

GERMANY



Country at a glance

- Population: 82.3 million (2010) [1]
- Total area: 357,022 sq. km [2]
- Carbon emissions per capita: 9.25 metric tons (2010) [3]
- Energy consumption per capita: 46.4 MWh (2010) [4]
- Percentage of global carbon emissions: 2.52% (2010) [3]



Audi Turbocharged Diesel-Electric Hybrid Racing Car in Germany

With their diesel hybrids, Audi won the 2012 and 2011 Le Mans 24 hour car races in France. This race is often used as the test bed and demonstrator of advanced automotive technology. German Audi here shows that diesel hybrid cars can have high performance as well as excellent fuel economy.

Audi R18 TDI by Addullah ALBargan Permission Under CC BY-ND 2.0 License
www.fotopedia.com/items/flickr-6782209416

Table 1 Breakdown of energy use, electricity and heat generation, 2010

	Primary energy sourced within country		Energy imports minus exports	Primary energy used within the country ^(a)				Electricity Generation ^(b)		Heat Generation ^(c)	
	unit	ktoe		%	ktoe	ktoe	GWh	%	GWh	%	GWh
Coal, including brown coal & peat		45,125	34	31,834	77,117	896,869	23	273,554	44	47,043	33
Oil fuels		3,315	3	112,667	105,140	1,222,776	32	8,361	1	2,260	2
Natural gas		9,691	7	60,097	73,385	853,466	22	86,829	14	71,324	50
Nuclear		36,630	28	0	36,630	426,004	11	140,556	23	0	0
Hydroelectric		1,757	1	0	1,757	20,431	1	20,427	3	0	0
Biofuels and waste		29,602	23	-193	29,409	342,024	9	39,865	6	20,548	15
Solar photovoltaics		1,005	1	0	1,005	11,684	0	11,682	2	0	0
Solar thermal		447	0	0	447	5,199	0	0	0	0	0
Tide, wave and ocean		0	0	0	0	0	0	0	0	0	0
Wind		3,250	2	0	3,250	37,800	1	37,793	6	0	0
Geothermal		529	0	0	529	6,147	0	28	0	285	0
Electricity (imported)		0	0	-1,286	0	0	0	0	0	0	0
Sub total Renewables		36,589	28	-193	36,396	423,284	11	109,795	18	20,833	15
Totals		131,349	100	203,119	328,667	3,822,399	100	619,095	100	141,460	100

Source: Based on World Energy Statistics and Balances Database 2012, "World Energy Balances." © OECD/IEA, 2012.

Notes:

Standard conversion used is 1 ktoe = 11.63 GWh

(a) Sum of energy sourced within country, energy imports minus exports, international marine and aviation bunkers and stock change flows.

(b) Includes all electricity generation, including any exported.

(c) Does not include electrical heating. Includes waste heat recovery from electricity generation plants.

Table 2 Breakdown of transport fuel use, 2010

	Total transport mix	%	Domestic aviation	Road	%	Rail	Pipeline transport	Domestic navigation	Non-specified (transport)
(in ktoe)									
Oil products	48,421	91	659	47,054	94	382	0	260	66
Natural gas	232	0	0	232	0	0	0	0	0
Biofuels and waste	2,960	6	0	2,960	6	0	0	0	0
Electricity	1,436	3	0	0	0	1,436	0	0	0
Sub total	2,960	6	0	2,960	6	0	0	0	0
Renewables									
Total	53,050	100	659	50,247	100	1,818	0	260	66

Source: Based on World Energy Statistics and Balances Database 2012, "World Energy Balances." © OECD/IEA, 2012.

Stand on climate change

Germany ratified the UNFCCC on 31 May 2002 and joined the Kyoto Protocol convention on 16 February 2005 [5]. As one of the major contributors of greenhouse gases in the EU in 2009 -2010, Germany accounts for almost 25 million tonnes of the CO₂ equivalent of the total CO₂ emissions in the EU [6].

Despite being one of the main contributors to climate change, Germany has met its Kyoto target of 21% in greenhouse gas reduction. On top of that, it emitted 28% less GHG in 2009 as compared to two decades ago, thereby exceeding the proposed targets set by the EU [7].

National climate change programmes

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety is the main Governmental organization responsible for Germany's environmental and climate issues. One of Germany's targets to mitigate climate change is to reduce greenhouse gas emissions by 40% by 2020. One of the more popular policies that Germany has adopted to mitigate climate change and reduce greenhouse gas emissions is to resort to using renewable energy sources.

Electricity

In the electricity sector, renewable energy sources being used constituted around 18% of the total electricity consumption in 2010. Table 1 below shows Germany's total electricity mix for 2010.

Since 2000, renewable energy usage has been increasing steadily. As Germany aims to have renewable energy as a major constituent in the country's total energy mix by 2050, it would thus be imperative for the gross electricity consumption to expand continuously. Extrapolated targets are as follows [8]:

- 35% by 2020
- 50% by 2030
- 65% by 2040
- 80% by 2050

Proposed strategies/policies to ensure further greater use of renewable energy in electricity generation are [8]:

1. More installation of wind farms in the North and Baltic Seas and also in the western and southern areas of Germany which have windy conditions. To the north and east of Germany, old wind farms will be replaced by newer, more powerful ones.
2. Expand storage facilities to compensate for periods when there is lack of wind or sunlight. Additional incentives to build more energy storage facilities have sufficed after a recent revision of the Energy industry Act (Energiewirtschaftsgesetz – EnWG).

3. Electricity grids to be expanded and upgraded such that they can carry renewable-generated electricity from the source of production and distribute it to the consumers. There will also be the introduction of smart grids to compensate for when installations do not generate appropriate amounts of electricity.
4. Imposing better labelling and bans on certain energy-inefficient appliances to encourage reductions in electricity consumption. From 2013, only companies that contribute to energy saving will be granted energy and electricity tax concessions.

Heating:

In the heating sector, buildings accounted for 40% of total energy consumption and are responsible for approximately a third of Germany's CO₂ emissions. Renewable energy sources accounted for around 10% of the heat production distributed to private homes.

Data in 2011 showed that 85% of waste heat produced from electricity generation was emitted to the atmosphere thus ultimately contributing to climate change. Cogeneration recovers waste heat for heating and/or industrial processes. By 2050, Germany aims to have buildings independent of fossil fuels and more dependent on renewable energy sources. This means that cogeneration of heat and power will increase continuously, and fuel cells with high electrical efficiency will have to be developed. As such, renewable energy for heat production will contribute a higher percentage in the total energy supplied and consumed. Extrapolated targets are as follows:

- 18% by 2020
- 30% by 2030
- 60% by 2050

Proposed strategies/policies to ensure further use of renewable energy in the **heating** sector:

1. Incentives: Home owners and companies will be granted monetary incentives if they install components that utilize renewable energy sources, or promote the construction of high efficient CHP installations. The CO₂ Building Modernization Programme provides a total of €1.5 billion for funding. The Market Incentive Programme for Renewable Energies funding increased to €350 million in 2012 and will increase to more than €400 million in 2013. The Combined Heat and Power Act (Kraft-Wärme-Kopplungs-Gesetz) is constantly reviewed, revised and improved to promote the construction and implementation of more CHP facilities and appliances [8].
2. Legislation: Continuous revision of the Energy Saving Ordinance (Energieeinsparverordnung – EnEV) to keep up and adapt to current times with regard to energy consumption for the heating sector. There is also constant revision of the Renewable Energies Heat Act (EEWärmeG) to ensure that the renewable energy responsible for heat production will increase [8].
3. Information – In attempt to raise the awareness of consumers with respect to energy, the Federal Government proposed more transparency in the labelling of buildings' energy consumption. This is aimed to encourage owners, landlords and tenants to make necessary upgrades to the energy facilities or appliances [8].

Transport:

18% of Germany's total GHG emissions are contributed by the transport sector, and road transport is responsible for more than 90% of the total GHG emitted. Emissions decreased by 7% between 2000 and 2008, due to vast improvements in vehicle efficiency. As a result, CO₂ emissions dropped from 182 g CO₂/km in 2000 to 152 g CO₂/km in 2010. The use of biofuels also increased, accounting for 5.8% of the transportation fuel consumption in 2010.

Using 2005 transport emissions data as the baseline, the Federal Government targeted a 10% fall in transport energy consumption by 2020, and a 40% drop by 2050. In order to meet this target, it is hoped that the use of

renewable energy sources, such as biofuels, will be used to power not only land transport, but also sea and air transport.

Proposed strategies/policies to ensure further use of renewable energy usage in the **transport** sector:

1. CO₂ emissions for cars and goods vehicles were capped at 130 g/km for passenger cars from 2012, followed by a further reduction of 95 g/km in 2020, to allow for increased energy efficiency in passenger cars and goods vehicles.
2. Introducing economic instruments in aviation and shipping such as an aviation tax which was introduced in 2011. The Federal Government is also presently working on an emissions trading scheme for international shipping in order to curb further growth in emissions. An “Energy Efficiency Design Index” for shipping has already been implemented at the international level.
3. Promotion of research and development that focuses on electromobility, alternative fuels, storage and combustion engine technologies. Battery technology and smart grid integration are prominent areas of interest for further research and development, all of which are being funded by the Federal Government from 2009 – 2013.
4. More focus and investment in the rail sector to reduce emissions in the freight industry, with a specific focus on hubs and bottlenecks in the rail infrastructure.
5. Establishment of more innovative transport strategies such as regulating the volume of traffic. It is hoped that these will encourage safe journeys for pedestrians, cyclists, drivers, and other public transport commuters in tandem with plans to reduce carbon and GHG emissions as well as mitigate climate change.

Industry:

The industrial sector accounts for 8% of total GHG emissions, and also a large percentage of the emissions produced from energy generation. Despite reducing industrial emissions by more than a third of the total over the past two decades, the proportion of gases that decreased in emissions was mainly CO₂. Other harmful gases such as fluorinated greenhouse gases were still being produced for cooling system technologies and the manufacturing of solar technologies.

Germany aims to reduce GHGs by 80-95% by 2050 relative to 1990. In order to meet this target, it is imperative that industrial emissions be reduced by a large amount. Another ambitious goal is to source new or alternative chemical substances and processes to ideally end the production of F-Gases.

Proposed strategies/policies to ensure further use of renewable energy in the **industrial** sector:

1. Introduce energy management systems with annual energy saving targets.
2. Continuous revision and improvement in the EU Emissions Trading System (EU ETS). This is to encourage development of low-carbon technologies and substances and promote energy saving and increased usage of renewable energy sources.
3. Strict enforcement of F-Gas (fluorinated greenhouse gases) regulations and further research and development to devise alternative cooling technologies that will aid in reducing F-gas emissions.

Key Legislation for climate change mitigation for Germany

1. Greenhouse Gas Emissions Act
2. Energy and Electricity Tax Act

3. Renewable Energy Sources Act
4. Renewable Energies Heat Act
5. Biofuel Quota Act and Biofuel Sustainability Ordinance
6. Combined Heat and Power Act
7. Energy Conservation Act and Energy Saving Ordinance
8. EU Regulation on CO₂ Standards for New Cars
9. Motor Vehicle Tax
10. Federal Trunk Road Toll Act
11. Regulatory Framework for CCS
12. Waste Shipment Ordinance
13. F-Gas Regulation
14. EU Ecodesign Directive
15. Energy Labeling

Ministries involved in climate change/energy policy making:

Ministries involved	Web links
The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)	www.bmu.de
Federal Environment Agency	www.umweltbundesamt.de/ and www.uba.de
Federal Agency for Nature Conservation	www.bfn.de
Federal Office for Radiation Protection	www.bfs.de
Federal Ministry of Education and Research (BMBF)	www.bmbf.de/en/
Federal Ministry of Transport, Building and Urban Development (BMVBS)	www.bmvbs.de/en/
Council of Environment Advisors (SRU)	www.umweltrat.de
Advisory Council to the Federal Government on Global Change (WBGU)	www.wbgu.de
Reactor Safety Commission (RSK) and Commission on Radiological Protection (SSK)	www.ssk.de and www.rskonline.de
Commission on Process Safety (KAS)	www.kas-bmu.de
Environmental Verification Committee (UGA)	www.uga.de
Commission on Waste Management (ESK)	www.enstorgungskomossaion.de
Environment Label Jury	www.blauer-engel.de/en

Education institutes involved in climate change/energy policy making:

Education Institutes involved	Web links
Framework Programme Research for Sustainable Development (FONA) (BMBF)	www.fona.de/en/
Fraunhofer Society (FhG)	www.fraunhofer.de/en/
Leibniz Science Association (Gottfried Wilhelm Leibniz Science Association, WGL)	www.leibniz-association.eu/

References

- [1] "World Population Prospects: The 2010 Revision." Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.
- [2] "CIA - The World Factbook." Available at: <https://www.cia.gov/library/publications/the-world-factbook/geos/id.html>. [Accessed: 13-Mar-2013].
- [3] CO₂ Emissions from Fuel Combustion Statistics database 2012, "Indicators for CO₂ emissions." © OECD/IEA, 2012.
- [4] World Energy Statistics and Balances database 2012, "World Energy Balances." © OECD/IEA, 2012.
- [5] "Status of Ratification of the Kyoto Protocol." Available at: http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php. [Accessed: 11-Mar-2013].
- [6] "EEA analysis in brief: Why did greenhouse gas emissions increase in the EU in 2010?" Available at: <http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2012/why-did-greenhouse-gas-emissions.pdf>. [Accessed: 11-Mar-2013].
- [7] "An Overview of German Climate and Energy Policy." Available at: http://www.buenosaires.diplo.de/contentblob/2705272/Daten/785396/Energiepolitik_Download.pdf. [Accessed: 11-Mar-2013].
- [8] "Climate Protection and Growth." Available at: http://www.bmu.de/files/english/pdf/application/pdf/broschuere_klima_wachstum_en_bf.pdf. [Accessed: 11-Mar-2013].