83] European Commission, *Green Paper: A European strategy for sustainable, competitive and secure energy*, http://eur-lex.europa.eu/LexUriServ/site/en/com/2006/com2006_0105en01.pdf

[84] European Commission, *Green Paper on energy efficiency or doing more with less*, http://eur-lex.europa.eu/LexUriServ/site/en/com/2005/com2005_0265en01.pdf

[85] European Parliament and Council, *Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol*, http://eur-lex.europa.eu/LexUriServ/site/en/oj/2004/l_049/l_04920040219en00010008.pdf

[86] European Parliament and Council, *Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport*, http://ec.europa.eu/energy/res/legislation/doc/biofuels/en_final.pdf

[87] European Parliament and Council, *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32003L0087:EN:HTML

[88] European Parliament and Council, *Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings*, http://www.energie-cites.eu/IMG/pdf/directive_batiments_en.pdf

[89] European Parliament and Council, *Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market*,

(7224/07)[90] requires the production of 20 per cent of energy in Europe to be from renewable sources by 2020, and requires greenhouse gas emission reductions of 20 per cent from 1990 levels by 2020.

- White Paper COM(2001) 370[91] envisaged a shifting of transport mode from road to rail and water. Its review (Communication COM(2006) 314[92]) changed the emphasis from curbing transport demand to disconnecting mobility from its negative consequences.
- Directive 1999/31/EC[93] requires Member States to gradually reduce the amount of biodegradable waste landfilled to 35 per cent of the 1995 level by 2020 (biodegradable waste produces methane, a potent greenhouse gas).

http://eur-lex.europa.eu/pri/en/oj/dat/2001/l_283/l_28320011027en00330040.pdf

[90] European Council, *Presidency Conclusions: Brussels European Council 8/9 March 2007*, http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/93135.pdf

[91] European Commission, *White Paper on European transport policy for 2010*, http://ec.europa.eu/transport/white_paper/documents/doc/lb_texte_complet_en.pdf

[92] European Commission, *Communication from the Commission to the Council and the European Parliament: Keep Europe moving – sustainable mobility for our continent*, http://ec.europa.eu/transport/transport_policy_review/doc/2006_transport_policy_review_en.pdf

[93] European Council, *Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0031:EN:HTML

Annex B Calculation of UK countries' carbon intensity

To calculate the carbon intensity of countries within the UK, available GDP data were first estimated for 2005 and subsequently adjusted to align with data from the US Energy Information Administration (Table 5).

Table 5 Estimated GDP for UK countries. Column one shows the actual GDP in 2004, which was then adjusted using a conversion factor supplied by National Statistics to estimate the 2005 GDP (column two). To align with the US Energy Information Administration data, which use 2000 PPP, the estimated 2005 GDP was deflated, using HM Treasury data, to give GDP in real terms for the year 2000 (column three).

	GDP (2004) (millions €)[94]	GDP (2005) (millions €)[95]	GDP (2005) (millions € (2000))[96]
UK	1,733,603	1,807,264	1,585,081
Wales	66,555	68,874	60,407
England	1,486,720	1,547,645	1,357,379
Northern Ireland	39,904	41,711	36,583
Scotland	140,424	146,860	128,805

Using the estimated deflated 2005 GDP for UK countries (Table 5), and the calculated carbon dioxide emissions for 2005, a carbon intensity calculation was conducted for each of the UK countries (Table 6).

Table 6 Carbon intensity of UK countries (CO2 emissions per thousand US dollars (2000)). The carbon intensity was calculated by dividing the CO2 emissions by GDP. When the calculations were carried out, the value for the UK's carbon intensity (0.34) was less than the US Energy Information Administration value (0.35). To compensate, a conversion factor was calculated based on the UK value, and each UK country's value was multiplied by this conversion factor (column four)

	CO2 emissions (Mt) (2005)[97,98]	GDP (2005) (millions € (2000))	Carbon intensity (CO2 emissions per thousand € (2000))	Conversion factor	Carbon intensity (CO2 emissions per thousand $ (2000))
UK	537.1	1,585,081	0.339		0.35
Wales	41.7	60,407	0.690		0.71
England	436.6	1,357,379	0.322	x 1.029	0.33
Northern Ireland	15.1	36,583	0.413		0.42
Scotland	43.7	128,805	0.339		0.35

[94] Eurostat, *Regional GDP per inhabitant in the EU 27*, http://epp.eurostat.ec.europa.eu/pls/portal/docs/PAGE/PGP_PRD_CAT_PREREL/PGE_CAT_PREREL_YEAR_2007/PGE_CAT_PREREL_YEAR_2007_MONTH_02/1-19022007-EN-AP.PDF

[95] Each listed value is multiplied by the increase between GVA in each UK country in 2004 and the value in 2005: UK = 4.249 per cent, Wales = 3.485 per cent, England = 4.098 per cent, Scotland = 4.583 per cent, Northern Ireland = 4.529 per cent; all calculated from http://www.statistics.gov.uk/downloads/theme_economy/GVA_NUTS2_Excel_tables_1995-2005.xls

[96] Deflated by HM Treasury figures for 2000/01 (85.26) and 2005/06 (97.211) from http://www.hm-treasury.gov.uk/media/6/8/GDP_Deflators_20071220_NA_update_circ.xls

[97] AEA Technology, 2007. *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2005*, http://www.airquality.co.uk/archive/reports/cat07/0709180907_DA_GHGI_report_2005.pdf

[98] Does not include unallocated emissions from international shipping and aviation