National Assembly for Wales

Greenhouse Gas Emissions in Wales
January 2012

This research paper replaces the previous Greenhouse Gas Emissions in Wales research paper to include the latest data up to 2009.

It provides a short synopsis of the policy framework guiding action on greenhouse gas emissions. The paper examines total greenhouse gas emissions, carbon dioxide and methane emissions at a national and UK level using the production and end-user approaches. Also included is information on the per capita emissions and carbon dioxide emissions for each local authority in Wales.

Comparisons cannot be made with data in previous versions of this paper, due to changes in the sources and methodologies used.

Research Service

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National Assembly for Wales

Greenhouse Gas Emissions in Wales
January 2012

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Research Service

Summary

This paper replaces a research paper titled Greenhouse Gas Emissions in Wales, published in July 2011, to include data up to 2009. Comparisons with previous publications cannot be made due to changes in the sources and methodologies used.

In 2009, Wales emitted 42.6 Mega tonnes (Mt) of greenhouse gases using the production approach; a 23.3 per cent reduction in emissions from the base year. **To reach the Welsh Government's 2020 target of reducing net greenhouse gas emissions by 40 per cent below the base year, emissions will need to be reduced by a further 16.7 percentage points from base year emissions in eleven years.**

In 2009, Wales emitted 34.8 Mt of carbon dioxide using the production approach; a 19.3 per cent reduction in emissions from the 1990 base year. 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 a further 0.7 percentage points from base year emissions in the next year.

Greenhouse gas emissions within the Welsh Government's devolved competence in 2009 were 30.1Mt. This was a decrease of 8.8 per cent from 2008. However the Committee on Climate Change expect that emissions will have increased again in Wales in 2010.

Of the EU-27, the UN Framework Convention on Climate Change (UNFCCC) Annex 1 Parties and the UK devolved administrations (accounting for 43 countries); Wales was ranked as having the 18th largest reduction in greenhouse gas emissions since the base year. The UK was ranked 17th. Of the same countries, **Wales was ranked as having the 6th highest greenhouse gas emissions per capita, while the UK was ranked 18th.**

On the basis of 'end-user' emissions, Wales has achieved much higher emissions reductions since the Base Year than if the production approach is used**. In 2009 Wales emitted 37.1 Mt of 'end-user' greenhouse gases (excluding exports), a reduction of 32.3 per cent from 1990.**

Neath Port Talbot had the highest 'end-user' carbon dioxide emissions of local authorities in Wales in 2009, while **Merthyr Tydfil** had the lowest. Carbon dioxide emissions per capita were lowest in the **South Wales Valleys, Cardiff and some parts of North Wales**. When only carbon dioxide emissions within the scope of local authorities' influence are considered, **Cardiff** had the highest 'end-user' carbon dioxide emissions in 2009, while **Merthyr Tydfil** had the lowest.

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1. Introduction

The earth's climate has been varying for millions of years, with some natural variation being natural and expected. However, recent, rapid increases in pollution are 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.

The United Nations Intergovernmental Panel on Climate Change (IPCC) **Working Group I** concluded in their Fourth Assessment that there is compelling scientific evidence that the activities of humankind are responsible for changing the climate of the planet; stating that:

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

It should be noted that there is not universal agreement that this is the case.

This human-induced change is what is usually referred to as 'climate change'. This paper concentrates on human-induced greenhouse gas emissions, providing analysis of the recent changes in emissions in Wales and makes comparisons with other UK countries.

Emissions of carbon dioxide are the most significant human-induced greenhouse gas. In addition to total greenhouse gas emissions, this paper therefore looks at carbon dioxide emissions, and also considers recent changes in methane emissions.

[1] United Nations Intergovernmental Panel on Climate Change, **Climate Change 2007 : Synthesis Report**, page39 [accessed 20 January 2012]

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 within each box.

UK Targets

Kyoto
Reduce the basket of six greenhouse gases by 12.5% compared to 1990 levels by 2008-2012

2010 CO_2 Target
Reduce CO_2 emissions by 20% compared to 1990 levels by 2010

2020 CO_2e Target
Reduce CO_2e emissions by at least 34% compared to 1990 levels by 2020

2050 CO_2e Target
Reduce CO_2e emissions by 80% compared to 1990 levels by 2050

CO_2e Budgets
for 2025, 2030, 2035, 2040 and 2045

Wales Targets

Annual Targets from 2011
At least 3% annual reduction in CO_2e emissions, in areas of devolved competence

Annual Sectoral Targets
Set minimum contribution to CO_2e emission reductions over a 10 year period

2020 Target
Net CO_2e emissions reduced by at least 40% compared to 1990 levels

2050 Target
Net CO_2e emissions reduced by at least 80% compared to 1990 levels

Scotland Targets

2010: Reduce CO_2e below 2009 national budget by 2010
2011-2019: CO_2e emissions to be lower than preceding year
2020: Net CO_2e emissions reduced by 42% compared to baseline
2020-2050: CO_2e emissions to be at least 3% lower than preceding year
2050: Net CO_2e emissions reduced by 80% compared to baseline

Northern Ireland Targets

2025: Reduce emissions of all GHGs (CO_2e) by 25% on baseline levels
2050: Net CO_2e emissions reduced by 80% compared to baseline

Source: AEA Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, page 3 September 2011 and Welsh Government, Climate Change Strategy for Wales page 34, October 2010 for Welsh targets.
Note: CO_2e is carbon dioxide equivalent emissions from greenhouse gases (GHGs).

2.1. International policy

The UN Framework Convention on Climate Change (UNFCCC)[2] sets an overall framework for intergovernmental efforts to tackle climate change, with the objective of stabilising greenhouse gas emissions in the atmosphere and reducing the human impact on the climate system.[3] 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[4], and one regional economic integration organisation (the EU), and entered into force on 21 March 1994.

The Kyoto Protocol[5] is the protocol to the UNFCCC which entered into force on 16 February 2005; 192 Parties[6] and one regional organisation (the EU) have ratified the Protocol to date.[7] The Protocol's major feature is mandatory targets on greenhouse gas emissions, whereas the UNFCCC encouraged countries to stabilise 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, and the UK has agreed to reduce its emissions to at least 12.5 per cent lower than the base year levels.[8]

The Kyoto agreement runs until 2012, and negotiations on a follow-up agreement have been taking place at UNFCCC conferences over previous years.

At the seventeenth UNFCCC conference, which was held in Durban, South Africa between 28 November and 9 December 2011,[9] following negotiations it was agreed by world governments that **a process would be launched to develop a protocol, another legal instrument or a legal outcome applicable to all Parties, through the Ad Hoc Working Group on the Durban Platform for Enhanced Action. It was also agreed that the Ad Hoc Working Group would complete its work no later than 2015, in order that this protocol, legal instrument or legal**

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[2] United Nations: **United Nations Framework Convention on Climate Change** [accessed 20 January 2012]
[3] AEA, ***Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009***, page 1 (September 2010) [accessed 20 January 2012]
[4] The number of **countries** that have ratified the convention as of 24 October 2011 [accessed 20 January 2012]
[5] United Nations: ***Kyoto Protocol to the United Nations Framework Convention on Climate Change***, 1998 [accessed 20 January 2012]
[6] Countries are divided into three main Parties according to their differing commitments from the Kyoto Protocol.
[7] The number of **Parties** to have ratified the protocol as of 24 October 2011 [accessed 20 January 2012]
[8] DECC, ***The UK Climate Change Programme Annual Report to Parliament*** , page 9, July 2008 [accessed 20 January 2012]
[9] United Nations, **United Nations Framework Convention on Climate Change Calendar 2011** [accessed 20 January 2012]

outcome can be adopted at the twenty-first session of the Conference of the Parties and come into effect and be implemented from 2020.[10]

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 second phase of the programme commenced in October 2005. 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 2ºC compared to pre-industrial levels, and has offered to increase its emissions reduction to 30 per cent by 2020, should other major emitting nations agree to take further action in a global agreement. Until an 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[11], and to increase the share of renewable energy to 20 per cent by 2020. The EU is also aiming to reduce domestic emissions by 80-95 per cent by 2050, as agreed at its Environment Council in November 2009.[12]
- Aviation will be included in the EU Emissions Trading Scheme from January 2012. The petrochemicals, ammonia and aluminium industries will be included from 2013, when the third trading period starts.[13]

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.[14] In March 2006 the then UK Labour Government published its new Climate Change Programme[15] which set out its policies and priorities for action on climate change, both across the UK and internationally.

The *Climate Change Act 2008*[16] provides a legal framework to reduce future greenhouse gas emissions by 80 per cent compared to 1990 levels by 2050, with a reduction in emissions of at least 34 per cent compared to 1990 levels by 2020.[17] It established a system of **'carbon budgeting'** every five years, during which time greenhouse gas emissions must be within predetermined limits. In

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[10] United Nations Framework Convention on Climate Change, **Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action. Proposal by the President**. 10 December 2011 [accessed 20 January 2012]
[11] European Union, **What is the EU doing on climate change**, [accessed 20 January 2012]
[12] European Union, **Roadmap for moving to a low-carbon economy in 2050** [accessed 20 January 2012]
[13] European union, **Emissions Trading System (EU ETS)**, [accessed 20 January 2012]
[14] Department of Energy and Climate Change, ***Climate Change: The UK Programme, Summary***, page 3, November 2000 [accessed 20 January 2012]
[15] Department of Energy and Climate Change, ***UK Climate Change Programme***, March 2006 [accessed 20 January 2012]
[16] ***Climate Change Act 2008*** (chapter 27) [accessed 20 January 2012]
[17] Department of Energy and Climate Change webpage, **Climate Change Act 2008** [accessed 20 January 2012]

addition, the Act also established the **Committee on Climate Change**, an independent body which advises the UK and Welsh Governments and reports to Parliament annually on progress towards targets and budgets.

In May 2011 it was announced that the UK Government is proposing a 50 per cent cut in greenhouse gas emissions for the carbon budget for 2023 to 2027, in line with advice it received from the Committee on Climate Change. This budget was set in law in June 2011.[18] In October 2011 the UK Government published its Carbon Plan, a Government-wide plan of action on domestic and international climate change. The Plan sets out the UK Government's actions and deadlines for its departments over the next five years.[19]

2.4. Wales policy

The previous Welsh Government's ***Climate Change Strategy for Wales***, published in October 2010, provided details of how Wales will aim to meet its target for 3 per cent annual reductions in carbon equivalent emissions from 2011 'in areas of devolved competence'[20] in effect excluding the power sector and energy intensive industries, and to achieve at least a 40 per cent reduction in all greenhouse gas emissions by 2020. The Committee on Climate Change states that the two targets are compatible; and that if the Welsh Government delivers the 3 per cent target then this could allow it to meet the economy-wide target as long as the power sector in Wales reduces emissions at the same rate as the sector in the rest of the UK and energy-intensive industries do not increase emissions.[21]

The Climate Change Commission for Wales first met in December 2007, and is an independent advisory body which helps to develop policy, and works towards creating a consensus on climate change.[22] The Commission is made up of stakeholders from businesses, the public sector, environmental organisations, the voluntary sector and representatives of the four major Welsh political parties.[23] The Commission worked alongside the Welsh Government to develop and approve the *Climate Change Strategy for Wales*.[24] The strategy sets out how and where the Welsh Government will act to reduce greenhouse emissions, and how they intend to work with partners such as the UK Government, businesses, organisations and communities. Targets are also set out for specific sectors such

[18] Department of Energy and Climate Change, **Carbon Budgets** [accessed 20 January 2012]
[19] Department of Energy and Climate Change, **Carbon Plan** [accessed 20 January 2012]
[20] Welsh Government: ***Climate Change Strategy for Wales*** page 34, October 2010 [accessed 20 January 2012]
[21] Committee on Climate Change, **Reducing emissions and preparing for climate change in Wales**, page 9, October 2011 [accessed 20 January 2012]
[22] Welsh Government, **Climate Change Commission Background and History** [accessed 20 January 2012]
[23] Welsh Government, **Climate Change Commission Membership** [accessed 20 January 2012]
[24] Welsh Government, ***Climate Change Strategy for Wales*** page 5, (October 2010) [accessed 20 January 2012]

as transport, business, agriculture and land use, waste, residents and the public sector.[25]

The *Climate Change Strategy* is supplemented by two delivery plans; the *Emissions Reduction Delivery Plan*[26], which provides information on the policies and programmes that the Welsh Government believes will enable it to meet its annual 3 per cent reduction in carbon emissions in devolved areas, and the *Adaptation Delivery Plan*[27] which gives details of actions aimed at increasing Wales' resilience to climate change.

Under the *Climate Change Act 2008*, the Welsh Government is required to report to the National Assembly for Wales on its climate change objectives, policies and priorities. The *Climate Change Strategy* and the two delivery plans were submitted by the Welsh Government to the Assembly as the first report under these requirements. The Minister for Environment and Sustainable Development confirmed on 18 October 2011 that he would be laying the Welsh Government's first annual progress report on delivery of the Climate Change Strategy in March 2012.[28] On the same day, the Committee on Climate Change published the 2011 progress report for Wales on reducing emissions and preparing for climate change.[29]

The Welsh Government has also recently published *Preparing for a changing climate*,[30] a policy statement which sets out its response to the challenges facing Wales in relation to climate change, and provides information on how it will implement relevant provisions of the *Climate Change Act 2008*. At the same time, it released its *Climate Change Engagement Strategy*,[31] aimed at helping people, communities and organisations to relate to and understand climate change, feel that they are able to make a difference to climate change and make more climate aware choices.

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[25] Welsh Government, ***Climate Change Strategy for Wales*** page 38, (October 2010) [accessed 20 January 2012]
[26] Welsh Government, **Delivery plan for Emission reduction**, October 2010 [accessed 20 January 2012]
[27] Welsh Government, **Adaptation Delivery Plan**, October 2010 [accessed 20 January 2012]
[28] Welsh Government, John Griffiths (Minister for Environment and Sustainable Development), **Climate Change Progress on Reducing Greenhouse Gas Emissions and Preparing for Climate Change**, 18 October 2011 [accessed 20 January 2012]
[29] Climate Change Commission, **Reducing emissions and preparing for climate change in Wales: 2011 Progress Report**, 18 October 2011[accessed 20 January 2012]
[30] Welsh Government, **Preparing for a changing climate**, October 2011 [accessed 20 January 2012]
[31] Welsh Government, **Climate Change Engagement Strategy**, October 2011 [accessed 20 January 2012]

3. Measuring Greenhouse Gas Emissions

There are two main approaches to calculating greenhouse gas emissions:

- **Production or 'source' 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**, and the AEA national figures have also been used to enable comparisons between the devolved nations and UNFCCC Annex 1 Parties[32] regarding total greenhouse gas emissions, carbon dioxide emissions and methane emissions in section 3.1. The AEA national figures have also been used to enable comparisons between the devolved nations regarding total greenhouse gas emissions, carbon dioxide emissions and methane emissions, which are in section 3.2 of this paper. Progress against the targets outlined in section 2 is measured using the production approach.
- **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 energy, rather than those associated with the geographical location of where energy production takes place. Non-energy production emissions are still counted at the place of production. The AEA publishes 'end-user' statistics for total greenhouse gas emissions, carbon dioxide emissions and methane emissions for each of the devolved nations, and comparisons have been made in section 3.5 of the paper. 'End-user' data for carbon dioxide emissions by local authority have also been published by AEA[33] and figures for the Welsh local authorities are included in section 3.6.

In this paper, the statistics in section 3.1 and 3.2 use the production approach and those in sections 3.3 and 3.6 use the 'end-user' methodology.

[32] **Annex 1 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 20 January 2012]
[33] AEA, ***2009 UK Carbon dioxide emissions for Local Authority and Government Office region level*** ,September 2011 [accessed 20 January 2012]

3.1. International emissions

Comparisons of greenhouse gas 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 between -8 per cent and +10 per cent of 1990 emissions by 2008-12. Information on assigned amounts for individual nations is available in **Annex B to the Kyoto protocol**. Figures are provided in this publication for total net greenhouse gas emissions, carbon dioxide emissions and methane emissions.

Full lists of total net greenhouse gas emissions, carbon dioxide emissions and methane emissions for the Annex 1 Parties, EU-27 and UK countries in 2009 are provided in Annexes A to C of this paper.

It is important to note that due to updated emissions data and changes to methodologies it is not possible to compare these figures with previous Research Service papers or previous UNFCCC publications.

3.1.1. Total net greenhouse gas emissions

Total greenhouse gas emissions are made up of six gases; carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.[34]

Figure 1 below shows the percentage change of total net greenhouse gas emissions between the base year (1990 or 1995) and 2009 for all of the UNFCCC Annex 1[35] Parties,[36] the EU-27[37] and the four UK countries.[38]

Of the 44 countries[39] (only including UK (ii) of the two values for the UK) included in figure 1, 13 have increased their total net greenhouse gas emissions since the base year, while 31 have reduced their emissions. The largest increase was in Turkey, increasing by over 100 per cent. The largest decreases in emissions were in Lithuania, Estonia and Romania, where emissions declined by over 60 per cent. Of the 10 countries with the largest declines in greenhouse gas emissions, 9 are economies in transition from the former Communist countries.

In terms of the largest reductions of total net greenhouse gas emissions of the 44 countries included in figure 1, **Wales is ranked 18th**, Scotland 15th, England 16th and Northern Ireland 20th. Under the Kyoto Protocol, Annex 1 parties are able to use 1990 or 1995 as the base year for emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, and a number of parties, including the United Kingdom and devolved nations, use 1995.[40] The background data used to derive figures 1 and 2 is available in **Annex A** to this paper.

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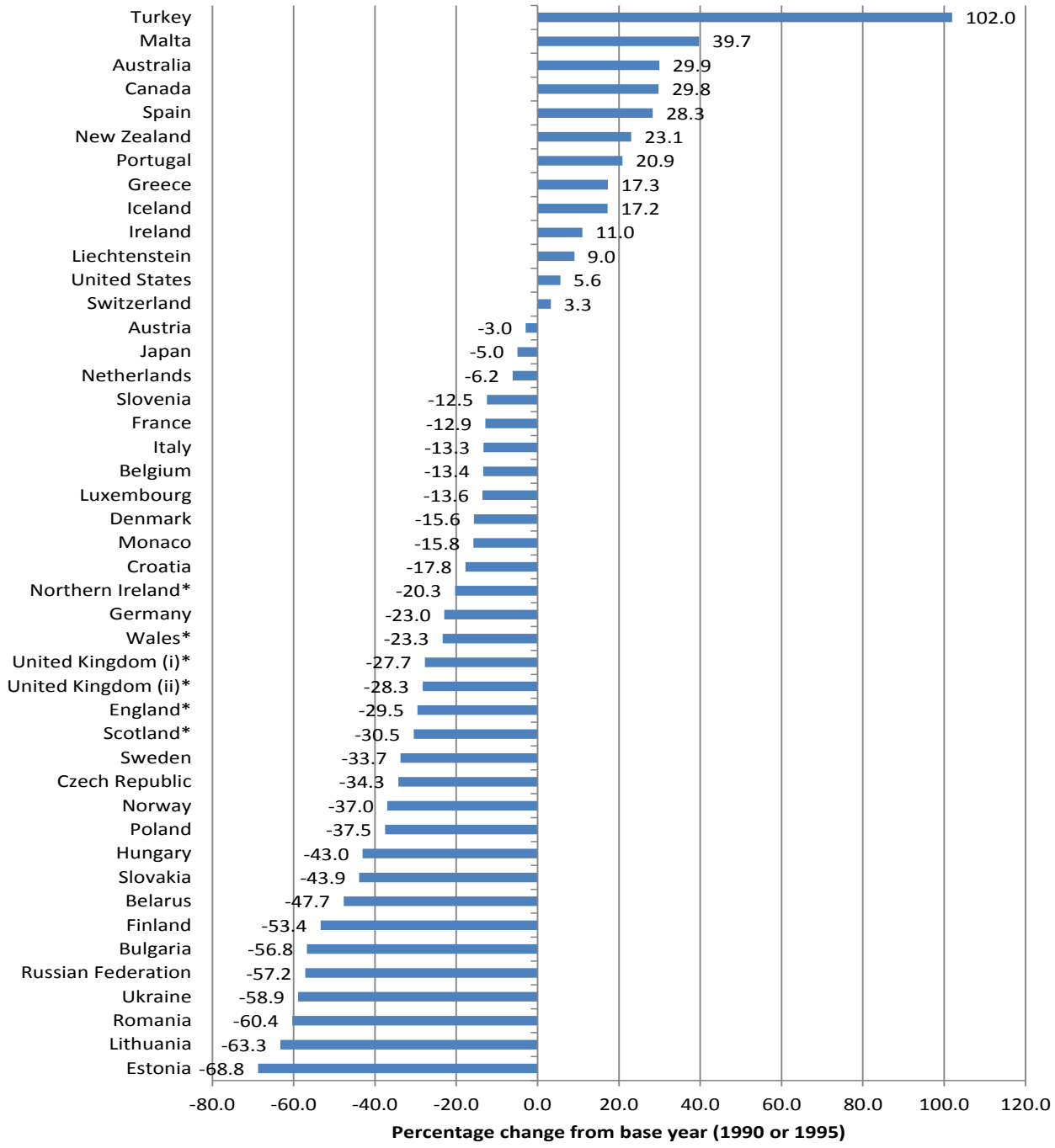
[34] AEA, *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009*, page v, September 2011 [accessed 20 January 2012]
[35] **Annex 1 Parties** include the industrialised countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 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 20 January 2012]
[36] The graph excludes Latvia even though it is part of the UNFCCC Annex 1 Parties as it had negative emissions in 2009. Total net greenhouse gas emissions in Latvia have declined from 11,380Gg to -9,761Gg, a decrease of 186 per cent.
[37] Data was not available from the UNFCCC for Cyprus.
[38] The UK countries are highlighted with a * on the graph
[39] Including all four UK countries and "UK (ii)" emissions (not "UK (i)").
[40] UNFCCC, **Kyoto Protocol Base Year Data** [accessed 20 January 2012]

Figure 1: Percentage change from the base year (1990 or 1995) of total net greenhouse gas emissions, by Country[(a)], including LULUCF[(b)], 2009 (Gg[41])



Source: UNFCCC, National Greenhouse Gas Inventory Data for the period 1990-2009, Table 6, page 16, November 2011 and: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, September 2011– data is available in Annex A of this research paper.

[41] One Gigagramme (Gg) equates to one thousand tonnes, or one kilotonnes (kt) (UK data is recorded in kt).

Notes:

(a) The graph excludes Latvia even though it is part of the UNFCCC Annex 1 Parties as it had negative emissions in 2009. Total net greenhouse gas emissions in Latvia have declined from 11,380Gg to -9,761Gg.

(b) LULUCF is land use, land use change and forestry.

UK (i) figure does not match those published in table 1; here the figure includes all unallocated emissions, 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 emissions and Crown Dependencies. These match the figures provided in table 1, (the figure for England also includes Crown Dependencies).

Countries with large populations and large economies tend to have the largest emissions. Due to this, focusing only on absolute emission levels gives a partial understanding of global greenhouse gas emissions. Examining total net greenhouse gas emissions per capita provides further explanation as to how emissions are distributed.[42] Total net greenhouse gas emissions per capita is the total net amount of greenhouse gases emitted by a country, divided by the population of the country.[43]

Figure 2 presents the total net greenhouse gas emissions (net emissions/removals) per capita for each of the EU-27,[44] the UNFCCC Annex 1 Parties[45] and the four UK countries.[46] Data for UK countries have been calculated using total net greenhouse gas emissions published in the AEA 2011 publication,[47] divided by the **mid-2009 population estimates**[48] for each country.

The total net greenhouse gas emissions per capita shown in figure 2 have been calculated by the Research Service, by dividing total net greenhouse gas 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 total net greenhouse gas emissions are also likely to vary slightly.

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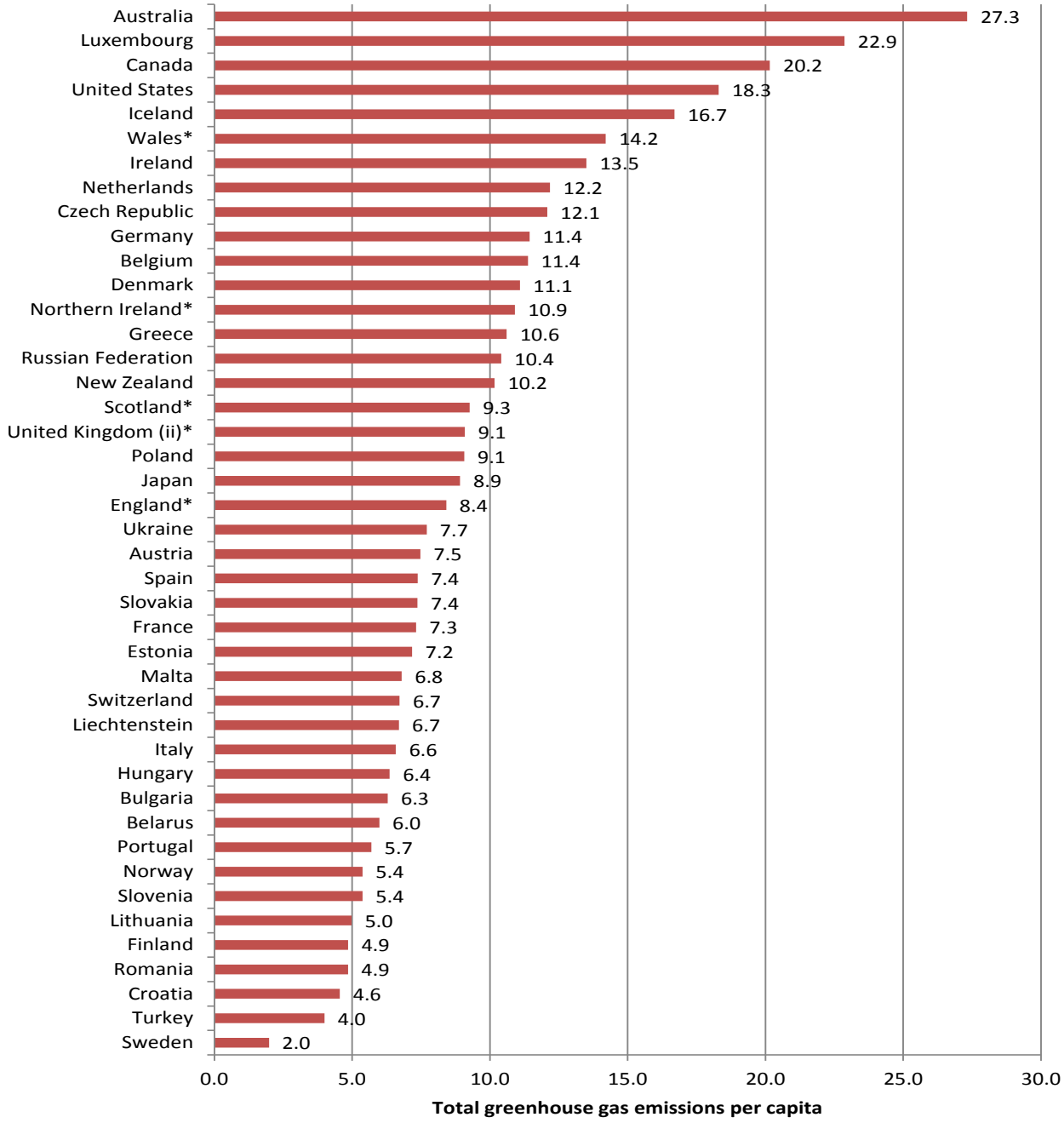
[42] World Resources Institute, ***Navigating the numbers, Greenhouse gas data and international climate policy,*** page 21, 2005 [accessed 20 January 2012]
[43] DBERR, ***Energy – its impact on the environment and society***, Annex 5A page 3, July 2006 [accessed 20 January 2012]
[44] Data for Cyprus and Monaco are not available and due to the negative levels of greenhouse gas emissions in Latvia it has also been excluded (see footnote 51).
[45] **Annex 1 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 20 January 2012]
[46] The UK countries are highlighted with a * on the graph
[47] AEA, **Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009**, page x (September 2011) [accessed 20 January 2012]
[48] Office for National Statistics, **Population Estimates for UK, England, Wales, Scotland and Northern Ireland, 2009** (Tables 4-7) [accessed 20 January 2012]

The total net greenhouse gas emissions per capita for the UK countries in 2009 were:

- Wales 14.2 tonnes per capita
- Northern Ireland 10.9 tonnes per capita
- Scotland 9.3 tonnes per capita
- England 8.4 tonnes per capita

Of the 43 countries included in figure 2, **Wales had the 6th highest total net greenhouse gas emissions per capita in 2009**. Australia had the highest, while Sweden had the lowest. The UK was ranked 18th highest (only including UK (ii) of the two values for the UK for the reasons set out earlier in the paper).

Figure 2: Total net greenhouse gas emissions per capita, 2009 (Gg[49] per thousand capita)[(a)]



Source: UNFCCC, National Greenhouse Gas Inventory Data for the period 1990-2009, Table 6, page 16, November 2011, UN, UN Demographic Yearbook 2009-10, (use 2009 figures), AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, September 2011, Office for National Statistics, Population Estimates for UK, England, Wales, Scotland and Northern Ireland, 2009 (Tables 4-7) and Research Service calculations- data is available in Annex A of this research paper.

Notes: See Figure 1

[49] One Gigagramme (Gg) equates to one thousand tonnes, or one kilotonnes (kt) (UK data is recorded in kt).

3.1.2. Carbon dioxide emissions

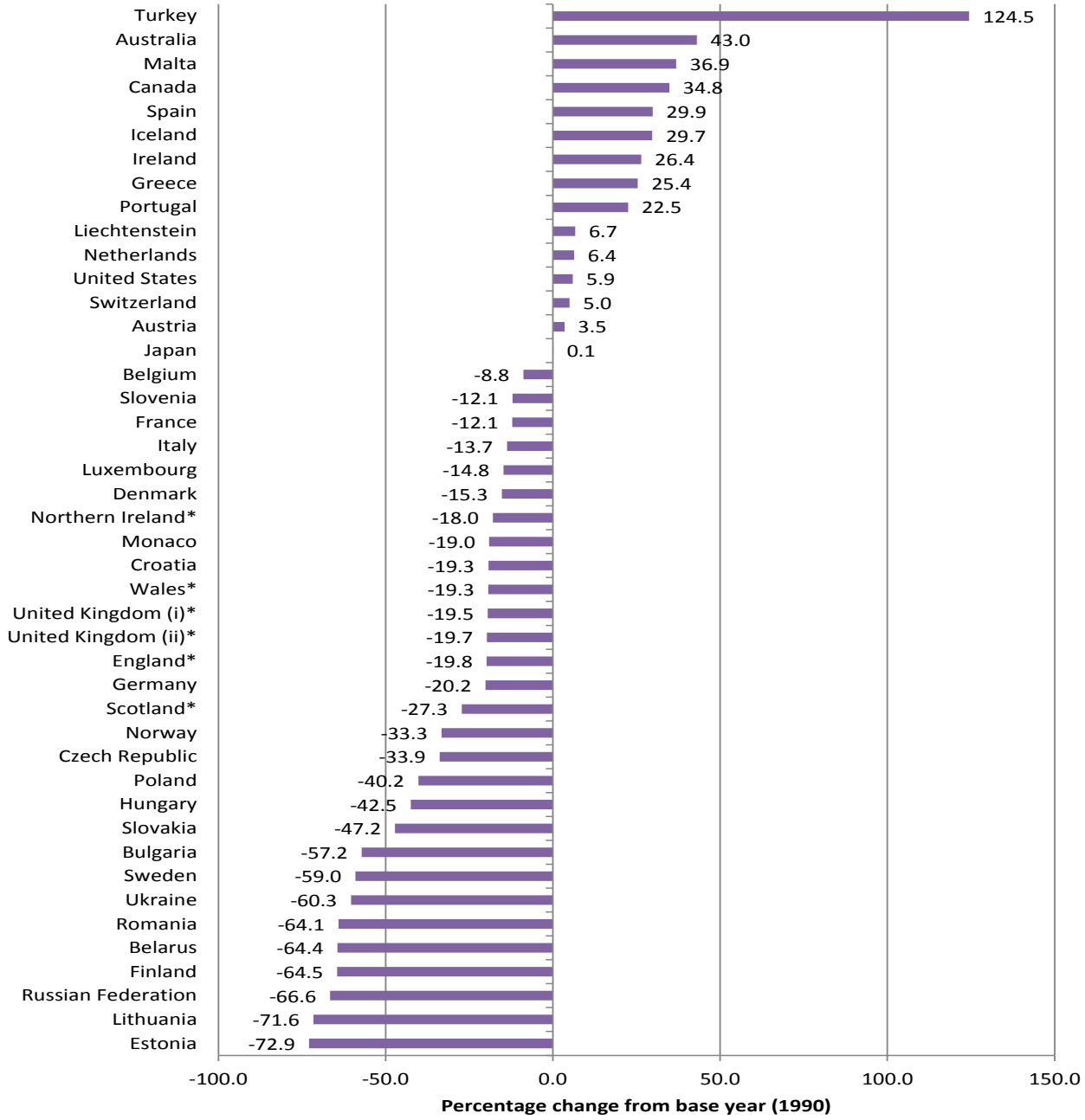
It is also possible to calculate percentage changes for carbon dioxide emissions between the 1990 base year and 2009 for all of the UNFCCC Annex 1[50] Parties,[51] the EU-27[52] and the four UK countries.[53] Figure 3 below sets out these changes.

Of the 43 countries[54] included in figure 3, 15 have increased their total carbon dioxide emissions since 1990, while 28 have reduced their emissions. The largest increase was in Turkey, increasing by over 100 per cent. The largest decreases in emissions were in Lithuania and Estonia, both declining by over 70 per cent. Of the 10 countries with the largest declines in carbon dioxide emissions, 8 are economies in transition from the former Communist countries.

In terms of the largest reductions of carbon dioxide emissions of the 43 countries included in figure 3, **Wales is ranked 19th**, Scotland 15th, England 17th and Northern Ireland 22nd (only including UK (ii) of the two values for the UK for the reasons set out earlier in the paper). The background data used to derive figures 3 and 4 is available in **Annex B** to this paper.

[50] **Annex 1 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 20 January 2012]
[51] The graph excludes Latvia even though it is part of the UNFCCC Annex 1 Parties as it had negative emissions in 2009. CO_2 emissions in Latvia have declined from 3,623 Gg to -13,701Gg, a decrease of 478.2 per cent. New Zealand is also excluded as its emissions have increased by 349.9 per cent. Carbon dioxide emissions in New Zealand have risen from 1,489Gg to 6,699 Gg.
[52] Data was not available from the UNFCCC for Cyprus.
[53] The UK countries are highlighted with a * on the graph
[54] Including all four UK countries and "UK (i)" emissions (not "UK (ii)").

Figure 3: Percentage change from the base year (1990) of carbon dioxide emissions, by Country[(a)], including LULUCF[(b)], 2009 (Gg[55])



Sources: UNFCCC, National Greenhouse Gas Inventory Data for the period 1990-2009, Table 8, page 18, November 2011 – for rest of sources see Figure 1 – data is available in Annex B to this paper

Notes:

(a) The graph excludes Latvia even though it is part of the UNFCCC Annex 1 Parties as it had negative emissions in 2009. Carbon dioxide emissions in Latvia have declined from 3,623Gg to -13,701Gg.

UK (i) figure does not match those published in table 2; here the figure includes all unallocated emissions, Crown Dependencies and Overseas Territories which have joined the UK's instruments of ratification to the UNFCCC and the Kyoto Protocol.

[55] One Gigagramme (Gg) equates to one thousand tonnes, or one kilotonnes (kt) (UK data is recorded in kt).

Figure 4 presents the carbon dioxide emissions (net emissions/removals) per capita for each of the EU-27,[56] the UNFCCC Annex 1 Parties and the four UK countries. Data for UK countries have been calculated using carbon dioxide emissions published in the AEA 2011 publication,[57] divided by the **mid-2009 population estimates**[58] for each country.

The carbon dioxide emissions per capita shown in figure 4 have been calculated by the 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 carbon dioxide emissions are also likely to vary slightly. Figures are not comparable with those in previous Research Service publications.

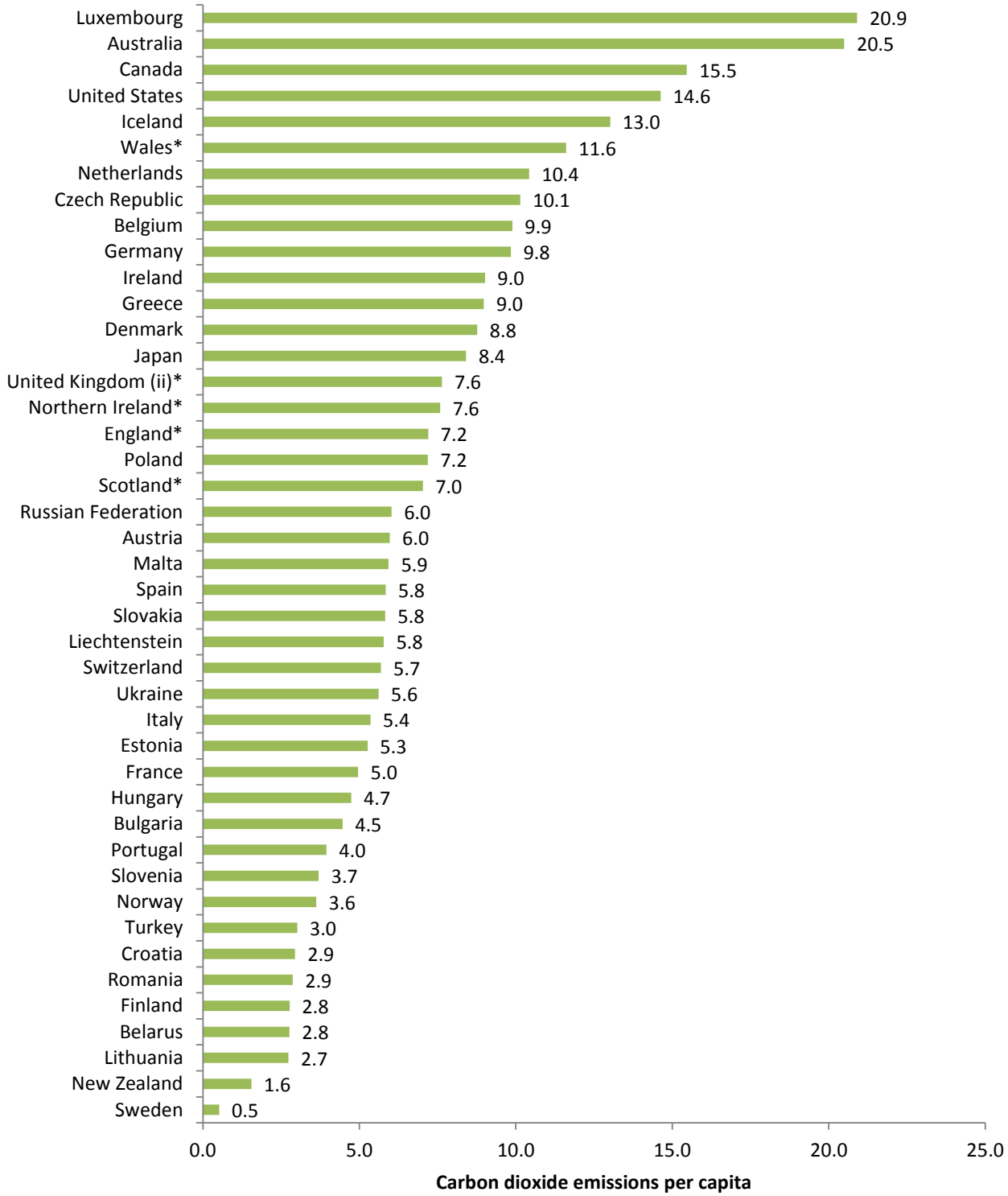
The carbon dioxide emissions per capita for the UK countries in 2009 were:

- Wales 11.6 tonnes per capita
- Northern Ireland 7.6 tonnes per capita
- England 7.2 tonnes per capita
- Scotland 7.0 tonnes per capita

Of the 43 countries included in figure 4, **Wales had the 6th highest carbon dioxide emissions per capita in 2009**. Luxembourg had the highest, while Sweden had the lowest. The UK was ranked 15th highest (only including UK (ii) of the two values for the UK for the reasons set out earlier in the paper).

[56] 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 64).
[57] AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, page x (September 2011) [accessed 20 January 2012]
[58] Office for National Statistics, Population Estimates for UK, England, Wales, Scotland and Northern Ireland, 2009 (Tables 4-7) [accessed 20 January 2012]

Figure 4: Carbon dioxide emissions per capita, 2009 (Gg[41] per thousand capita)[(a)(b)]



Sources: UNFCCC, National Greenhouse Gas Inventory Data for the period 1990-2009, Table 8, page 18, November 2011 – for rest of sources see figure 2 – data is available in Annex B to this paper.

Notes: See figure 3.

3.1.3. Methane emissions

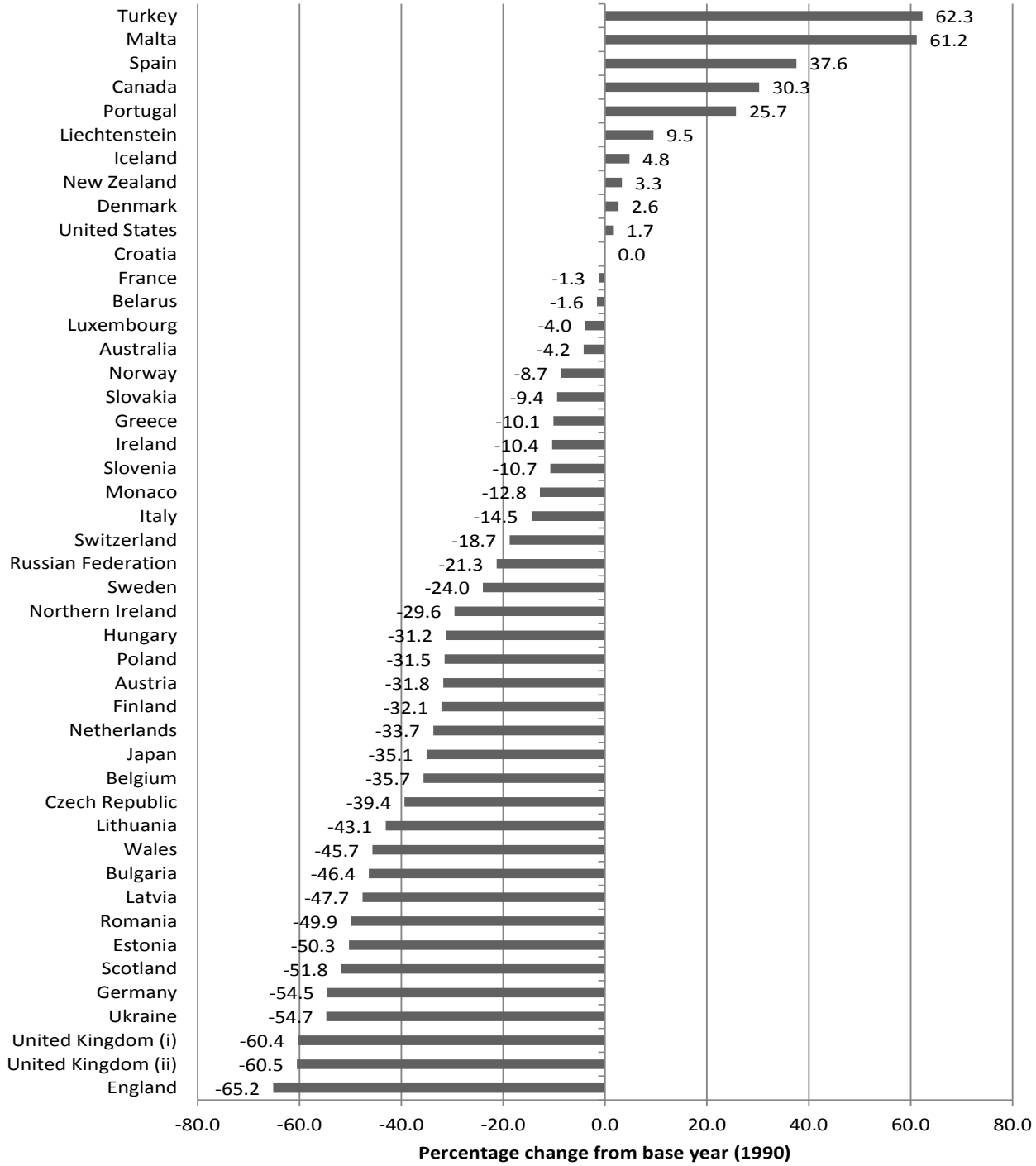
It is also possible to calculate percentage changes for methane emissions between the 1990 base year and 2009 for all of the UNFCCC Annex 1 Parties, the EU-27[59] and the four UK countries.[60] Figure 5 below sets out these changes.

Of the 45 countries[61] included in figure 5, 10 have increased their total methane emissions since 1990, while 34 have reduced their emissions, and Croatia's emissions have stayed at the same level. The largest increase was in Turkey, increasing by over 60 per cent. The largest decreases in emissions were in England, the United Kingdom, Ukraine, Germany, Scotland and Estonia, all with emissions declining by over 50 per cent.

In terms of the largest reductions of methane emissions of the 45 countries included in figure 5, **Wales is ranked 10th**, Scotland 5th, England 1st and Northern Ireland 20th (only including UK (ii) of the two values for the UK for the reasons set out earlier in the paper). The background data used to derive figures 5 and 6 is available in **Annex C** to this paper.

[59] Data was not available from the UNFCCC for Cyprus.
[60] The UK countries are highlighted with a * on the graph
[61] Including all four UK countries and "UK (ii)" emissions (not "UK (i)").

Figure 5: Percentage change from the base year (1990) of methane emissions, by Country, including LULUCF[(a)], 2009 (Gg[62])



Source: UNFCCC, National Greenhouse Gas Inventory Data for the period 1990-2009, Table 10, page 20 – for rest of sources - see figure 1 – data is available in Annex C of this research paper.

Notes: No Annex I countries have been excluded from these figures – for the remainder of the notes see figure 1.

[62] One Gigagramme (Gg) equates to one thousand tonnes, or one kilotonnes (kt) (U data is recorded in kt).

Figure 6 presents the methane emissions (net emissions/removals) per capita for each of the EU-27,[63] the UNFCCC Annex 1 Parties and the four UK countries. Data for UK countries have been calculated using methane emissions published in the AEA 2011 publication,[64] divided by the **mid-2009 population estimates**[65] for each country.

The methane emissions per capita shown in figure 6 have been calculated by the Research Service, by dividing methane 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 methane emissions are also likely to vary slightly.

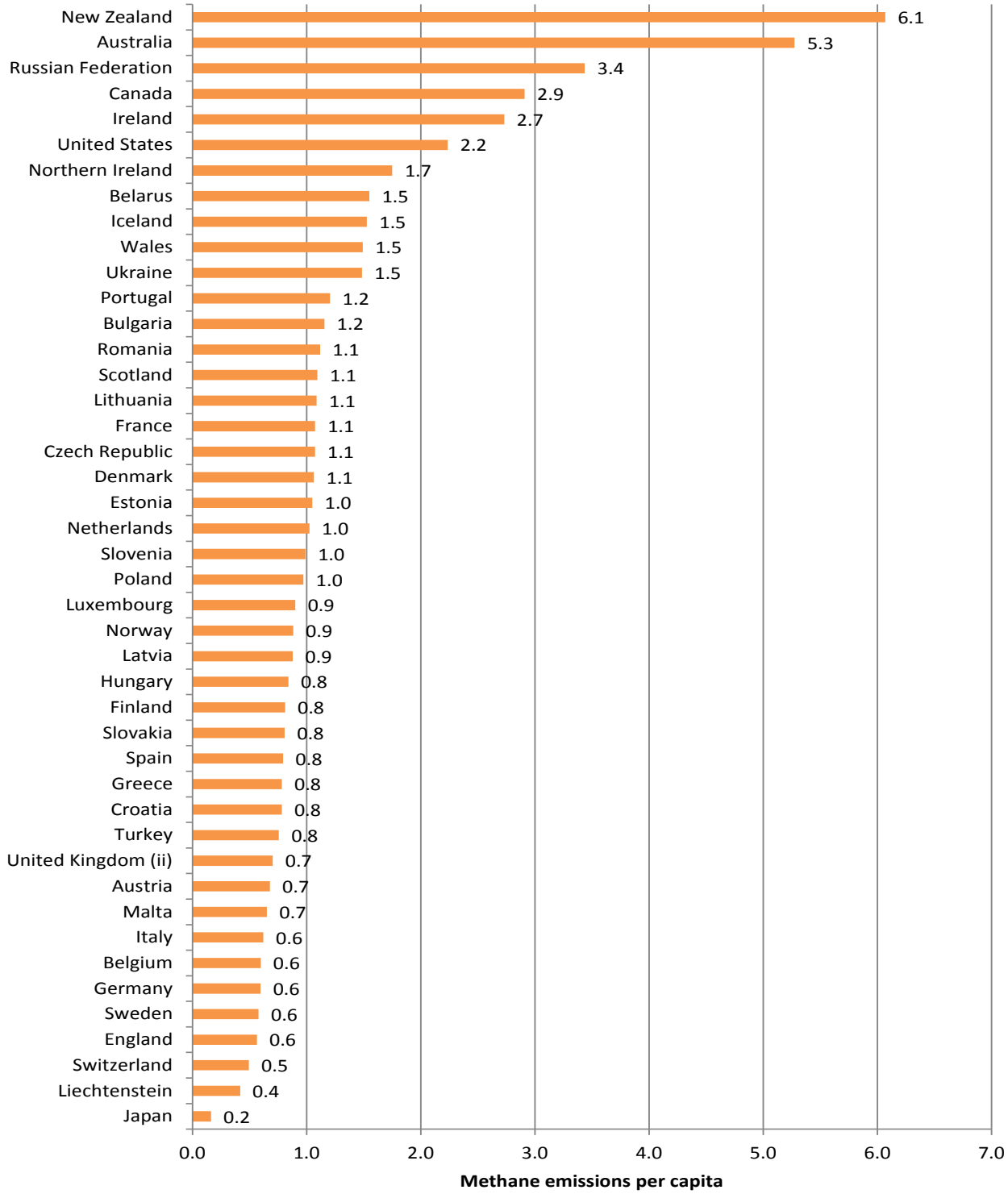
The methane emissions per capita for the UK countries in 2009 were:

- Northern Ireland 1.7 tonnes per capita
- Wales 1.5 tonnes per capita
- Scotland 1.1 tonnes per capita
- England 0.6 tonnes per capita

Of the 44 countries included in figure 6, **Wales had the 10th highest methane emissions per capita in 2009**. New Zealand had the highest, while Japan had the lowest. The UK was ranked 11th lowest (only including UK (ii) of the two values for the UK for the reasons set out earlier in the paper).

[63] Data for Cyprus and Monaco are not available.
[64] AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, page x (September 2011) [accessed 20 January 2012]
[65] Office for National Statistics, Population Estimates for UK, England, Wales, Scotland and Northern Ireland, 2009 (Tables 4-7) [accessed 20 January 2012]

Figure 6: Methane emissions per capita, 2009 (Gg[66] per thousand capita)[(a)]



Source: UNFCCC, National Greenhouse Gas Inventory Data for the period 1990-2009, Table 10, page 20 – for rest of sources - see figure 2 – data is available in Annex C of this research paper.

Notes: See figure 2

[66] One Gigagramme (Gg) equates to one thousand tonnes, or one kilotonnes (kt) (U data is recorded in kt).

3.2. National Emissions calculations using the production approach

This section uses the production approach to compare total net greenhouse gas emissions in Wales, and other UK countries, with the targets outlined in the previous chapter. It then goes on to look at data using the production approach for carbon dioxide emissions and methane emissions in Wales and the other UK countries.

Throughout this Section due to updated emissions data and changes to methodologies, it is not possible to compare the figures published here with previous Research Service papers or previous AEA inventory publications.

3.2.1. Total net greenhouse gas emissions

There has been a general downward trend in greenhouse gas emissions in Wales over the past 19 years, although there have been rises in emissions in some years. **In 2009, total net emissions of greenhouse gases in Wales were 42.6 Mega tonnes (Mt), 23.3 per cent lower than the base year (1990 or 1995)[67,68], and there was a decrease of 6.7Mt between 2008 and 2009**. In comparison with the other UK countries in 2009, Wales has reduced its emissions (below the 1990 or 1995 base year) by 23.3 per cent, which is 5 percentage points less than the UK average, as shown in table 1. Scotland has had the largest reduction in emissions, of 30.5 per cent.

In a written statement in September 2011, John Griffiths AM, the Minister for Environment and Sustainable Development stated that:

> The figures indicate a general downward trend in overall emissions. It is clear that the UK economic downturn has been a major factor in the steep decline in emissions in 2009.[69]

The Committee on Climate Change however consider that emissions are likely to increase again in 2010.[70]

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[67] AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration GHG Inventory Pivot Tables (by source basis), September 2011 [accessed 20 January 2012]
[68] Under the Kyoto Protocol, Annex 1 parties are able to use 1990 or 1995 as the base year for emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, and a number of parties, including the United Kingdom and devolved nations, use 1995.
[69] Welsh Government, John Griffiths (Minister for Environment and Sustainable Development), Greenhouse Gas Emissions in Wales in 2009, 19 September 2011 [accessed 20 January 2012]
[70] Climate Change Commission, Reducing emissions and preparing for climate change in Wales: 2011 Progress Report, page 13, 18 October 2011[accessed 20 January 2012]

Table 1: Greenhouse gas emissions and percentage change from base year (1990 or 1995)[(a)], Wales and the UK[(b)], 1995 to 2009 (Mt CO_2 e)

	Wales		England		Scotland		Northern Ireland		United Kingdom	
Year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year
Base Year	55.6	..	618.7	..	69.2	..	24.5	..	783.1	..
1995	51.7	..	550.3	..	66.1	..	24.3	..	712.4	..
1998	53.5	-3.7	537.5	-13.1	65.6	-5.3	23.9	-2.5	701.3	-10.5
1999	54.5	-1.9	508.6	-17.8	61.8	-10.7	23.9	-2.2	669.5	-14.5
2000	56.2	1.1	507.1	-18.0	63.7	-8.0	23.4	-4.3	669.9	-14.5
2001	53.1	-4.4	513.9	-16.9	63.0	-9.0	23.7	-3.1	673.9	-13.9
2002	46.4	-16.5	504.4	-18.5	59.2	-14.6	21.6	-11.7	652.0	-16.7
2003	47.4	-14.8	509.4	-17.7	58.5	-15.5	21.5	-12.1	656.0	-16.2
2004	50.9	-8.4	505.4	-18.3	56.0	-19.1	21.3	-12.9	652.8	-16.6
2005	49.5	-11.0	502.8	-18.7	54.8	-20.8	22.1	-9.6	647.7	-17.3
2006	50.4	-9.3	493.6	-20.2	58.1	-16.0	22.6	-7.8	641.2	-18.1
2007	47.3	-14.9	490.8	-20.7	53.9	-22.1	21.2	-13.3	630.3	-19.5
2008	49.3	-11.3	478.0	-22.7	51.8	-25.2	21.2	-13.3	616.0	-21.3
2009	42.6	-23.3	436.0	-29.5	48.1	-30.5	19.5	-20.3	561.8	-28.3

Source: AEA, **Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration GHG Inventory Pivot Tables (by source basis),** September 2011

..= not applicable

Notes:

(a) The base years for carbon dioxide, methane and nitrous oxide emissions are 1990. The base years for hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride are 1995. AEA has calculated the base year figure for total greenhouse gas emissions based on the figures for the corresponding base years.

(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 of the countries within the UK, but are instead recorded in an 'unallocated' inventory category. Unallocated total net greenhouse gas emissions accounted for 2.8 per cent (16.1Mt) of the UK's emissions in 2009, an increase from 1.9 per cent in 1990.[71] There are no 'unallocated' emissions for hydrofluorocarbons, perfluorocarbons or sulphur hexafluoride. Unallocated emissions make up the difference between the sum of the four devolved nations' total net greenhouse gas emissions and the UK figure.

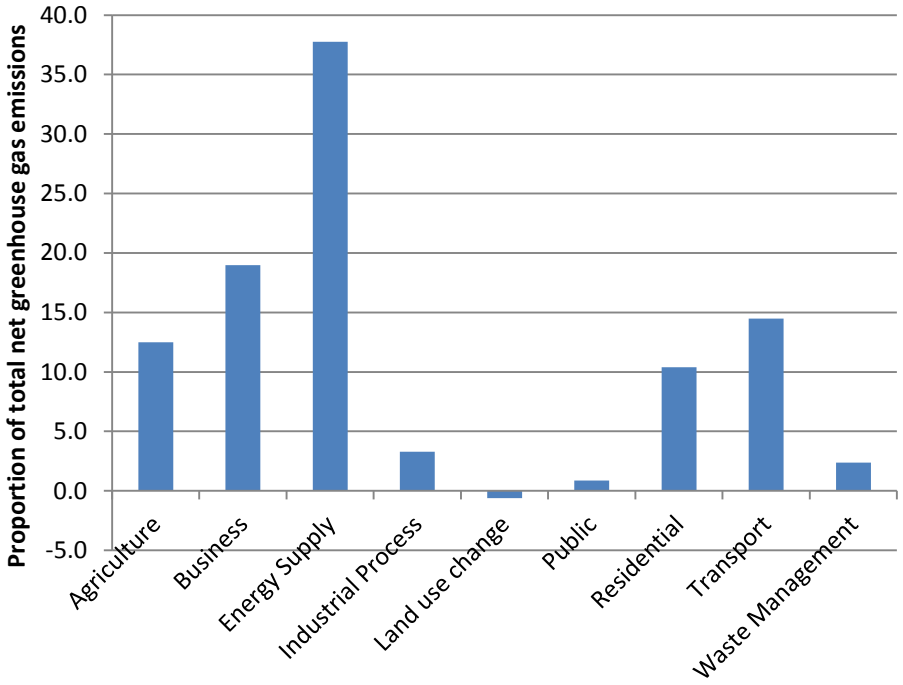
The major sources of greenhouse gas emissions in Wales are power stations, road transport and combustion from the iron and steel sector, which produce large amounts of carbon dioxide; enteric fermentation in cattle and sheep,[72] which

[71] AEA, ***Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009***, page 81, September 2011 [accessed 20 January 2012]

[72] The United Nations Intergovernmental Panel on Climate Change (IPCC) states that: "Methane is produced in herbivores as a byproduct of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into

produce large amounts of methane, and agricultural soil, which produces large amounts of nitrous oxide.[73] Figure 7 below shows total net greenhouse gas emissions in Wales by sector in 2009. It can be seen that the energy supply sector produced most total net greenhouse gas emissions in 2009, producing 38 per cent of all total net greenhouse gas emissions. Business produced 19 per cent, while residential, transport and agriculture each produced between 10 and 15 per cent of total net greenhouse gas emissions in Wales in 2009.

Figure 7: Total net greenhouse gas emissions in Wales by sector, 2009 (per cent)



Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration GHG Inventory Pivot Tables (by source basis), (Wales tab) September 2011 and Research Service calculations - data is available in Annex D of this research paper.

Figure 8 shows the trend of greenhouse gas emissions in Wales in comparison with the UK trend and the trend lines to achieve the UK 2020 target of reducing total net greenhouse gas emissions by 34 per cent below the 1990 base year. It also shows the trend lines for the Welsh Government target of reducing net greenhouse gas emissions by 40 per cent and the 2008-12 Kyoto Protocol target of the UK reducing greenhouse gas emissions by 12.5 per cent, also by 2020.

To reach the Welsh Government's 2020 target of reducing greenhouse gas emissions by 40 per cent below the 1990 base year, emissions will need to be

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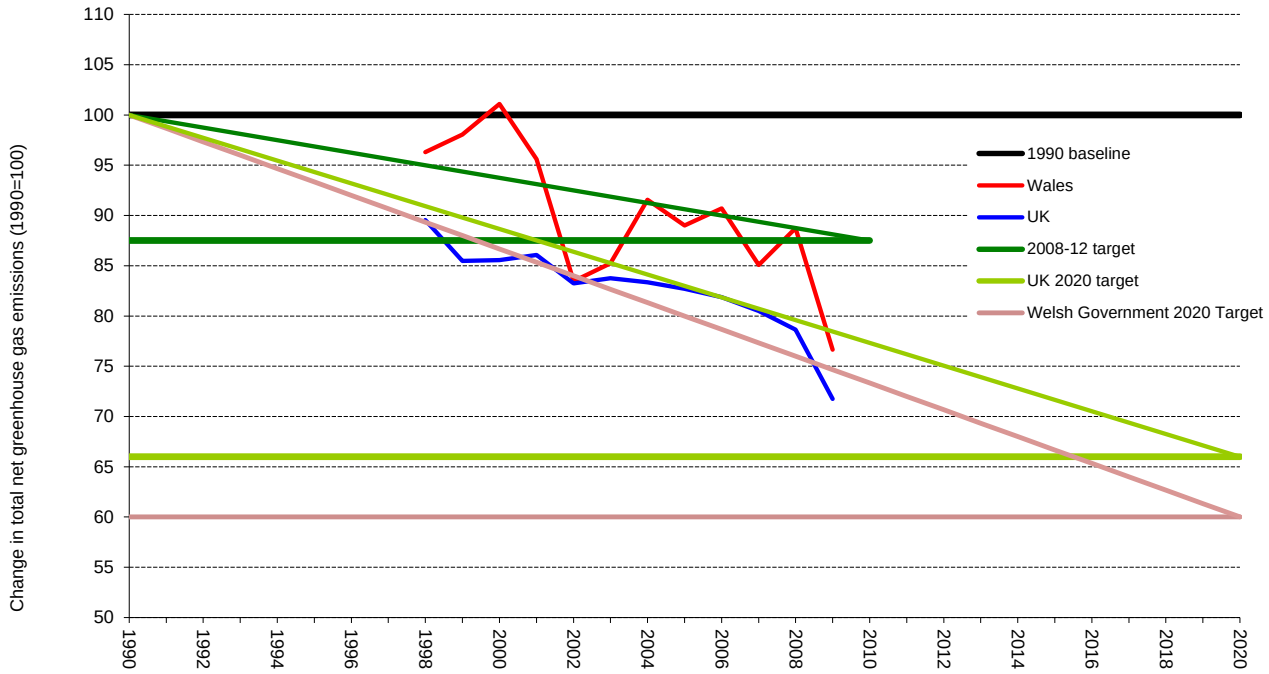
simple molecules for absorption into the bloodstream…ruminant livestock (e.g. cattle, sheep) are major sources of methane."

[73] AEA, *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009*, page 45, September 2011 [accessed 20 January 2012]

reduced by a further 16.7 percentage points from base year emissions in eleven years.

Figure 8: Trends in total net greenhouse gas emissions from 1990 to 2009, (against base year) Wales and UK



Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, September 2011

(a) For figures prior to 1998, data is only available for 1990 and 1995; therefore these years have not been included on the trend lines.
(b) Different methodologies have been used from previous AEA publications; therefore comparisons cannot be made with previous papers.

3.2.2. Carbon dioxide emissions

Carbon dioxide accounts for approximately 85 per cent of total net greenhouse gas emissions in the UK.[74] Wales has performed inconsistently in reducing carbon dioxide emissions over the past 19 years. **In 2009, total emissions of carbon dioxide in Wales were 34.8 Mt, representing a 19.3 per cent decrease from the base year (1990)[75]. However, there was a large decrease of 6.8 Mt between 2008 and 2009**. In comparison with the other UK countries in 2009, Wales has

[74] AEA, *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009*, page ix, September 2011 [accessed 20 January 2012]
[75] Ibid. page 45

reduced its emissions (below the 1990 base year) by 0.4 percentage points less than the UK average, as shown in table 2. Scotland has had the largest reduction in emissions, of 27.3 per cent.

The Committee on Climate Change however consider that emissions are likely to increase again in 2010.[76]

Table 2: Carbon dioxide emissions[(a)] and percentage change from base year (1990), Wales and the UK[(b)], 1990 to 2009 (Mt CO_2)

	Wales		England		Scotland		Northern Ireland		United Kingdom	
Year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year
1990	43.2	..	465.2	..	50.2	..	16.5	..	588.1	..
1995	40.8	-5.4	424.3	-8.8	49.4	-1.6	16.7	1.1	549.1	-6.6
1998	43.1	-0.2	421.7	-9.3	49.9	-0.6	16.2	-2.2	549.7	-6.5
1999	44.3	2.7	413.9	-11.0	47.0	-6.4	16.4	-0.7	540.5	-8.1
2000	46.4	7.5	417.7	-10.2	49.3	-1.7	16.3	-1.3	547.6	-6.9
2001	43.9	1.7	431.2	-7.3	49.4	-1.6	16.7	0.9	559.8	-4.8
2002	37.4	-13.3	424.8	-8.7	46.0	-8.4	15.1	-8.7	542.2	-7.8
2003	38.5	-10.9	434.8	-6.5	45.9	-8.5	15.1	-8.4	552.1	-6.1
2004	42.0	-2.6	432.9	-6.9	43.6	-13.2	15.1	-8.9	551.2	-6.3
2005	40.5	-6.2	432.2	-7.1	42.5	-15.4	15.9	-3.8	548.2	-6.8
2006	41.9	-2.9	425.3	-8.6	45.9	-8.6	16.4	-0.9	544.8	-7.4
2007	39.2	-9.3	424.1	-8.8	42.0	-16.4	15.1	-8.4	536.2	-8.8
2008	41.6	-3.7	412.3	-11.4	40.0	-20.3	15.2	-7.8	523.6	-11.0
2009	34.8	-19.3	373.0	-19.8	36.5	-27.3	13.6	-18.0	472.2	-19.7

Source: AEA, **Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration GHG Inventory Pivot Tables (by source basis),** September 2011

Notes:

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

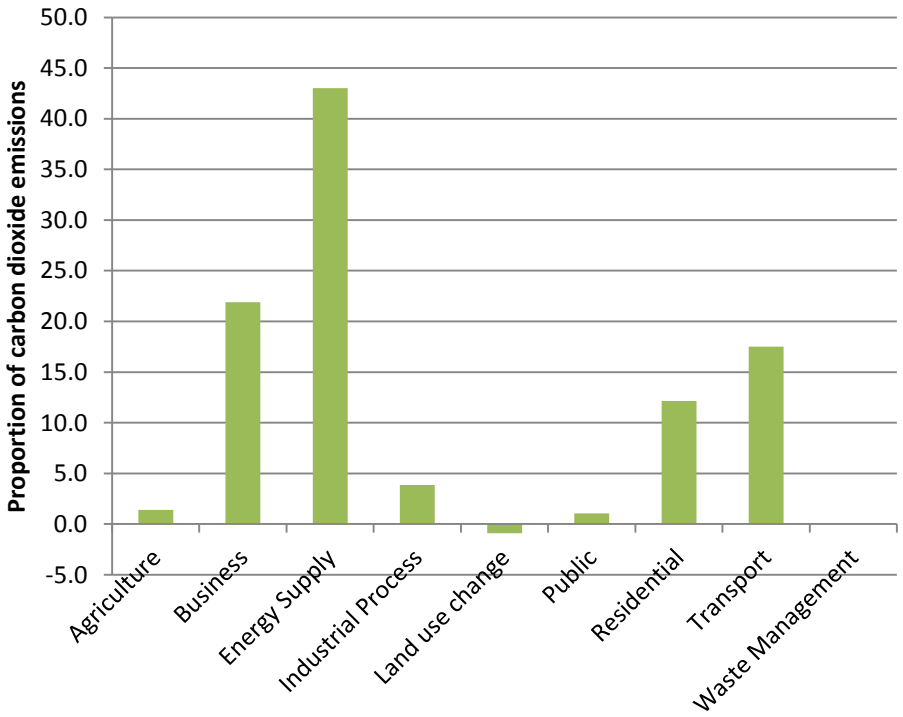
(b) Data includes Crown Dependencies but excludes Overseas Territories – emissions from Crown Dependencies are allocated to England.

Emissions from offshore sources are not allocated to any of the countries within the UK, but are instead recorded in an 'unallocated' inventory category. Unallocated carbon dioxide emissions accounted for 3 per cent (14.3Mt) of the UK's emissions in 2009, an increase of 9.3 per cent since 1990.[77] Unallocated emissions make up the difference between the sum of the four devolved nations' total net greenhouse gas emissions and the UK figure.

It can be seen from figure 9 that the energy supply sector produced 43 per cent of all carbon dioxide emissions in Wales in 2009, which was the largest proportion of all sectors. Business produced 22 per cent, and transport produced 18 per cent of all carbon dioxide emissions in Wales during 2009.

[76] Climate Change Commission, **Reducing emissions and preparing for climate change in Wales: 2011 Progress Report**, page 13, 18 October 2011[accessed 20 January 2012]
[77] AEA, ***Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009***, page 81, September 2011 [accessed 20 January 2012]

Figure 9: Carbon dioxide emissions in Wales by sector, 2009 (per cent)



Source: Source: AEA, **Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration GHG Inventory Pivot Tables (by source basis),** (Wales tab), September 2011 and Research Service calculations – data is available in Annex D of this research paper.

It is estimated that power generation contributed 32.2 per cent of total Welsh carbon dioxide emissions in 2009, which is slightly higher than the UK proportion of 31.8 per cent. Annual generation figures have fluctuated significantly over this period, including a rise of approximately 30 per cent in power station emissions between 2007 and 2008 due to Aberthaw Power Station re-opening following its plant shutdown during 2007.[78]

Wales is a net exporter of electricity i.e. it exports more than it uses. Data indicates that in 2009 just over 26 per cent of all power generated in Wales, was exported to England. The amount of electricity exported by Wales decreased from 11,682 GWh in 2008 to 8,287 GWh in 2009. This reflects the decrease in the level of electricity demand in England.[79]

The Environment Agency has provided details[80] of the top 13 carbon dioxide emitters in the EU Emissions Trading Scheme (EUETS) in Wales from 2005 to 2010, and these are shown in Table 3. The EUETS covers around 11,000 installations across Europe, which account for approximately 45 per cent of European Union

[78] AEA, *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009*, page 46, September 2011 [accessed 10 October 2011]
[79] Ibid. page 46
[80] The Environment Agency provided these figures on request.

carbon dioxide emissions. The Environment Agency has advised that approximately 95 per cent of verified EUETS emissions in Wales are attributable to these 13 emitters. The remaining 42 installations in Wales covered by the EUETS accounted for approximately 5 per cent of verified emissions. Welsh emitters contributed approximately 10 per cent of verified emissions at the UK level between 2005 and 2010.

Table 3: Top 13 carbon dioxide emitters in the EUETS in Wales, 2005-10 (Mt CO_2)

	2005		2006		2007		2008		2009		2010	
Site	Allocated Emissions	Verified Emissions	Allocated Emissions	Verified Emissions	Allocated Emissions	Verified Emissions	Allocated Emissions	Verified Emissions	Allocated Emissions	Verified Emissions	Allocated Emissions	Verified Emissions
Port Talbot Steelworks	7.8	6.1	7.8	6.6	7.8	7.1	7.8	6.9	7.8	5.3	7.8	7.3
Aberthaw Power Station	4.1	5.3	4.1	7.3	4.1	4.2	4.1	7.0	4.1	5.0	4.1	4.7
Connahs Quay Power Station	1.9	3.4	1.9	3.2	1.9	3.4	1.9	3.3	1.9	3.2	1.9	3.0
Chevron Limited - Pembroke	2.1	2.3	2.1	2.3	2.1	2.5	2.1	2.2	2.1	2.5	2.1	2.5
Baglan Bay Power Station	0.8	1.1	0.8	1.1	0.8	1.4	0.8	0.7	0.8	0.3	0.8	1.2
Deeside Power Station	0.7	1.0	0.7	0.6	0.7	0.9	0.7	1.2	0.7	1.2	0.7	1.2
Murco Petroleum Milford Haven Refinery	1.2	1.0	1.2	1.2	1.2	1.2	1.2	1.1	1.2	1.1	1.3	0.9
Uskmouth Power Plant	0.9	1.0	0.9	0.9	0.9	0.7	0.9	1.3	0.9	0.7	0.9	0.4
Shotton Combined Heat and Power	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.5	0.4
South Hook LNG Terminal	0.0	0.0	0.1	0.0	0.3	0.0	0.3	0.0	0.3	0.1	0.3	0.3
Lafarge Cement UK - Aberthaw	0.4	0.0	0.4	0.0	0.4	0.2	0.4	0.3	0.4	0.3	0.4	0.3
Barry Power Station	0.3	0.3	0.3	0.2	0.3	0.4	0.3	0.5	0.3	0.5	0.3	0.2
Padeswood Works	0.8	0.3	0.8	0.6	0.8	0.6	0.8	0.5	0.8	0.3	0.8	0.2
Total of top 13 emitters	**21.4**	**22.4**	**21.5**	**24.6**	**21.9**	**22.9**	**21.9**	**25.6**	**21.9**	**20.9**	**21.9**	**22.5**
Other Wales Operators	1.4	0.5	1.6	0.5	1.8	0.5	1.8	1.0	1.8	1.0	1.8	1.1
Wales Total	**22.8**	**22.9**	**23.1**	**25.0**	**23.6**	**23.5**	**23.6**	**26.6**	**23.6**	**21.8**	**23.6**	**23.6**

Source: Environment Agency

Notes:

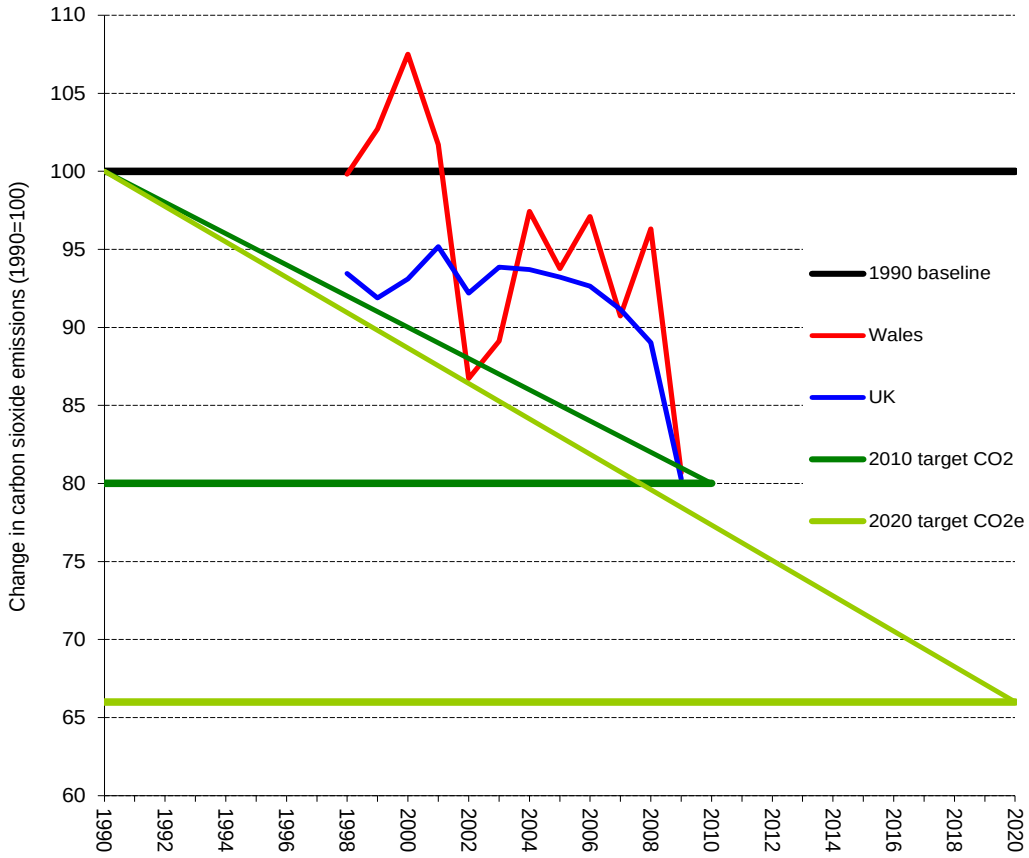
(a) The Environment Agency advises that emissions figures for Wales are potentially volatile as they are influenced significantly by a small number of installations.

(b) Verified emissions for the 2005-10 period have been influenced significantly by the global recession and maintenance works at Aberthaw Power Station in 2007.

As can be seen in Table 3 above, **in 2010 the Tata Steelworks in Port Talbot was the largest emitter of carbon dioxide in the EUETS in Wales, with verified emissions of 7.3Mt of carbon dioxide**. Over the 2005 to 2010 period, the 55 installations in Wales covered by the EUETS were allocated 140.4Mt of carbon dioxide emissions. Actual verified carbon dioxide emissions during this period were 143.4Mt.

Figure 10 shows the trend of carbon dioxide emissions in Wales in comparison with the UK trend and the trend lines against the UK 2010 target of reducing carbon dioxide emissions by 20 per cent below the 1990 base year. It also shows the 2020 target of the UK reducing total greenhouse gas emissions by 34 per cent.

Figure 10: Trends in carbon dioxide emissions from 1990 to 2009 (against the 1990 base year), Wales and UK



Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration GHG Inventory Pivot Tables (by source basis), September 2011

(a) For figures prior to 1998, data is only available for 1990 and 1995; therefore these years have not been included on the trend lines.
(b) Different methodologies have been used from previous AEA publications; therefore comparisons cannot be made with previous papers.

3.2.3. Methane emissions

Wales has consistently reduced methane emissions over the past 19 years. **In 2009, methane emissions in Wales were 4.5Mt, 45.7 per cent lower than the base year (1990)[81], although there was a rise of 0.1 Mt in 2009 compared to**

[81] AEA, *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009*, page xv , September 2011 [accessed 20 January 2012]

2008. In comparison with the other UK countries in 2009, Wales has reduced its emissions (below the 1990 base year) by 14.8 percentage points less than the UK average, as shown in table 4. England has had the largest reduction in emissions, of 65.2 per cent.

Table 4: Methane emissions and percentage change from base year (1990), Wales and the UK[(a)], 1990 to 2009 (Mt CO_2e)

	Wales		England		Scotland		Northern Ireland		United Kingdom	
Year	Emissions (Mt)	Percentage change since base year	Emissions (Mt)	Percentage change since base year	Emissions (Mt)	Percentage change since base year	Emissions (Mt)	Percentage change since base year	Emissions (Mt)	Percentage change since base year
1990	8.2	..	83.8	..	11.8	..	4.4	..	110.1	..
1995	6.8	-17.8	67.2	-19.9	10.1	-13.9	4.0	-9.1	89.9	-18.4
1998	6.1	-26.3	56.2	-32.9	9.0	-24.0	3.8	-13.7	76.7	-30.4
1999	5.9	-28.2	52.2	-37.8	8.2	-30.2	3.7	-17.8	71.3	-35.2
2000	5.7	-31.2	48.3	-42.4	7.9	-33.4	3.5	-21.5	66.5	-39.6
2001	5.2	-36.6	43.8	-47.8	7.2	-39.3	3.4	-24.4	60.7	-44.9
2002	5.1	-38.3	41.6	-50.4	6.7	-43.3	3.3	-26.2	57.7	-47.6
2003	5.0	-39.1	36.5	-56.5	6.1	-48.0	3.2	-28.4	51.9	-52.9
2004	5.0	-38.7	34.7	-58.7	6.1	-48.4	3.1	-29.2	50.1	-54.5
2005	5.1	-38.2	33.2	-60.4	6.1	-48.1	3.2	-27.6	48.5	-56.0
2006	4.8	-42.0	32.3	-61.5	6.0	-48.9	3.2	-28.8	47.0	-57.3
2007	4.6	-44.4	30.8	-63.2	6.0	-49.4	3.2	-28.4	45.5	-58.7
2008	4.4	-46.9	30.0	-64.2	5.9	-50.1	3.1	-29.1	44.3	-59.8
2009	4.5	-45.7	29.2	-65.2	5.7	-51.8	3.1	-29.6	43.4	-60.5

Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, September 2011

Note:

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

Enteric fermentation[82] from cattle is the largest source of methane emissions in Wales, providing 30 per cent of all methane emissions in Wales in 2009, and fermentation from sheep is also a significant source of methane emissions, although these have declined since the base year due to decreases in cattle and sheep numbers over this period.[83] In the energy sector, fugitive emissions from fuels such as leaks from the natural gas supply network and methane seepage from mining activities are a further source of methane emissions, accounting for 22.4 per cent of all methane emissions in Wales in 2009.[84]

[82] The United Nations Intergovernmental Panel on Climate Change (IPCC) states that: "Methane is produced in herbivores as a byproduct of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream…ruminant livestock (e.g. cattle, sheep) are major sources of methane."
UNIPCC, IPCC Guidelines for National Greenhouse Gas Inventories (page 10.24), February 2009 [accessed 20 January 2012]

[83] AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, page 53, September 2011 [accessed 20 January 2012]

[84] Ibid. page 46

3.3. National Emissions calculated using the 'end-user' approach

Emissions of greenhouse gases are typically reported under international conventions using the production approach, which allocates emissions to the source sector at the point of their release.[85] However, to provide a more representative view of consumption rather than production, end-user inventories can be used. Emissions associated with sector consumption of all fuels, including emissions associated with electricity use are shown in end-user inventories.[86]

Table 5 below compares the UK distribution of greenhouse gas emissions by end user and by source/production in 2009. The devolved administrations' 'end-user' inventories include emissions relating to the refining of fuels that are subsequently exported outside the UK.[87] These appear within the 'exports' line in the devolved administrations' 'end-user' inventories. The AEA publishes two sets of 'end-user' figures, one set including exported emissions, and one set excluding exported emissions. Imports such as electricity imported from the EU and consumed in the UK are not included.

Table 5: Share of greenhouse gas emissions by source and by 'end-user', 2009

Percentage of greenhouse gas emissions

	By source	End-user	End-user excluding exports
England	77.6	80.6	78.7
Scotland	8.6	8.7	8.4
Wales	7.6	6.9	6.6
Northern Ireland	3.5	3.8	3.7
Unallocated	2.8	0.0	0.0

Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, page 132, September 2011 [accessed 20 January 2012]

It can be seen that Wales has a smaller share of 'end-user' emissions, 6.9 per cent of UK emissions, in comparison to its share of 7.6 per cent of 'by source' UK emissions.

[85] AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, page 128, September 2011 [accessed 24 October 2011]
[86] Ibid. page 128
[87] Ibid. page 128

This section uses the 'end-user' approach to compare total net greenhouse gas emissions in Wales and other UK countries. It then goes on to look at data using the 'end-user' approach for carbon dioxide emissions and methane emissions in Wales and the other UK countries.

3.3.1. 'End-user' greenhouse gas emissions

As stated above, it is possible to measure 'end-user' emissions either including or excluding exports; figures excluding exports are set out below.

Overall there has been a general downward trend in 'end-user' greenhouse gas emissions (excluding exports) in Wales over the past 19 years, although there have been rises in some years. **In 2009, total 'end-user' emissions of greenhouse gases in Wales were 37.1 Mega tonnes (Mt), 32.3 per cent lower than the base year (1990 or 1995)[88], and there was a decrease of 5.1 Mt between 2008 and 2009**. Of the other UK countries, Scotland has had the largest reduction in emissions, of 35.7 per cent. As can be seen in table 6, Wales has had a greater reduction in 'end-user' greenhouse gas emissions excluding exports than England, Northern Ireland and the UK over the past 19 years.

Table 6: 'End-user' greenhouse gas emissions excluding exports and percentage change from base year (1990 or 1995), Wales and the other UK countries, 1990 to 2009 (Mt CO_2 e)

	Wales		England		Scotland		Northern Ireland		United Kingdom	
Year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year
Base Year	54.8	..	620.2	..	73.5	..	25.3	..	773.8	..
1990	54.9	..	617.0	..	73.4	..	25.3	..	770.6	..
2003	45.4	-17.2	518.3	-16.4	54.9	-25.3	22.2	-12.3	640.8	-17.2
2004	45.9	-16.2	515.0	-17.0	53.9	-26.7	22.0	-13.0	636.8	-17.7
2005	44.6	-18.6	509.9	-17.8	54.3	-26.1	22.2	-12.3	631.0	-18.5
2006	45.0	-17.9	505.2	-18.5	53.1	-27.8	22.6	-10.7	625.9	-19.1
2007	43.9	-19.9	496.8	-19.9	51.5	-29.9	22.4	-11.5	614.6	-20.6
2008	42.2	-23.0	486.9	-21.5	50.8	-30.9	21.9	-13.4	601.8	-22.2
2009	37.1	-32.3	442.0	-28.7	47.2	-35.7	20.8	-17.8	547.1	-29.3

Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration End User GHG emissions data for 1990, 2003-2009 – Issue 1, September 2011 [accessed 20 January 2012]

3.3.2. 'End-user' carbon dioxide emissions

In relation to 'end-user' carbon dioxide emissions excluding exports, there has been a general downward trend in in Wales over the past 19 years, although there have been rises in emissions in some years. **In 2009, 'end-user' emissions of**

[88] Under the Kyoto Protocol, Annex 1 parties are able to use 1990 or 1995 as the base year for emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, and a number of parties, including the United Kingdom and devolved nations, use 1995.

carbon dioxide in Wales were 29.8 Mega tonnes (Mt), 29.3 per cent lower than the base year (1990)[89], and there was a decrease of 4.9 Mt between 2008 and 2009. Of the other UK countries, Scotland has had the largest reduction in emissions, of 33.1 per cent. As can be seen in table 7, Wales has had a greater reduction in 'end-user' greenhouse gas emissions excluding exports than England, Northern Ireland and the UK over the past 19 years.

Table 7: 'End-user' carbon dioxide emissions excluding exports and percentage change from base year (1990), Wales and the other UK countries, 1990 to 2009 (Mt CO_2)

	Wales		England		Scotland		Northern Ireland		United Kingdom	
Year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year
1990	42.2	..	467.4	..	53.3	..	16.7	..	579.6	..
2003	36.6	-13.3	443.3	-5.2	42.1	-21.0	15.6	-6.6	537.6	-7.2
2004	37.3	-11.6	441.9	-5.5	41.3	-22.5	15.5	-7.2	536.0	-7.5
2005	36.0	-14.7	438.6	-6.2	41.8	-21.6	15.8	-5.4	532.2	-8.2
2006	36.8	-12.8	436.5	-6.6	40.7	-23.6	16.2	-3.0	530.2	-8.5
2007	36.1	-14.5	429.4	-8.1	39.5	-25.9	16.1	-3.6	521.1	-10.1
2008	34.7	-17.8	420.6	-10.0	38.9	-27.0	15.7	-6.0	509.9	-12.0
2009	29.8	-29.3	378.1	-19.1	35.6	-33.1	14.7	-12.0	458.2	-20.9

Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration End User GHG emissions data for 1990, 2003-2009 – Issue 1, September 2011 [accessed 20 January 2012]

3.3.3. 'End-user' methane emissions

There has also been a general downward trend in 'end-user' methane emissions excluding exports in Wales over the past 19 years. **In 2009, 'end-user' emissions of methane in Wales were 4.0 Mega tonnes (Mt), 52.7 per cent lower than the base year (1990)[90], and there was a decrease of 0.1 Mt between 2008 and 2009**. Of the other UK countries, England has had the largest reduction in emissions, of 64.0 per cent. As can be seen in table 8, Wales has had a greater reduction in 'end-user' greenhouse gas emissions excluding exports than Northern Ireland over the past 19 years.

[89] AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration End User GHG emissions data for 1990, 2003-2009 – Issue 1, September 2011 [accessed 20 January 2012]
[90] Ibid.

Table 8: 'End-user' methane emissions excluding exports and percentage change from base year (1990), Wales and the other UK countries, 1990 to 2009 (Mt CO_2e)

	Wales		England		Scotland		Northern Ireland		United Kingdom	
Year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year	Emissions (Mt)	Percentage change from base year
1990	8.5	..	83.1	..	12.9	..	5.1	..	109.6	..
2003	4.9	-42.4	36.6	-56.0	6.4	-50.4	3.4	-33.3	51.3	-53.2
2004	4.8	-43.5	35.0	-57.9	6.3	-51.2	3.3	-34.9	49.4	-54.9
2005	4.7	-44.7	33.6	-59.6	6.3	-51.2	3.4	-33.3	48.0	-56.2
2006	4.5	-47.1	32.5	-60.9	6.2	-51.9	3.3	-34.9	46.5	-57.6
2007	4.3	-49.4	31.4	-62.2	6.0	-53.5	3.3	-34.9	45.0	-58.9
2008	4.1	-51.8	30.5	-63.3	6.0	-53.5	3.3	-34.9	43.9	-59.9
2009	4.0	-52.7	29.9	-64.0	5.7	-55.7	3.3	-34.9	42.9	-60.9

Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009: Devolved Administration End User GHG emissions data for 1990, 2003-2009 – Issue 1, September 2011 [accessed 20 January 2012]

3.4. Greenhouse gas emissions within devolved competence

The Welsh Government's ***Climate Change Strategy for Wales***, published in October 2010, provided details of how Wales will aim to meet its target for 3 per cent annual reductions in carbon equivalent emissions from 2011 'in areas of devolved competence',[91] against a baseline of average emissions over 2006-10. The target covers around 70 per cent of total Welsh greenhouse gas emissions, although emissions from the power sector and energy-intensive industries in the EUETS are not included in the target as they are not within devolved competence.

A mixture of 'by source' and 'end-user' emissions are included within the scope of the target, and the key sectors identified by the Committee on Climate Change are transport, business, residential and agriculture.[92] Based on the Welsh Government's methodology, direct emissions included are those from all sectors except those from the power sector and energy-intensive industries in the EUETS, while the indirect emissions included are those from electricity use.[93]

At present it is not possible to measure progress against the 2006-10 baseline as figures for greenhouse gas emissions in Wales disaggregated in this way are only currently available for 2008 and 2009. However, the Committee on Climate Change has used the figures for these two years as a basis to estimate a provisional baseline for 2006-09,[94] as an indicator of Wales' progress in reducing emissions within its devolved competence. Table 9 below shows the total greenhouse gas emissions within Wales' devolved competence for 2008 and 2009.

Table 9: Direct and indirect greenhouse gas emissions within Wales' devolved competence, by sector, 2008 and 2009 (Mt CO_2e)

	2008			2009		
Sector	Direct emissions	Indirect emissions (end-user electricity emissions)	Total emissions	Direct emissions	Indirect emissions (end-user electricity emissions)	Total emissions
Transport	6.4	0.1	6.5	6.2	0.1	6.2
Business	5.2	5.9	11.1	4.3	5.1	9.4
Residential	4.7	3.2	7.9	4.4	2.9	7.3
Agriculture and Land Use	5.1	0.3	5.4	5.1	0.2	5.3
Waste	1.0	0.0	1.0	1.0	0.0	1.0
Public Sector	0.4	0.6	1.0	0.4	0.6	0.9
Total	23.0	**10.0**	**33.0**	**21.3**	**8.9**	**30.1**

Source: AEA and Committee on Climate Change

Note:

(a) Total emissions may not be equal to the sum of direct emissions and indirect emissions due to rounding.

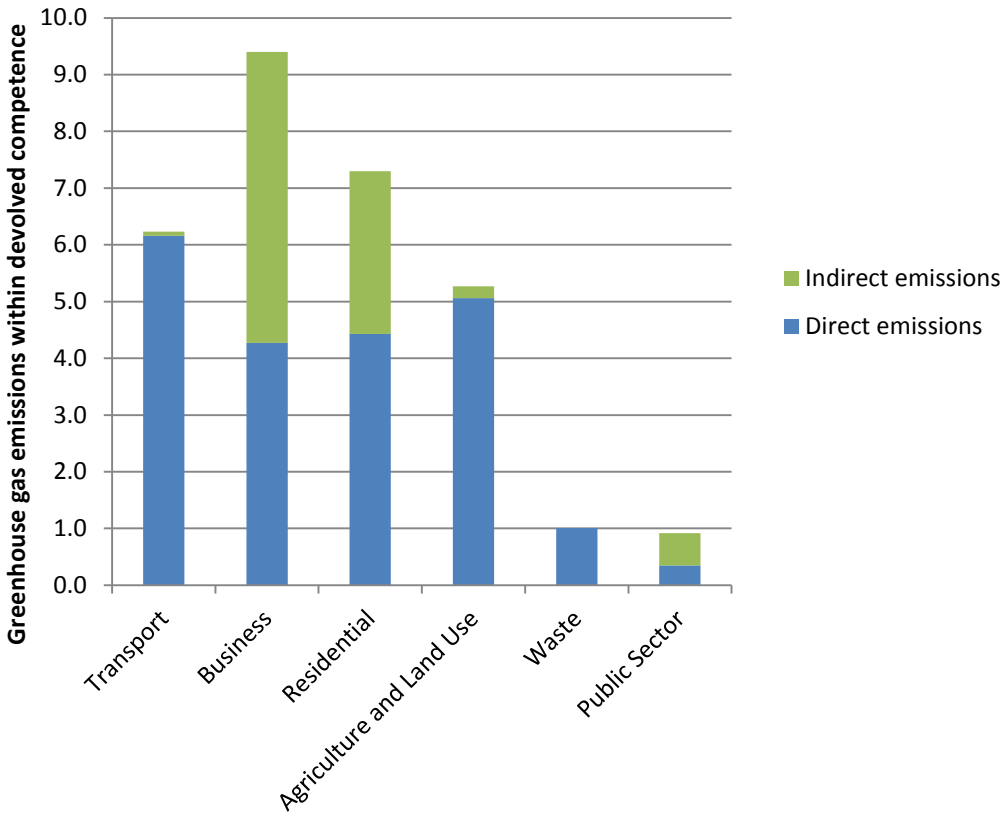
[91] Welsh Government: ***Climate Change Strategy for Wales*** page 34, October 2010 [accessed 24 October 2011]
[92] Committee on Climate Change, **Reducing emissions and preparing for climate change in Wales**, page 7, October 2011 [accessed 24 October 2011]
[93] Ibid. page 7
[94] Ibid.

As can be seen in Table 9, greenhouse gas emissions within the Welsh Government's devolved competence in 2009 were 30.1Mt. Total greenhouse gas emissions within devolved competence in 2008 were 33.0Mt, so the 2009 figure was a decrease of 8.8 per cent from the 2008 figure.

The largest source of emissions in 2009 was business, with emissions of 9.4Mt. Residential, transport and agricultural emissions were the next highest sources of greenhouse gas emissions within devolved competence. It can also be seen that around 70 per cent of emissions were direct emissions, and approximately 30 per cent of emissions were electricity related 'end-user' emissions. Figure 11 shows the distribution of greenhouse gas emissions in devolved areas in 2009 by sector.

It should be noted that Figures 11 and 12 cannot be compared to the graphs in section 3.2 of this paper as the figures in section 3.2 are calculated using the 'production' approach whereas the data used in Figures 11 and 12 were calculated by the Committee on Climate Change using a combination of the 'production' and 'end-user' methods.

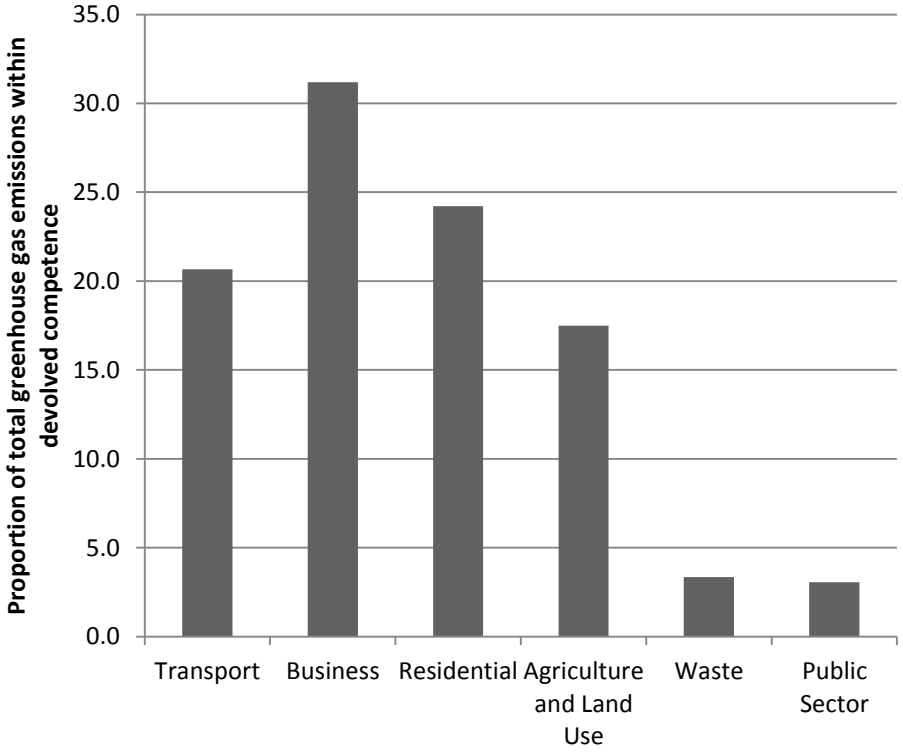
Figure 11: Total greenhouse gas emissions within devolved competence by sector, 2009 (Mt CO_2e)



Source: AEA and Committee on Climate Change

Figure 12 shows the proportion of total greenhouse gas emissions within devolved competence by sector for 2009. It can be seen from Figure 12 that 31 per cent of total greenhouse gas emissions within devolved competence are from the business sector. The next highest sectors were the residential sector, which made up 24 per cent of emissions within devolved competence, and the transport sector which accounted for 21 per cent of emissions.

Figure 12: Percentage of total greenhouse gas emissions in Wales within devolved competence by sector, 2009



Source: AEA, Committee on Climate Change and Research Service calculations

3.5. Comparison of changes in production and 'end-user' emissions

Comparing the different levels of emissions for each of the UK countries using the production and 'end-user' approaches shows the difference between energy production and energy consumption patterns. Table 10 provides a summary of the changes in levels of carbon dioxide, methane and total greenhouse gas emissions between 1990 and 2009 for each of the UK countries for the production and 'end-user' approaches.

Table 10: Changes in emissions levels for Wales and the other UK countries from base year (1990 or 1995) using production and 'end-user' approaches, base year to 2009 (Mt CO_2e)

Percentage change in emissions from base year to 2009

Country	Gas	Production approach	End-user approach including exports	End-user approach excluding exports
Wales	Carbon Dioxide	-19.3	-27.2	-29.3
	Methane	-45.7	-52.5	-52.7
	Total Greenhouse Gases	-23.3	-30.6	-32.3
England	Carbon Dioxide	-19.8	-17.9	-19.1
	Methane	-65.2	-63.7	-64.0
	Total Greenhouse Gases	-29.5	-27.7	-28.7
Scotland	Carbon Dioxide	-27.3	-32.3	-33.1
	Methane	-51.8	-55.6	-55.7
	Total Greenhouse Gases	-30.5	-35.0	-35.7
Northern Ireland	Carbon Dioxide	-18.0	-10.8	-12.0
	Methane	-29.6	-34.8	-34.9
	Total Greenhouse Gases	-20.3	-16.8	-17.6
United Kingdom	Carbon Dioxide	-19.7	-19.7	-20.9
	Methane	-60.5	-60.5	-60.9
	Total Greenhouse Gases	-28.3	-28.3	-29.3

Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, page 134, September 2011 [accessed 20 January 2012]

As can be seen from Table 10, there are variations between the UK countries in whether they have higher levels of emissions reductions according to the production or 'end-user' approach. The 2009 AEA report states that:

> Wales has a smaller share of end user emissions compared to the by source estimates, and on the basis of end user emissions has achieved much higher emissions reductions since the Base Year than the by source inventories indicate.[95]

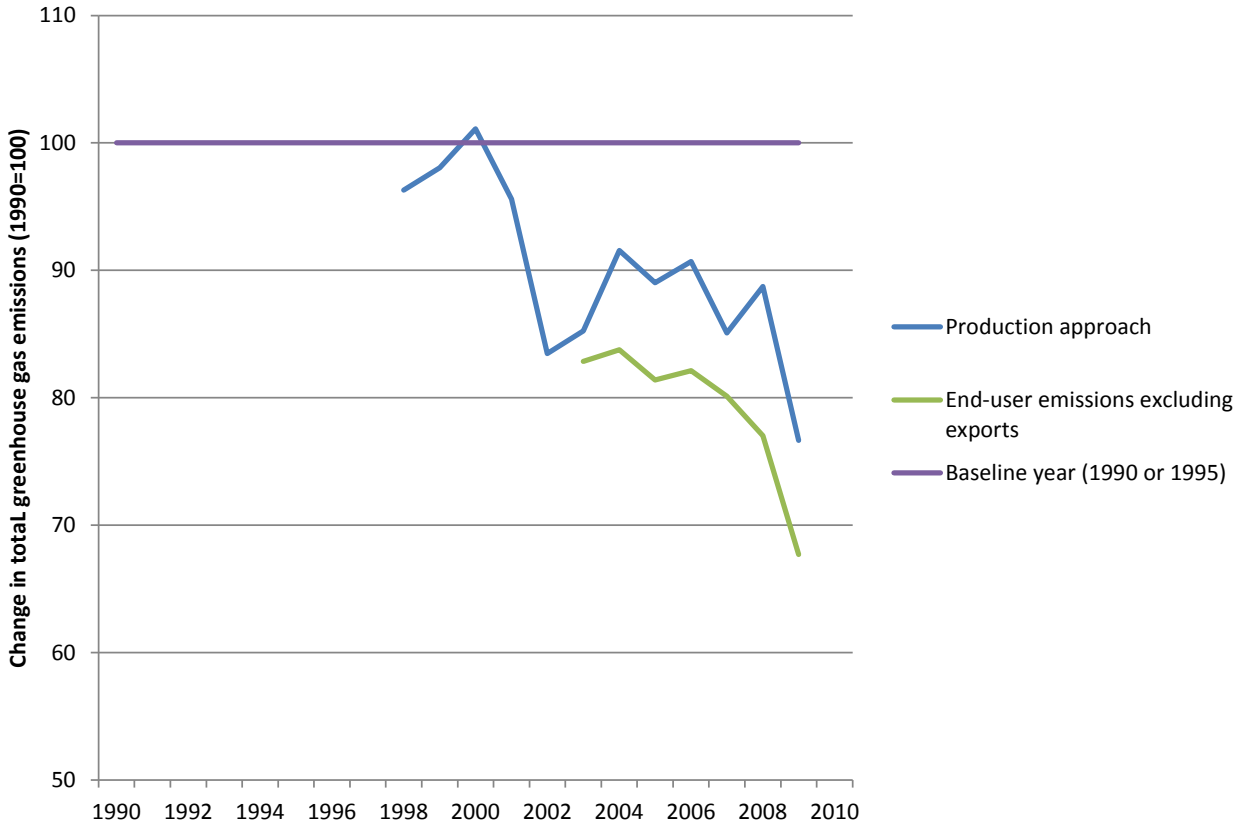
The underlying reason for this is that Wales is a net exporter of electricity to England and has a high percentage share of oil and solid fuel process industries, namely refineries and collieries.[96]

[95] AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, page 133, September 2011 [accessed 20 January 2012]

Of the other UK countries, Scotland has also achieved higher emissions reductions on the 'end-user' basis as it exports electricity to England and Northern Ireland, and has a number of major gas and oil terminals, and also the Grangemouth refinery. England and Northern Ireland both have higher levels of emissions reductions on a production basis compared to 'end-user' emissions, which indicates that both countries consume more fuel or electricity than they produce.[97]

Figure 13 provides an index of the trends of total greenhouse gas emissions levels for Wales for the production and 'end-user' methods of measuring emissions.

Figure 13: Trends in greenhouse gas emissions levels for Wales from base year (1990 or 1995) using production and 'end-user' approaches, 1990 to 2009 (Mt CO_2e)



Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, September 2011

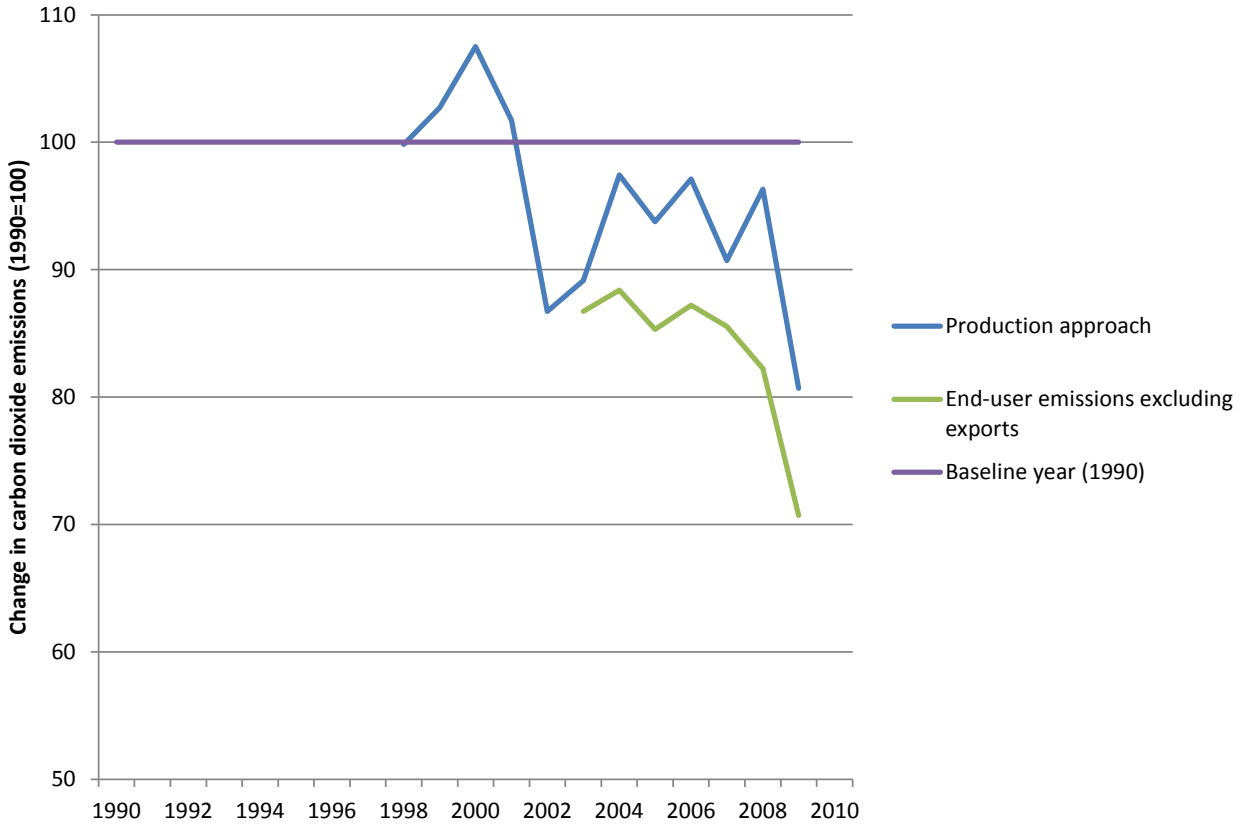
(a) For greenhouse gas emissions calculated using the production approach, prior to 1998, data is only available for 1990 and 1995; therefore these years have not been included on the trend lines.

(b) For greenhouse gas emissions calculated using the 'end-user' approach, prior to 2003, data is only available for 1990; therefore this year has not been included on the trend lines.

[96] Ibid. page 133
[97] Ibid. page 133

Figure 14 provides an index of the trends of carbon dioxide emissions levels for Wales for the production and 'end-user' methods of measuring emissions.

Figure 14: Trends in carbon dioxide emissions levels for Wales from base year (1990) using production and 'end-user' approaches, 1990 to 2009 (Mt CO_2)



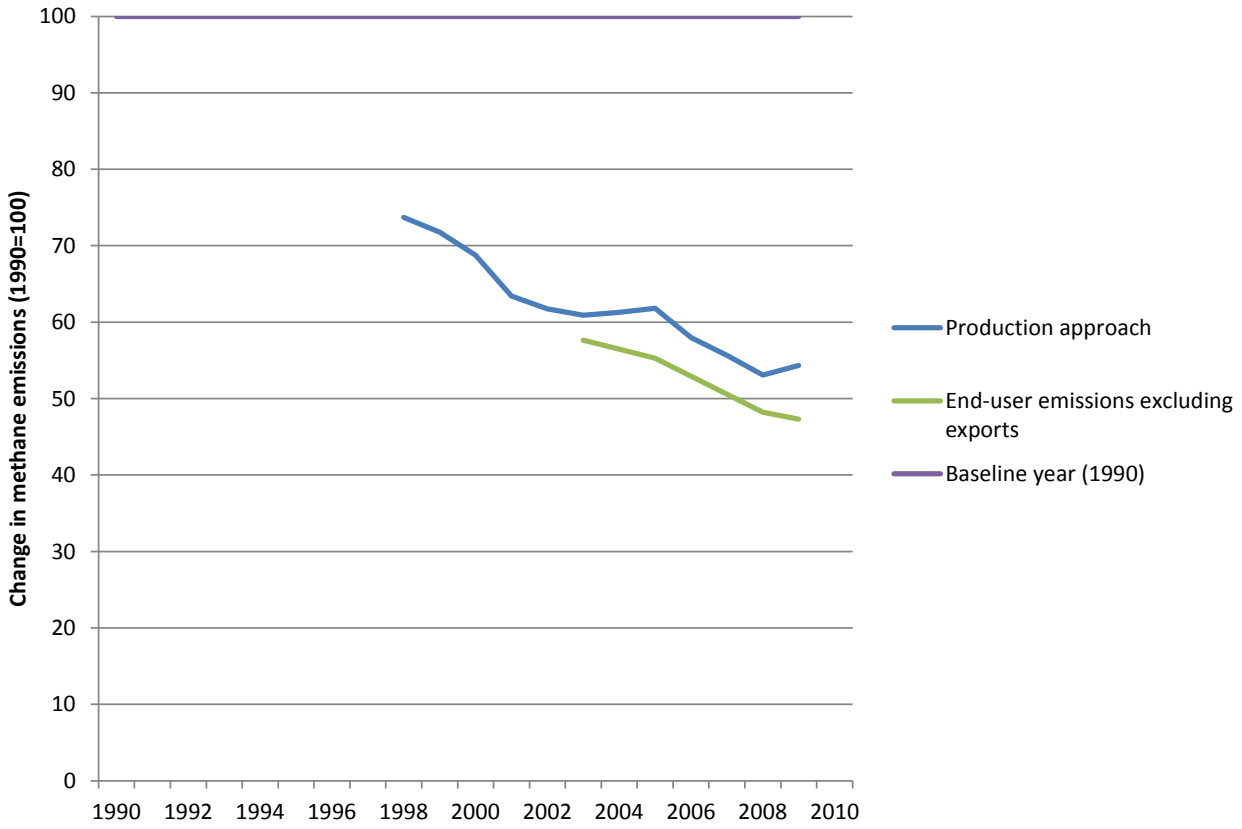
Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, September 2011

(a) For carbon dioxide emissions calculated using the production approach, prior to 1998, data is only available for 1990 and 1995; therefore these years have not been included on the trend lines.

(b) For carbon dioxide emissions calculated using the 'end-user' approach, prior to 2003, data is only available for 1990; therefore this year has not been included on the trend lines.

Figure 15 provides an index of the trends in methane emissions levels for Wales for the production and 'end-user' methods of measuring emissions.

Figure 15: Trends in methane emissions levels for Wales from base year (1990) using production and 'end-user' approaches, 1990 to 2009 (Mt CO_2e)



Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, September 2011

(a) For methane emissions calculated using the production approach, prior to 1998, data is only available for 1990 and 1995; therefore these years have not been included on the trend lines.

(b) For methane emissions calculated using the 'end-user' approach, prior to 2003, data is only available for 1990; therefore this year has not been included on the trend lines.

3.6. Local authority carbon dioxide emissions

Figures at a local authority level are available for carbon dioxide emissions, both for all emissions within local authorities and for emissions that are within the scope of local authorities' influence. This paper includes both sets of figures to provide further detail on carbon dioxide emissions within local authorities.

3.6.1. Total carbon dioxide emissions within local authorities

The principal methodology for allocating emissions to local authorities allocates emissions on an 'end user' basis. As explained in Section 3 above, 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.

The values arising from this methodology give an idea of geographical use, rather than production, so it is useful in informing about emissions from use of energy in local authority areas. Detailed carbon dioxide emissions for 2009 by sector, and local authority are shown in table 11. Figures were first collected by the UK Government's Department for Energy and Climate Change (DECC) in 2005. Figure 16 shows the percentage change in total carbon dioxide emissions between 2005 and 2009, by local authority.

The Wales figure for total 'end-user' carbon dioxide emissions in table 11 (28.4Mt) differs from the figure in table 7 (29.8Mt) as there are a number of methodological differences in how the two datasets are assembled. Additionally, some sectors are excluded from the figures in table 11, including domestic shipping, domestic aviation, military transport and international shipping and aviation.[98]

[98] DECC, **Local and regional CO2 emissions for 2005-2009 (full dataset) – Wales reconciliation**, September 2011 [accessed 20 January 2012]

Table 11: Carbon dioxide emissions by sector and local authority, 2009 (kt CO_2)

Local Authority	Industry & Commercial	Domestic	Road Transport	LULUCF (b)	Total	Welsh rank /22 (of total emissions)	UK rank /434 (of total emissions)
Isle of Anglesey	309	205	131	29	674	17	315
Gwynedd	257	324	272	-91	762	15	281
Conwy	173	272	267	-5	707	16	304
Denbighshire	192	229	195	9	625	18	334
Flintshire	1,124	412	385	1	1,922	3	67
Wrexham	813	310	217	6	1,346	8	126
Powys	374	388	336	-139	959	13	203
Ceredigion	221	214	158	14	607	20	344
Pembrokeshire	597	327	228	21	1,172	10	146
Carmarthenshire	556	481	429	16	1,482	4	105
Swansea	522	520	375	7	1,423	6	114
Neath Port Talbot	5,523	303	285	-13	6,098	1	13
Bridgend	493	287	291	12	1,083	11	171
Vale of Glamorgan	755	268	222	11	1,256	9	135
Cardiff	970	647	653	2	2,271	2	60
Rhondda Cynon Taf	530	502	452	-18	1,467	5	106
Merthyr Tydfil	118	129	90	2	340	22	417
Caerphilly	374	371	251	-2	994	12	194
Blaenau Gwent	208	157	80	1	447	21	399
Torfaen	286	185	141	-2	609	19	342
Monmouthshire	248	216	345	-33	776	14	273
Newport	652	287	440	-4	1,375	7	124
Wales	**15,295**	**7,034**	**6,243**	**-178**	**28,393**	**..**	**..**

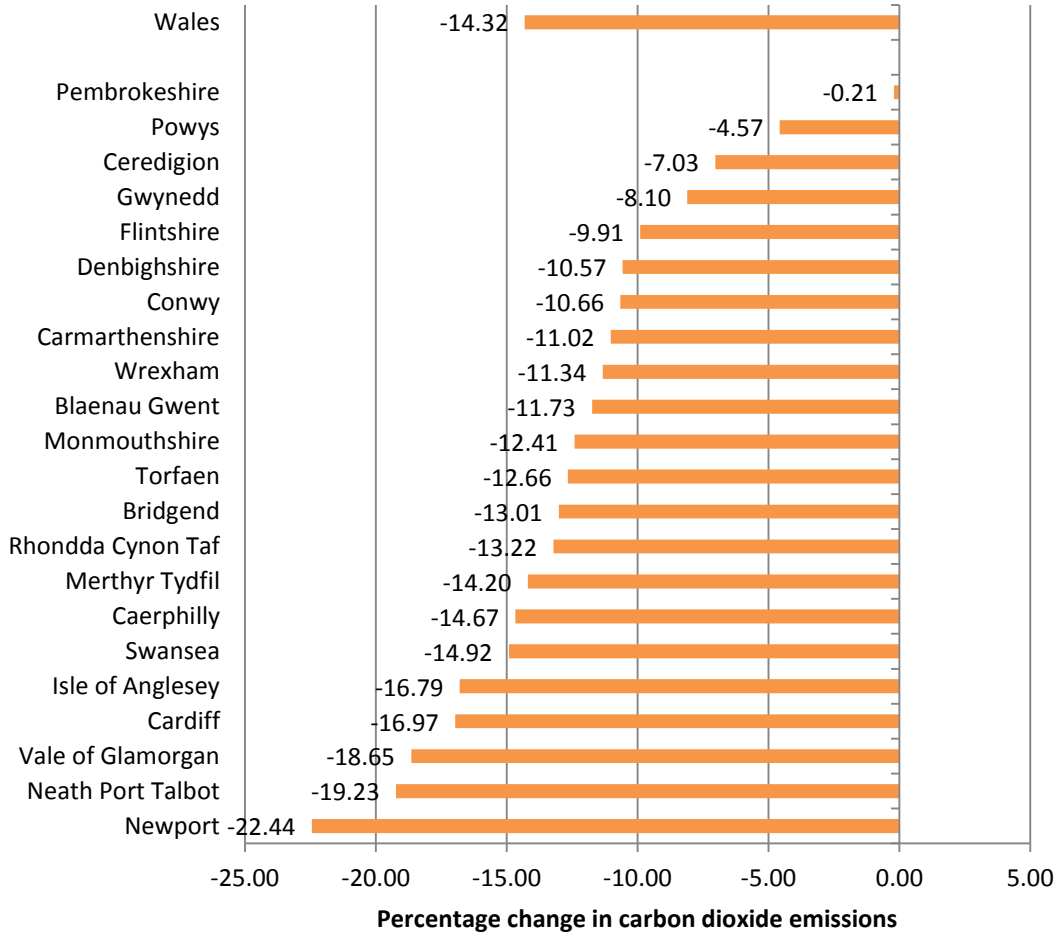
Source: DECC, Local and regional CO2 emissions for 2005-2009 (full dataset), (Summary tab), September 2011 and Research Service calculations.
(a) Different methodologies have been used from previous AEA publications; therefore comparisons cannot be made with previous papers.
(b) LULUCF – Land use, land use change and forestry.

Figure 17 shows the ranking of emissions levels of Welsh local authorities in comparison to all local authorities in the UK.

The following observations can be made from table 11 and figures 16 and 17:

- The local authority with the highest carbon dioxide emissions in 2009 was **Neath Port Talbot** (the main contributor to this is the Tata Steelworks in Port Talbot), although it reduced its emissions by 19.2 per cent between 2005 and 2009, the second most of the Welsh local authorities;
- Industrial and commercial emissions accounted for 54 per cent of all carbon dioxide emissions in Wales in 2009;
- All Welsh local authorities reduced their carbon dioxide emissions between 2005 and 2009. **Newport** reduced their emissions by the most (22.4 per cent), while **Pembrokeshire** reduced its emissions by the least (0.2 per cent); and
- Of the 434 local authorities in the UK, **Neath Port Talbot** had the 13th highest emissions in 2009. **Merthyr Tydfil** (with the lowest emissions in Wales) had the 417th highest carbon dioxide emissions of UK local authorities.

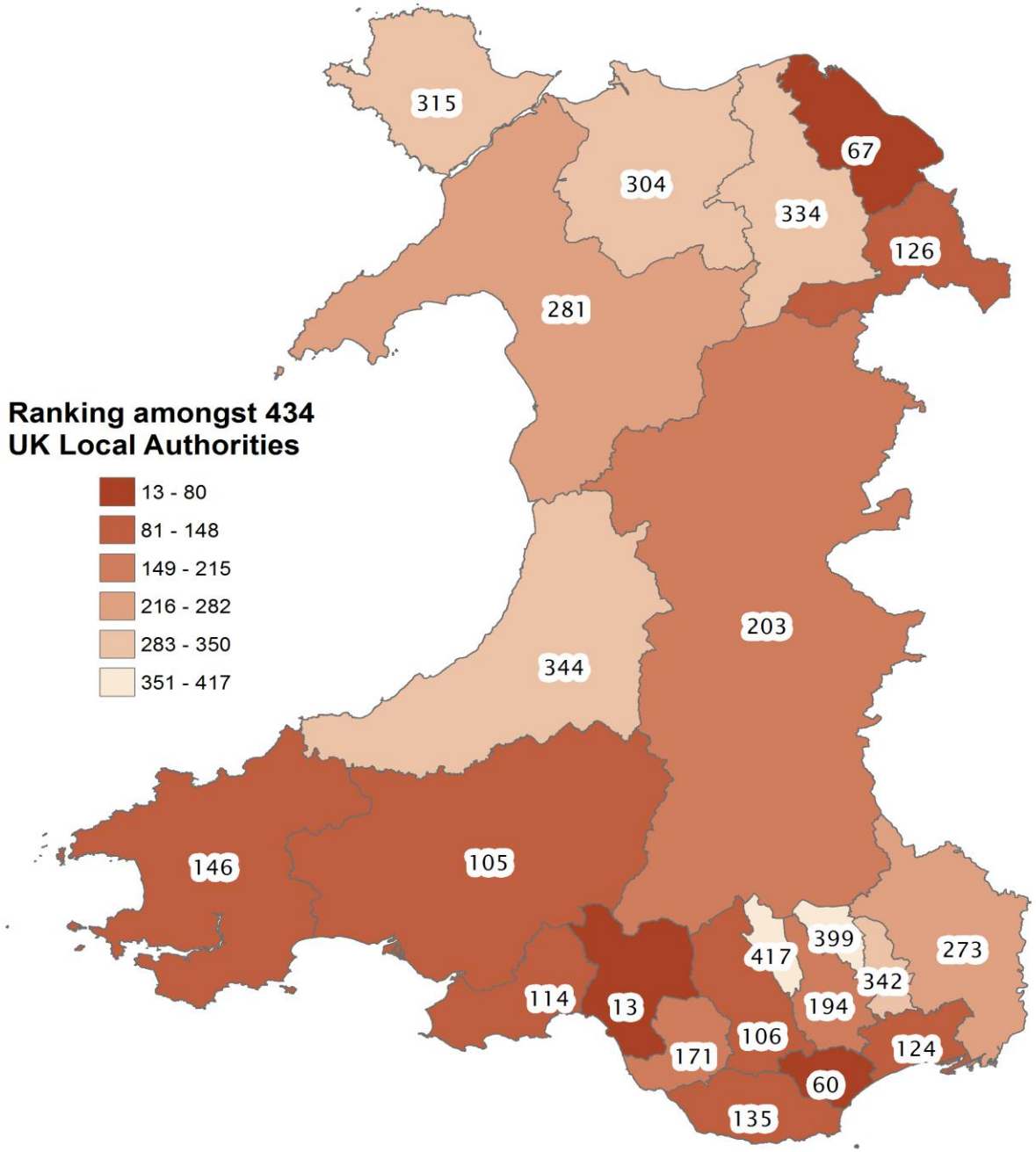
Figure 16: Percentage change in carbon dioxide emissions between 2005 and 2009, by Welsh local authority



Source: DECC, **Local and regional CO2 emissions for 2005-2009 (full dataset),** (Summary tab), September 2011 and Research Service calculations

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

Figure 17: Ranking of carbon dioxide emissions in comparison to UK local authorities, by Welsh local authority, 2009



Source: Research Service

Per capita emissions provide an indication of the level of emissions in comparison with the population size of a local authority. Table 12 provides carbon dioxide emissions per capita in 2009 by sector, while figure 18 highlights the geographical differences of the total emissions per capita.

The following observations can be made from table 12 and figure 18:

- The highest emissions per capita were in **Neath Port Talbot** (44.4 tonnes per capita), while **Caerphilly** had the lowest (5.8 tonnes per capita). (The main contributor to the high Neath Port Talbot figure is the Tata steelworks in Port Talbot).
- The contribution of the Tata steelworks to the **Neath Port Talbot** figure is also reflected in its industry and commercial carbon dioxide emissions, which at 40.2 tonnes per capita are the highest in Wales. **Conwy** had the lowest industrial and commercial emissions, 1.6 tonnes per capita.
- There is little difference between domestic carbon dioxide emissions across Wales, ranging from 1.9 to 3.0 tonnes per capita. **Cardiff** had the lowest domestic emissions, while the **Isle of Anglesey** had the highest.
- **Monmouthshire** had the highest road transport emissions per capita, at 3.9 tonnes per capita, while **Blaenau Gwent** had the lowest, 1.2 tonnes per capita.
- 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.

Table 12: Carbon dioxide emissions per capita[a], by sector in Wales, 2009 (tonnes per capita)

Local Authority	Industry & Commercial	Domestic	Road Transport	LULUCF (b)	Total
Isle of Anglesey	4.5	3.0	1.9	0.4	9.8
Gwynedd	2.2	2.7	2.3	-0.8	6.4
Conwy	1.6	2.4	2.4	0.0	6.3
Denbighshire	2.0	2.4	2.0	0.1	6.5
Flintshire	7.5	2.7	2.6	0.0	12.8
Wrexham	6.1	2.3	1.6	0.0	10.1
Powys	2.8	2.9	2.5	-1.1	7.3
Ceredigion	2.9	2.8	2.1	0.2	7.9
Pembrokeshire	5.1	2.8	1.9	0.2	10.0
Carmarthenshire	3.1	2.7	2.4	0.1	8.2
Swansea	2.3	2.2	1.6	0.0	6.2
Neath Port Talbot	40.2	2.2	2.1	-0.1	44.4
Bridgend	3.7	2.1	2.2	0.1	8.1
Vale of Glamorgan	6.1	2.2	1.8	0.1	10.1
Cardiff	2.9	1.9	1.9	0.0	6.8
Rhondda Cynon Taf	2.3	2.1	1.9	-0.1	6.3
Merthyr Tydfil	2.1	2.3	1.6	0.0	6.1
Caerphilly	2.2	2.1	1.5	0.0	5.8
Blaenau Gwent	3.0	2.3	1.2	0.0	6.5
Torfaen	3.2	2.0	1.6	0.0	6.7
Monmouthshire	2.8	2.5	3.9	-0.4	8.8
Newport	4.6	2.0	3.1	0.0	9.8
Wales	**5.1**	**2.3**	**2.1**	**-0.1**	**9.5**

Source: DECC, **Local and regional CO2 emissions for 2005-2009 (full dataset),** (Summary tab), September 2011 and Research Service calculations

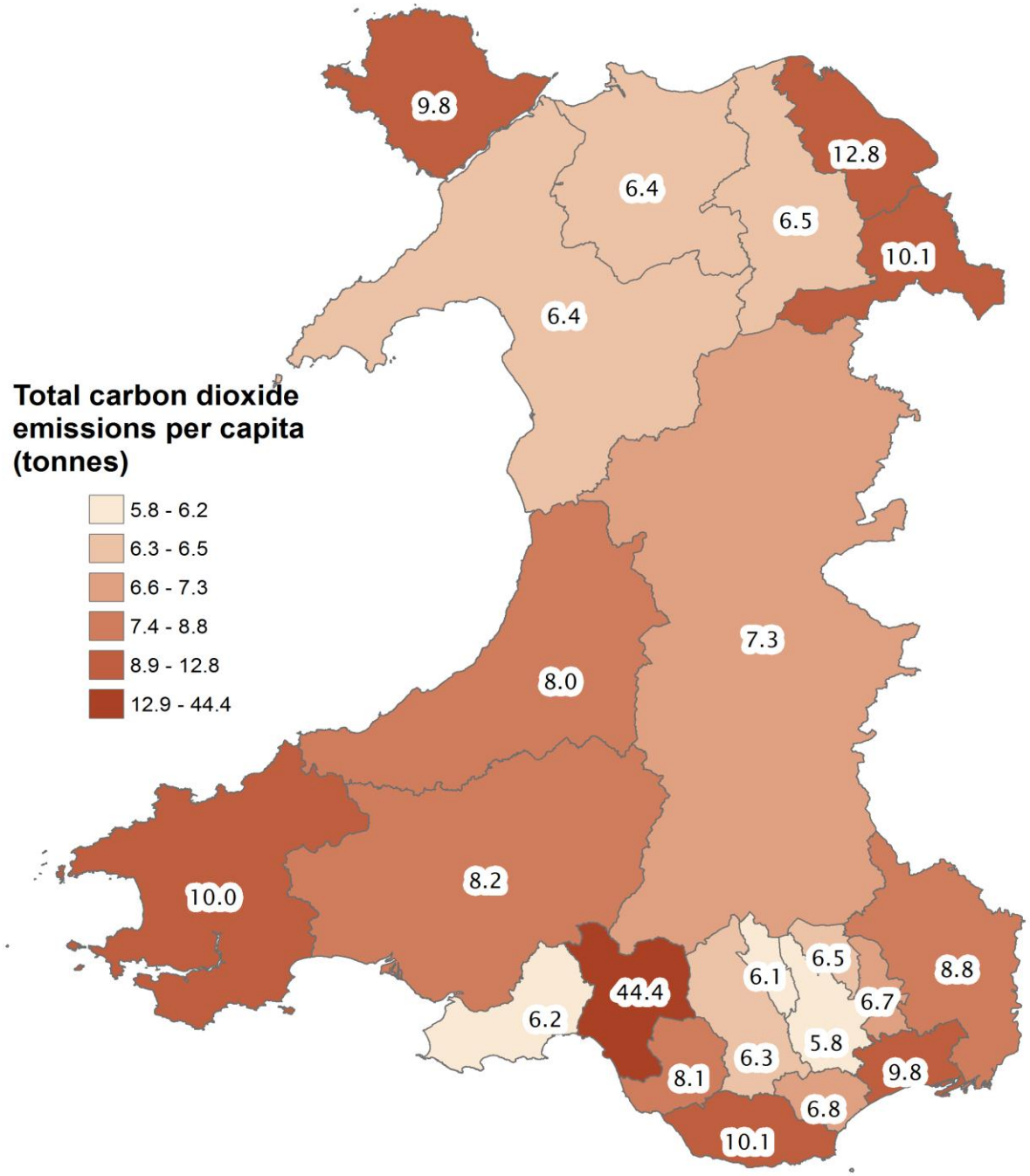
(a) LULUCF – Land use, land use change and forestry

(b) Total may not add up to the sum of the sectors due to rounding.

Notes:

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

Figure 18: Total carbon dioxide emissions per capita, by Welsh local authority, 2009



Source: Research Service

3.6.2. Carbon dioxide emissions that local authorities can influence

DECC also collates a dataset which represents the level of carbon dioxide emissions that local authorities are directly able to influence. This excludes a number of types of emissions that it deems are not within the scope local authorities' influence. These are:

- Motorways – all emissions from the "Road transport (motorways)" sector have been removed;
- EU Emissions trading schemes sites – these emissions have been removed from the "Large industrial installations" sector, with the exception of energy suppliers (e.g. power stations), whose emissions are indirectly included via the end-user estimates for electricity use. Note that not all the emissions from the "Large industrial installations" sector are produced by EU ETS installations, hence the fact that there are emissions remaining in this sector in the subset;
- Diesel railways – all emissions from the "Diesel Railways" sector have been excluded;
- Land Use, Land Use Change, and Forestry – all emissions belonging to the "LULUCF Net emissions" sector have been excluded from the main dataset.[99]

Figures for carbon dioxide emissions within the scope of local authorities for 2009 by sector, and local authority are shown in table 13. Figures were first collected by DECC in 2005. Figure 19 shows the percentage change in carbon dioxide emissions within the scope of local authorities between 2005 and 2009, by local authority.

[99] DECC, **Local Authority CO2 emissions estimates 2009: Statistical Summary and UK maps**, pages 18-19, 15 September 2011 [accessed 20 January 2012]

Table 13: Carbon dioxide emissions within the scope of local authorities by sector and local authority, 2009 (kt CO_2)

Local Authority	Industry & Commercial	Domestic	Road Transport	Total	Welsh rank /22 (of total emissions)	UK rank /434 (of total emissions)
Isle of Anglesey	305	205	131	641	17	294
Gwynedd	254	324	272	849	13	209
Conwy	167	272	267	706	15	265
Denbighshire	190	229	195	614	18	306
Flintshire	742	412	385	1,540	2	77
Wrexham	810	310	217	1,337	5	100
Powys	371	388	336	1,094	10	139
Ceredigion	193	214	158	566	20	332
Pembrokeshire	583	327	228	1,138	8	133
Carmarthenshire	512	481	407	1,400	4	93
Swansea	518	520	291	1,329	6	101
Neath Port Talbot	668	303	175	1,146	7	129
Bridgend	412	287	181	880	12	194
Vale of Glamorgan	340	268	189	798	14	231
Cardiff	943	647	538	2,128	1	51
Rhondda Cynon Taf	521	502	382	1,405	3	91
Merthyr Tydfil	118	129	90	337	22	418
Caerphilly	372	371	251	994	11	165
Blaenau Gwent	208	157	80	445	21	396
Torfaen	281	185	141	606	19	311
Monmouthshire	236	216	251	703	16	268
Newport	610	287	224	1,121	9	134
Wales	**9,355**	**7,034**	**5,388**	**21,777**	..	..

Source: DECC, **Emissions within the scope of influence of Local Authorities for 2005-09,** (Subset summary tab), September 2011 and Research Service calculations.

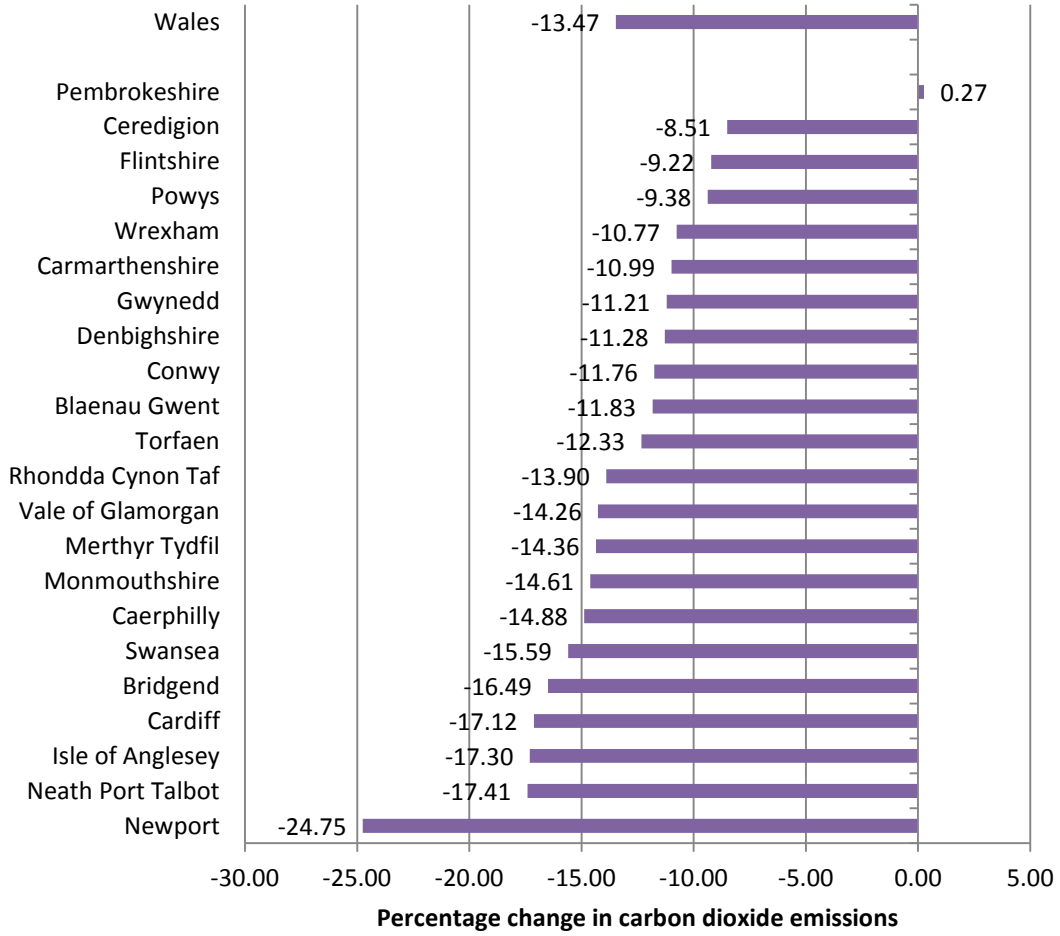
Figure 20 shows the ranking of emissions levels within the scope of local authorities of the Welsh local authorities in comparison to all local authorities in the UK.

The following observations can be made from table 13 and figures 19 and 20:

- The local authority with the highest carbon dioxide emissions within its scope of influence in 2009 was **Cardiff**, although it reduced its emissions by 17.1 per cent between 2005 and 2009, the fourth most of the Welsh local authorities;
- When only emissions within the scope of local authorities are considered, the industrial and commercial emissions of **Neath Port Talbot, the Vale of Glamorgan and Flintshire** decreased considerably from the figures shown in Table 11. This is mainly due to the exclusion of the EUETS sites from emissions within the scope of local authorities as the majority of the top 13 Welsh emitters in the EUETS scheme are situated within these three local authorities.

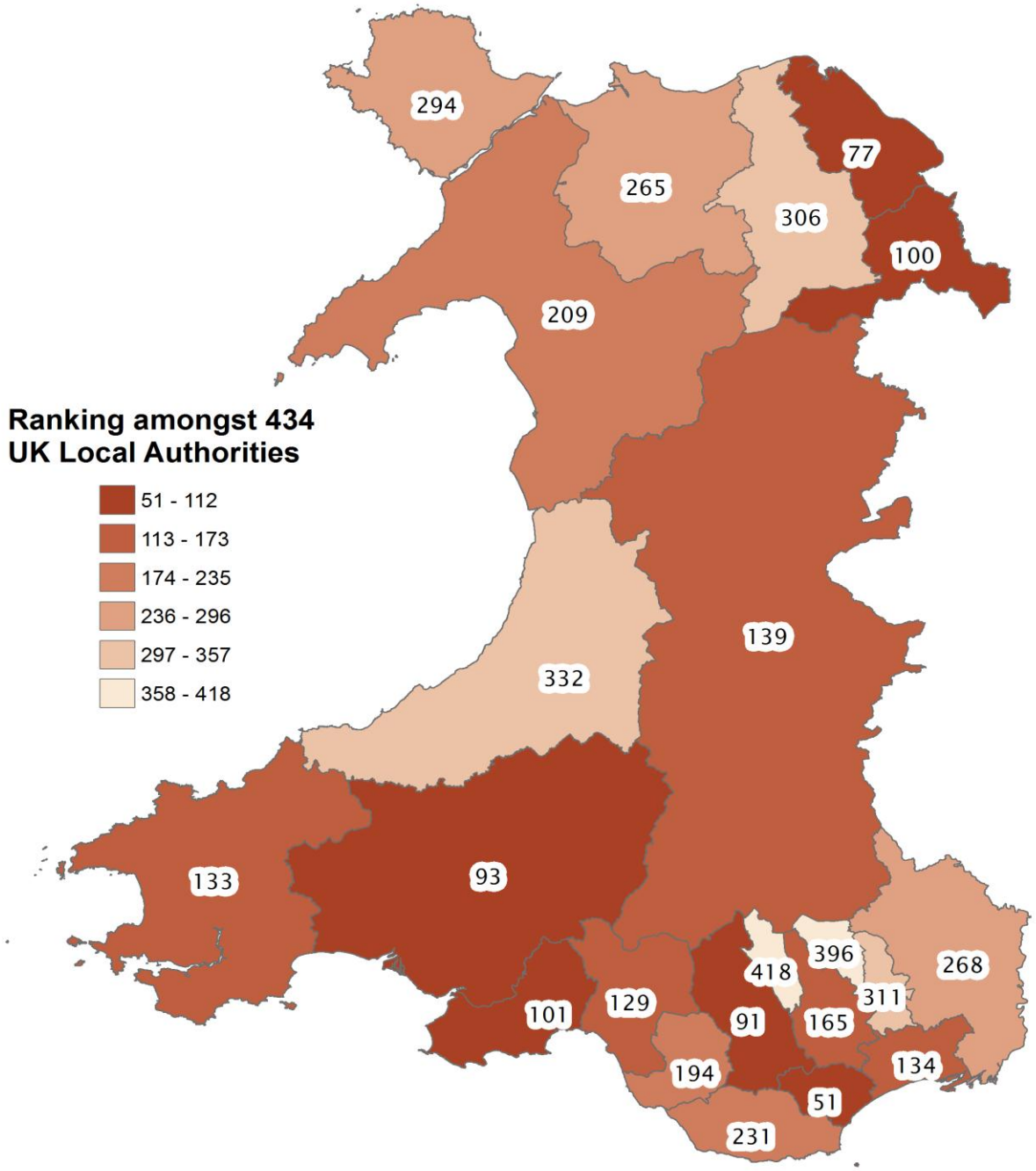
- Industrial and commercial emissions accounted for 43 per cent of all carbon dioxide emissions within the scope of influence of local authorities in Wales in 2009;
- **All Welsh local authorities except Pembrokeshire** reduced the carbon dioxide emissions within the scope of their influence between 2005 and 2009. **Newport** reduced their emissions by the most (24.8 per cent), while **Pembrokeshire's** emissions increased by 0.3 per cent; and
- Of the 434 local authorities in the UK, **Cardiff** had the 51st highest emissions within the scope of its influence in 2009. **Merthyr Tydfil** (with the lowest emissions in Wales) had the 418th highest carbon dioxide emissions of UK local authorities.

Figure 19: Percentage change in carbon dioxide emissions within the scope of influence of local authorities between 2005 and 2009, by Welsh local authority



Source: DECC, Emissions within the scope of influence of Local Authorities for 2005-09, (Subset summary tab), September 2011 and Research Service calculations.

Figure 20: Ranking of carbon dioxide emissions within the scope of local authorities' influence in comparison to UK local authorities, by Welsh local authority, 2009



Source: Research Service

Per capita emissions provide an indication of the level of emissions in comparison with the population size of a local authority. Table 14 provides carbon dioxide emissions per capita within the scope of local authorities in 2009 by sector, while figure 21 highlights the geographical differences of emissions per capita.

The following observations can be made from table 14 and figure 21:

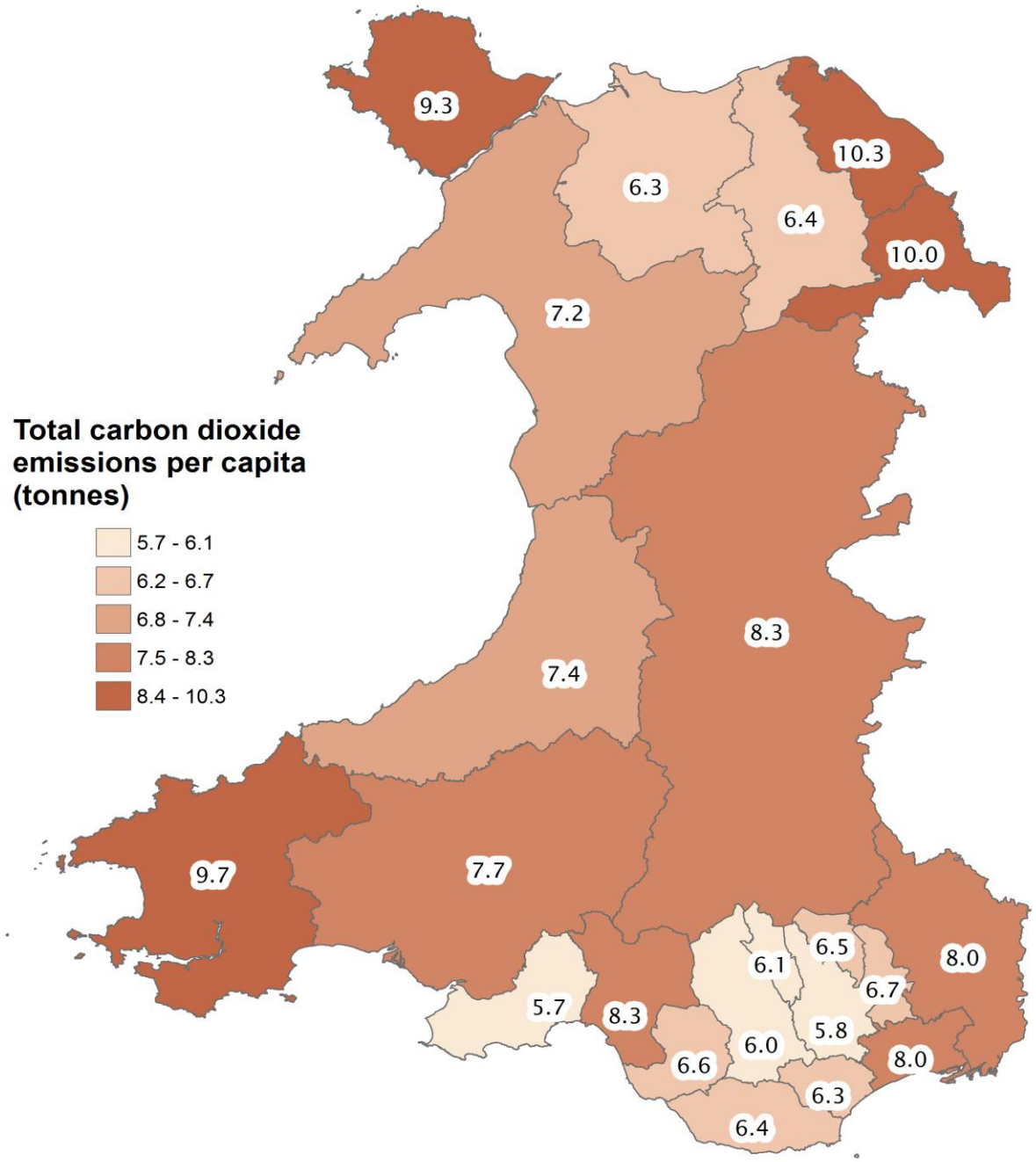
- The highest emissions per capita were in **Flintshire** (10.3 tonnes per capita), while **Swansea** had the lowest (5.7 tonnes per capita).
- At 6.1 tonnes per capita, **Wrexham's** industrial and commercial emissions are the highest in Wales. **Conwy** had the lowest industrial and commercial emissions, 1.5 tonnes per capita.
- There is little difference between domestic carbon dioxide emissions across Wales, ranging from 1.9 to 3.0 tonnes per capita. **Cardiff** had the lowest domestic emissions, while the **Isle of Anglesey** had the highest.
- **Monmouthshire** had the highest road transport emissions per capita, at 2.8 tonnes per capita, while **Blaenau Gwent** had the lowest, 1.2 tonnes per capita.

Table 14: Carbon dioxide emissions within the scope of local authorities per capita[a], by sector in Wales, 2009 (tonnes per capita)

Local Authority	Industry & Commercial	Domestic	Road Transport	Total
Isle of Anglesey	4.4	3.0	1.9	9.3
Gwynedd	2.1	2.7	2.3	7.1
Conwy	1.5	2.4	2.4	6.3
Denbighshire	2.0	2.4	2.0	6.4
Flintshire	5.0	2.7	2.6	10.3
Wrexham	6.1	2.3	1.6	10.0
Powys	2.8	2.9	2.5	8.3
Ceredigion	2.5	2.8	2.1	7.4
Pembrokeshire	5.0	2.8	1.9	9.7
Carmarthenshire	2.8	2.7	2.3	7.7
Swansea	2.2	2.2	1.3	5.7
Neath Port Talbot	4.9	2.2	1.3	8.3
Bridgend	3.1	2.1	1.3	6.6
Vale of Glamorgan	2.7	2.2	1.5	6.4
Cardiff	2.8	1.9	1.6	6.3
Rhondda Cynon Taf	2.2	2.1	1.6	6.0
Merthyr Tydfil	2.1	2.3	1.6	6.1
Caerphilly	2.2	2.1	1.5	5.8
Blaenau Gwent	3.0	2.3	1.2	6.5
Torfaen	3.1	2.0	1.6	6.7
Monmouthshire	2.7	2.5	2.8	8.0
Newport	4.3	2.0	1.6	8.0
Wales	**3.1**	**2.3**	**1.8**	**7.3**

Source: DECC, **Emissions within the scope of influence of Local Authorities for 2005-09**, (Subset summary tab), September 2011 and Research Service calculations.

Figure 21: Total carbon dioxide emissions per capita, by Welsh local authority, 2009



Source: Research Service

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 greenhouse gas emissions at an international, European, UK and Welsh level.

- **Climate Change Commission for Wales**
- Welsh Government website on **Climate Change**
- The Welsh Government's **Wales Carbon Footprint** website
- **The Department of Energy and Climate Change** (DECC)
- **Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990 to 2009**, published by AEA
- **2009 Local Authority Carbon Dioxide figures**, published by DECC
- **Emissions within the scope of influence of Local Authorities for 2005-09**, published by DECC
- **Reducing emissions and preparing for climate change in Wales: 2011 Progress Report**, published by the Climate Change Commission
- The UK Government's **Carbon Plan**
- The UK Government's **Committee on Climate Change**
- **The Met Office Hadley Centre**
- **Tyndall Centre for Climate Change Research**
- **European Climate Change Programme**
- **UN Framework Convention on Climate Change**

Annex A: Total net greenhouse gas emissions, by country

Country	GHG emissions (Gg) 1990 (base year)	GHG emissions (Gg) 2009	Mid-2009 population (thousands)	Percentage change from base year	CO2 per capita (g per capita)
England*	618,659	435,996	51,810	-29.5	8.4
Northern Ireland*	24,483	19,508	1,789	-20.3	10.9
Scotland*	69,227	48,116	5,194	-30.5	9.3
United Kingdom (i)*	783,308	565,987	..	-27.7	..
United Kingdom (ii)*	783,110	561,785	61,811	-28.3	9.1
Wales*	55,572	42,602	2,999	-23.3	14.2
Australia	461,618	599,829	21,955	29.9	27.3
Austria	64,435	62,534	8,365	-3.0	7.5
Belarus	110,605	57,843	9,665	-47.7	6.0
Belgium	141,788	122,840	10,796	-13.4	11.4
Bulgaria	110,369	47,715	7,585	-56.8	6.3
Canada	523,777	679,734	33,720	29.8	20.2
Croatia	24,506	20,153	4,429	-17.8	4.6
Czech Republic	192,818	126,740	10,491	-34.3	12.1
Denmark	72,546	61,204	5,519	-15.6	11.1
Estonia	30,813	9,620	1,340	-68.8	7.2
Finland	55,330	25,786	5,311	-53.4	4.9
France	526,288	458,483	62,621	-12.9	7.3
Germany	1,216,727	937,262	81,902	-23.0	11.4
Greece	102,069	119,706	11,283	17.3	10.6
Hungary	111,953	63,765	10,023	-43.0	6.4
Iceland	4,544	5,326	319	17.2	16.7
Ireland	54,255	60,222	4,459	11.0	13.5
Italy	457,362	396,449	60,193	-13.3	6.6
Japan	1,196,976	1,137,690	127,558	-5.0	8.9
Latvia	11,380	-9,761	2,255	-185.8	-4.3
Liechtenstein	221	241	36	9.0	6.7
Lithuania	45,319	16,633	3,339	-63.3	5.0
Luxembourg	13,175	11,388	498	-13.6	22.9
Malta	2,008	2,806	413	39.7	6.8
Monaco	108	91	..	-15.8	..
Netherlands	214,544	201,347	16,530	-6.2	12.2
New Zealand	35,661	43,881	4,316	23.1	10.2
Norway	41,211	25,964	4,829	-37.0	5.4
Poland	553,856	346,049	38,153	-37.5	9.1
Portugal	50,098	60,566	10,632	20.9	5.7
Romania	262,755	104,178	21,470	-60.4	4.9
Russian Federation	3,449,581	1,477,756	141,909	-57.2	10.4
Slovakia	71,193	39,944	5,418	-43.9	7.4
Slovenia	12,541	10,978	2,042	-12.5	5.4
Spain	264,110	338,920	45,929	28.3	7.4
Sweden	27,814	18,430	9,299	-33.7	2.0
Switzerland	50,397	52,037	7,744	3.3	6.7
Turkey	142,159	287,120	71,897	102.0	4.0
Ukraine	863,361	354,875	46,053	-58.9	7.7
United States	5,320,257	5,618,165	307,007	5.6	18.3

Sources and notes: See Figures 1 and 2

Annex B: Carbon dioxide emissions, by country

Country	CO2 emissions (Gg) 1990 (base year)	CO2 emissions (Gg) 2009	Mid-2009 population (thousands)	Percentage change from base year	CO2 per capita (g per capita)
England	465,169	372,975	51,810	-19.8	7.2
Northern Ireland	16,532	13,561	1,789	-18.0	7.6
Scotland	50,191	36,505	5,194	-27.3	7.0
United Kingdom (i)	591,091	475,807	..	-19.5	..
United Kingdom (ii)	588,136	472,161	61,811	-19.7	7.6
Wales	43,157	34,821	2,999	-19.3	11.6
Australia	314,496	449,875	21,955	43.0	20.5
Austria	48,288	49,962	8,365	3.5	6.0
Belarus	75,207	26,752	9,665	-64.4	2.8
Belgium	117,073	106,748	10,796	-8.8	9.9
Bulgaria	79,012	33,849	7,585	-57.2	4.5
Canada	386,740	521,489	33,720	34.8	15.5
Croatia	16,156	13,043	4,429	-19.3	2.9
Czech Republic	160,839	106,385	10,491	-33.9	10.1
Denmark	57,079	48,372	5,519	-15.3	8.8
Estonia	26,023	7,052	1,340	-72.9	5.3
Finland	41,435	14,713	5,311	-64.5	2.8
France	353,492	310,629	62,621	-12.1	5.0
Germany	1,009,739	805,959	81,902	-20.2	9.8
Greece	80,784	101,293	11,283	25.4	9.0
Hungary	82,547	47,495	10,023	-42.5	4.7
Iceland	3,201	4,152	319	29.7	13.0
Ireland	31,801	40,198	4,459	26.4	9.0
Italy	373,817	322,481	60,193	-13.7	5.4
Japan	1,071,520	1,073,029	127,558	0.1	8.4
Latvia	3623	-13,701	2,255	-478.2	-6.1
Liechtenstein	195	208	36	6.7	5.8
Lithuania	32,094	9,128	3,339	-71.6	2.7
Luxembourg	12,216	10,411	498	-14.8	20.9
Malta	1,790	2,450	413	36.9	5.9
Monaco	105	85	..	-19.0	..
Netherlands	161,961	172,298	16,530	6.4	10.4
New Zealand	1,489	6,699	4,316	349.9	1.6
Norway	26,231	17,499	4,829	-33.3	3.6
Poland	458,866	274,205	38,153	-40.2	7.2
Portugal	34,290	42,000	10,632	22.5	4.0
Romania	171,560	61,588	21,470	-64.1	2.9
Russian Federation	2,559,988	855,148	141,909	-66.6	6.0
Slovakia	59,786	31,573	5,418	-47.2	5.8
Slovenia	8,598	7,553	2,042	-12.1	3.7
Spain	206,567	268,246	45,929	29.9	5.8
Sweden	11,843	4,852	9,299	-59.0	0.5
Switzerland	41,956	44,046	7,744	5.0	5.7
Turkey	96,492	216,578	71,897	124.5	3.0
Ukraine	651,367	258,484	46,053	-60.3	5.6
United States	4,238,184	4,490,130	307,007	5.9	14.6

Sources and notes: See figures 3 and 4

Annex C: Methane emissions, by country

Country	CH4 emissions (Gg) 1990 (base year)	CH4 emissions (Gg) 2009	Mid-2009 population (thousands)	Percentage change from base year	CH4 per capita (g per capita)
England	83,811	29,194	51,810	-65.2	0.6
Northern Ireland	4,445	3,130	1,789	-29.6	1.7
Scotland	11,784	5,676	5,194	-51.8	1.1
United Kingdom (i)	110,608	43,837	..	-60.4	..
United Kingdom (ii)	110,125	43,448	61,811	-60.5	0.7
Wales	8,230	4,471	2,999	-45.7	1.5
Australia	120,902	115,802	21,955	-4.2	5.3
Austria	8,305	5,666	8,365	-31.8	0.7
Belarus	15,224	14,978	9,665	-1.6	1.5
Belgium	10,027	6,452	10,796	-35.7	0.6
Bulgaria	16,351	8,765	7,585	-46.4	1.2
Canada	75,305	98,105	33,720	30.3	2.9
Croatia	3,461	3,463	4,429	0.0	0.8
Czech Republic	18,565	11,246	10,491	-39.4	1.1
Denmark	5,714	5,864	5,519	2.6	1.1
Estonia	2,827	1,405	1,340	-50.3	1.0
Finland	6,349	4,309	5,311	-32.1	0.8
France	68,108	67,243	62,621	-1.3	1.1
Germany	107,293	48,799	81,902	-54.5	0.6
Greece	9,827	8,832	11,283	-10.1	0.8
Hungary	12,228	8,408	10,023	-31.2	0.8
Iceland	464	487	319	4.8	1.5
Ireland	13,590	12,178	4,459	-10.4	2.7
Italy	43,671	37,352	60,193	-14.5	0.6
Japan	31,910	20,717	127,558	-35.1	0.2
Latvia	3,779	1,978	2,255	-47.7	0.9
Liechtenstein	13	15	36	9.5	0.4
Lithuania	6,370	3,624	3,339	-43.1	1.1
Luxembourg	467	448	498	-4.0	0.9
Malta	167	269	413	61.2	0.7
Monaco	0.66	0.57	..	-12.8	..
Netherlands	25,539	16,922	16,530	-33.7	1.0
New Zealand	25,354	26,191	4,316	3.3	6.1
Norway	4,667	4,262	4,829	-8.7	0.9
Poland	54,133	37,076	38,153	-31.5	1.0
Portugal	10,188	12,809	10,632	25.7	1.2
Romania	47,907	23,995	21,470	-49.9	1.1
Russian Federation	619,736	487,693	141,909	-21.3	3.4
Slovakia	4,828	4,372	5,418	-9.4	0.8
Slovenia	2,263	2,020	2,042	-10.7	1.0
Spain	26,491	36,449	45,929	37.6	0.8
Sweden	7,067	5,369	9,299	-24.0	0.6
Switzerland	4,705	3,823	7,744	-18.7	0.5
Turkey	33,498	54,368	71,897	62.3	0.8
Ukraine	151,013	68,345	46,053	-54.7	1.5
United States	674,858	686,271	307,007	1.7	2.2

Sources and notes: See figures 5 and 6

Annex D: Total net greenhouse gas and carbon dioxide emissions in Wales in 2009, by sector

Sector	Total net greenhouse gas emissions (Mt)	Percentage of total net greenhouse gas emissions	Carbon dioxide emissions (Mt)	Percentage of carbon dioxide emissions
Agriculture	5.3	12.5	0.5	1.4
Business	8.1	19.0	7.6	21.9
Energy Supply	16.1	37.7	15.0	43.0
Industrial Process	1.4	3.3	1.3	3.9
Land use change	-0.3	-0.6	-0.3	-0.9
Public	0.4	0.9	0.4	1.1
Residential	4.4	10.4	4.2	12.1
Transport	6.2	14.5	6.1	17.5
Waste Management	1.0	2.4	0.0	0.0
Total	**42.6**	**100.0**	**34.8**	**100.0**

Source: AEA, Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2009, September 2011 [accessed 20 January 2012]