

# Case study: Climate Neutral building stock in Germany



POWERING GLOBAL IMPACT  
THROUGH SOCIAL SCIENCE

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February 2017

Acknowledgement: Research funded by the EPSRC (award number EP/M008215/1) has contributed to this report.

## Policy description

The German federal government aims to make Germany's entire building stock "climate neutral" by 2050.<sup>i</sup> The government is pursuing a cross-cutting strategic approach which includes high thermal performance standards of new buildings, progressive improvements in the energy efficiency of the existing building stock, deployment of building-level renewable heat technologies and use of both CHP and renewable sources in district heating.

A wide range of policies and programmes contribute to the climate neutrality goal (a selection of which is shown in Table 1). These include grants and subsidised loans for energy efficiency (both retrofit and new buildings going beyond regulated minimum standards) through the KfW bank, building standards regulating both thermal performance and heat supply for new buildings (by stipulating minimum levels of either renewable heat, CHP or district heating), and grant funding, e.g. through the Market Incentive Programme, for renewable heat installations. In addition to Federal government financial support, the Länder and even municipalities organise complementary regulation and funding programmes.

Table 1: Key legislation and policies supporting a climate-neutral building stock

Name	Inception	Latest Revision	Type	Key building-related provisions
National Energy Efficiency Action Plan (NAPE)	2014	n/a	Strategy	Expansion of funding for refurbishments (e.g. the KfW-run CO2 Building Modernisation Programme) and the introduction of tax incentives for efficiency measures on the national and federal state level. Transposes EU Energy Efficiency Directive (2012/27/EU)
Market Incentive Programme (MAP)	1999	2015	Grant Funding	Along with the KfW bank, MAP is the main financial tool for promoting renewable heat, mainly in existing buildings (e.g. solar water heating systems, heat pumps, pellets/woodchips)
Act on Energy Saving (EnEG)	1976	2014	Law	Buildings must comply with several minimum energy and heating performance standards. Addresses technical aspects related to replacement of boilers, thermal insulation, energy performance certificates, etc. Transposes Energy Performance of Buildings Directive (2010/31/EU)

Energy Saving Ordinance (EnEV)	2002	2015	Law	Sets energy performance requirements for new buildings/existing buildings in case of major renovation. New builds must not exceed the annual primary energy requirement of a corresponding reference building and must comply with prescribed minimum component standards. Transposes 2010/31/EU. Latest tightening of standards came into force in 2016 with max energy requirement 25% lower than 2014.
Renewable Energy Heating Act (EEWärmeG)	2009	2015	Law	targets a 14% share of renewable energies for heating and cooling in the building sector by 2020. Introduces an obligation for using a certain share of renewable energy in new buildings if this is economically possible.

## Targets

The Government has set a (non-statutory) target to reduce primary non-renewable energy demand in the building sector by 80% in 2050 relative to average 2005-08 levels.<sup>ii</sup> The target is absolute (i.e. it isn't set by reference to the size of the building stock) but is described as an "order of magnitude" target. It can be achieved by a combination of reducing final energy demand and replacing fossil sources with renewables.

The target was first articulated in the 2010 *Energiekonzept*<sup>iii</sup> which drew on a study commissioned by the Federal Ministry for Economic Affairs and Energy (BMWi)<sup>iv</sup>. This study explored a range of modelled scenarios<sup>v</sup> to demonstrate that economy-wide climate change objectives were achievable (i.e. GHG reductions of at least 40% by 2020 and 80-95% by 2050, relative to 1990 levels), and that economy-wide primary energy consumption could be reduced by half by 2050. The target to reduce non-renewable primary energy demand by 80% was thus one of a range of scenario-informed targets which (a) were regarded as feasible and (b) would together meet the economy-wide target. The scenarios included ongoing use of fossil gas in power generation as a means of managing intermittent renewable production. This was regarded as more efficient if operated as CHP and makes up the bulk of the remaining 20% fossil fuel input to heating.<sup>vi</sup>

Table 2: Targets set by the *Energiekonzept* (2010)

year	Climate Targets	Renewables Targets		Efficiency Targets			
	GHG (versus 1990)	Share electricity	Share total	Primary Energy (versus 2008)	Buildings (versus 2005-2008 average)	Energy productivity	Building renovation (annual rate)
2020	-40%	35%	18%	-20%	-20% (final energy)	Increase by 2.1% p.a.	Doubling from 1 to 2%
2030	-55%	50%	30%				
2040	-70%	65%	45%				
2050	-80%	80%	60%	-50%	-80% (non-renewable primary energy)		

Public debate and scrutiny of the 2010 *Energiekonzept* targets predominantly focused on electricity generation, and this intensified in 2011 in the wake of the Fukushima disaster and the decision to phase out nuclear power in Germany. Implications for buildings were thus relatively absent from debate, and only recently have more detailed constraints on achieving the 80% target been analysed. The *Energy Efficiency Strategy for Buildings*, published in November 2015<sup>vii</sup> commissioned detailed scenarios<sup>viii</sup> for meeting the 2050 target. On the efficiency side, the greatest savings potential lies in heating applications, followed by hot water, lighting and cooling/ventilation. The

main renewable energy sources are renewably-sourced electricity for heat pumps and district heating as well as biomass, solar thermal and ambient heat.

An assessment of the limits to each of these options formed the basis of a scenario analysis: for efficiency, a maximum final energy savings potential by 2050 of 54% compared to 2008 levels, while for renewable penetration, an upper limit of 1,800 PJ (around 50% of 2008 consumption). This suggests quite a narrow space of possibility, narrower than many previous estimates had assumed; efficiency gains of 36-54% would need to be matched by a renewable contribution of 69-57%, respectively, in order to reach the overall 80% decarbonisation target. Moreover, this target range was compared against the 'business-as-usual' prognosis, which revealed only a 60% reduction by 2050.

Efficiency targets and associated policy initiatives were bolstered in 2014 with the release of the 2020 Climate Action Programme<sup>ix</sup> and the Energy Efficiency Action Plan (NAPE)<sup>x</sup>. These policies were enacted amid concerns that Germany was not on track to fulfil its overall target of a 40% reduction in GHG emissions by 2020.<sup>xi</sup> This partly reflected the persistence of coal use in the power sector, but also the difficulties of increasing the rate of efficiency renovation in the building stock from around 1% per year to a target of 2%.<sup>xii</sup> Indeed, the target of a 20% reduction in final energy demand for heat by 2020 is projected to be missed.<sup>xiii</sup>

## Timescales

2020 and 2050 are crucial dates across German energy policy, with final and primary energy demand targets for buildings set within a suite of other sectoral targets. With the publication of its latest Climate Action Programme, the German government has also set specific GHG reduction targets for the building sector by 2030, of around 66-67% relative to 1990 levels.<sup>xiv</sup>

Achieving the 80% reduction target by 2050 will have significant consequences for the gas grids, particularly as non-fossil gas sources are often regarded as more appropriate to transport than heating. In 2011 natural gas accounted for around a third of household heat energy<sup>xv</sup> and the German government has not set a "phase-out" date for gas in buildings. This perhaps reflects more general political commitments:

We want to create incentives, not order compulsory renovation. Economic incentives are at the heart of our policy, not telling our citizens what to do.<sup>xvi</sup>

Nonetheless, Germany has adopted relatively rigorous energy performance standards both for new buildings and for buildings undergoing renovation (a measure promoted by the EU Energy Performance of Buildings Directive<sup>xvii</sup>). Performance standards enforced under the regulations are limited by the legal requirement they be "economically viable" (meaning upfront costs should be lower than discounted savings over a 20 year period as seen from the building occupant's perspective)<sup>xviii</sup>. However, this is not calculated on a case-by-case basis (so is not equivalent to the UK Green Deal's "Golden Rule"), but applies to broad categories of building.

Policymakers see stretching performance standards for new buildings both as ensuring a steady path to near-zero energy new buildings required by EU directives from 2019/2021 (public/all buildings) and as avoiding future retrofit requirements. Tightening of building standards occurred in 2016, 2009 and 2007. Enhanced KfW support is available for new build and retrofits that go beyond regulated minima as a means of supporting innovation and cost reduction creating both domestic and export benefits. KfW advanced standards are set relative to standards set out in the EnEv (e.g. 30% lower energy demand) and are broadly aligned with expected future iterations of the EnEv.

## Communication

In the public press release for the Energy Efficiency Strategy for Buildings, the German government appealed to citizens to 'play their part' in achieving the 'common' target of a carbon neutral building stock by 2050.<sup>xix</sup> In addition to drawing on such notions of shared responsibility, the targets have been framed in the context of broader economic and environmental benefits, with an emphasis on a double dividend for citizens who can save both money and the environment.

Minister of Energy Sigmar Gabriel noted that the targets were ambitious yet achievable; in an official communication, he stated that 'I am happy to report that our renewable energy targets for 2020 may even be

exceeded. With this new strategy we are showing citizens what still needs to be done to achieve a carbon-neutral building stock by 2050.’<sup>xx</sup>

Stakeholder forums and policy consultations enabled citizens to understand the challenges and trade-offs of decarbonisation and ultimately help shape policy. To this end, the government established the Buildings Platform in 2014, which brought together relevant stakeholders from commerce, civil society, academia and government ministries to feed into what was called a ‘holistic’ strategy for decarbonising buildings by 2050.<sup>xxi</sup> A series of plenary sessions allowed stakeholders to submit hundreds of proposals on how to achieve the 2050 target, including quantifying the expected contribution from the various policy measures and incentives. Expert Working Groups were subsequently established to analyse specific issues in greater depth (e.g. the ‘Advice and Information’ Working Group tackled the issue of developing tailored advisory services for households, companies and municipalities).<sup>xxii</sup> Focussing on ways to achieve the 2050 targets in the most cost-effective and efficient way formed the common thread throughout this consultation and engagement process.

In encouraging citizens to make efficiency improvements, the German government follows the slogan: “Supply information – Provide support – Demand action”. As noted in the NAPE,

“energy efficiency policy is still founded on information, communication and advice. Information and advisory services will raise awareness among all energy users... Only well-informed citizens and companies will be able to take long-term decisions that result in higher energy efficiency and individual energy cost savings.”<sup>xxiii</sup>

To this end, the government has supported a number of initiatives to communicate the benefits of renovation and renewable energy installations for homeowners and businesses (see appendix). In many cases it has done so using public private partnerships (e.g. through the *Deutsche Energie Agentur*, or DENA), or in partnership with industry associations.

In most cases, these initiatives are focussed on benefits – e.g. the cost savings, added value, and environmental benefits of efficiency measures. Information sites and brochures tend to emphasise the amount of subsidy available, rather than the total cost to the consumer. As such, discussions of trade-offs are usually absent.

One function of communication initiatives is to help navigate the large number of incentive schemes organised by different levels of government and applicable to different circumstances. This may be indicative of a funding landscape that is congested; but it also shows that support is tailored to specific targets and particular types of building owners<sup>1</sup>.

A specific Federal government attempt to incentivise debt-averse homeowners to invest in energy efficiency illustrates the trade-offs across different levels of government, which in this case has led to deadlock. The Federal proposal was to allow households to claim costs of energy efficiency measures against their income tax. Estimated abatement was 2.1m tCO<sub>2</sub>e by 2020<sup>xxiv</sup>. However, two attempts to introduce the measure were blocked by different Länder each citing negative consequences for their tax revenues from the different designs proposed.<sup>xxv</sup>

## Context-specific factors

Surveys in Germany reveal a consistently high degree of concern about climate change<sup>xxvi</sup> and high levels of support for the *Energiewende*<sup>xxvii</sup>. A relatively high proportion of the German population regard climate change as among the most serious problems facing the world. One component of popular support for the broad objectives of decarbonisation is the inclusive design of support for renewable electricity generation which is more favourable to individual, cooperative and municipal investment than UK support mechanisms.<sup>xxviii</sup> Anecdotal evidence suggests low carbon technologies have become part of conspicuous consumption in Germany, with solar panels or heat pumps taking the place among affluent Germans once held by a BMW or Mercedes in the front drive.

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<sup>1</sup> For example, a subsidised energy efficiency loan may be attractive to a young family moving in to a home they anticipate occupying for many years, whereas an older occupant of an inefficient building may be less attracted to long term debt.

Germany has three distinct levels of government: the Federal government, Länder (states) and local authorities. Alongside federally funded programmes, Länder and local authorities engage in various forms of promotion and support for energy efficiency and renewable energy supply that are tailored to local circumstances and priorities. Where local measures are adopted, a priority is often placed on improving publicly owned buildings, both for the contribution energy saving can make to public budgets, and as a means of showing leadership in climate protection. In addition, Germany's financial sector is more distributed than the UK's, with a large number of Savings- and Cooperative-Banks dedicated to specific geographical areas.<sup>xxix</sup> KfW finance is channelled through this networks of banks which are able also to signpost additional local and regional support measures.

Macroeconomic analysis of energy efficiency support finds KfW programmes make net positive contributions to public budgets, with €1.4bn spending generating between €6bn and €17bn<sup>xxx</sup>. This is principally due to sales and income taxes raised from subsidised activities, as well as reduced social security payments through job creation.<sup>xxxi</sup> Funding for these programmes is allocated from the federal budget, but generates benefit across all levels of government, particularly the Länder. These effects reflect the high labour intensity and low levels of imports associated with energy efficiency.

## Conclusions

- Germany used system-wide modelling to develop sector-specific targets, including an 80% reduction in non-renewable primary energy demand by 2050.
- Extracting a target from an economy-wide model allows integration with other aspects of the energy system (e.g. the infrequent use of fossil-fired power stations to fill gaps in renewable electricity could also provide heat). However more refined analysis was required to map the possibilities for achieving the 80% buildings target and this found that nearly the full potential for both energy efficiency and renewable heat would be required.
- Converting the building stock to be “climate neutral” demands a wide variety of interventions. As well as fitting the right technologies to the right buildings, policies need to be tailored to be attractive to different constituencies.
- While support for the goals of the Energiewende is high, and in spite of a wide array of initiatives, the annual rate of energy efficiency retrofit remains stubbornly difficult to raise from 1% to 2%.
- The balance of powers/competencies across local government, the Länder and the Federal government means a large number of measures have been put in place, allowing for some policy innovation and targeting, but perhaps also leading to an excessively complex funding landscape. Relationships across multiple levels of governance have also stymied a policy whose advocates saw it as an important means of reaching households currently not attracted by low cost loans.

### Appendix: Selected Energy Efficiency Communication Campaigns

Title	Sector	Sponsor	Description	Website
<b>Efficiency Networks Initiative</b>	Businesses	Federal Ministry of Economic Affairs and Energy (BMWi)	Platform for industry to cooperate and build local networks sharing ideas and resources for improving energy efficiency.	<a href="http://www.effizienznetzwerke.org">www.effizienznetzwerke.org</a>
<b>Energy Consulting</b>	All	Federal Office for Economic Affairs and Export Control (BAFA)	Energy efficiency consulting for SMEs, Local Municipalities and Private Households, providing individual refurbishment plans.	<a href="http://www.bafa.de/DE/Energie/Energieberatung/energieberatung_node.html">www.bafa.de/DE/Energie/Energieberatung/energieberatung_node.html</a>
<b>House of the Future</b>	Households	German Energy Agency (DENA)	Information portal for energy efficiency projects, including a list of experts and funding sources.	<a href="http://www.zukunft-haus.info/startseite.html">www.zukunft-haus.info/startseite.html</a>

<b>Electricity Savings Check</b>	Households	Federal Association of Energy and Climate Change Agencies (EAD)	Impartial energy advice to households, plus energy-saving devices for low-income households free of charge.	<a href="http://www.stromspar-check.de/">www.stromspar-check.de/</a>
<b>Home Transition</b>	Households	Energy Efficient Building Alliance (GEEA)	Technical information on technologies available to improve efficiency.	<a href="http://www.die-hauswende.de/">www.die-hauswende.de/</a>
<b>Energy Funding Database</b>	All	BMWi	A database for specific funding sources, including local and regional initiatives.	<a href="http://www.energiefoerderung.info/">www.energiefoerderung.info/</a>
<b>Germany makes it efficient</b>	Households	BMWi	Country-wide citizen's advice and information portal for efficiency initiatives.	<a href="http://www.machts-effizient.de">www.machts-effizient.de</a>

<sup>i</sup> BMUB (2014) The German Government's Climate Action Programme 2020: Cabinet Decision of 3 December 2014, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, available: [http://www.bmub.bund.de/fileadmin/Daten\\_BMU/Pool/Broschueren/aktionsprogramm\\_klimaschutz\\_2020\\_broschuere\\_en\\_bf.pdf](http://www.bmub.bund.de/fileadmin/Daten_BMU/Pool/Broschueren/aktionsprogramm_klimaschutz_2020_broschuere_en_bf.pdf) [accessed 15 Jul 2015].

<sup>ii</sup> 'Primary energy' forms are here classed as fossil fuels, liquid/gaseous biomass, solid biomass, electricity, and district heating. Solar thermal and other ambient sources (geothermal, water, etc) are considered 'final energy'.

<sup>iii</sup> BMUB (2010) Energy Concept: For an Environmentally Sound, Reliable and Affordable Energy Supply, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, available: <https://www.bmwi.de/BMWi/Redaktion/PDF/E/energiekonzept-2010,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf> [accessed 13 Jan 2017].

<sup>iv</sup> [http://www.ewi.uni-koeln.de/fileadmin/user\\_upload/Publikationen/Studien/Politik\\_und\\_Gesellschaft/2010/EWI\\_2010-08-30\\_Energieszenarien-Studie.pdf](http://www.ewi.uni-koeln.de/fileadmin/user_upload/Publikationen/Studien/Politik_und_Gesellschaft/2010/EWI_2010-08-30_Energieszenarien-Studie.pdf)

<sup>v</sup> [www.bmub.bund.de/N46370-1/](http://www.bmub.bund.de/N46370-1/)

[http://www.ewi.uni-koeln.de/fileadmin/user\\_upload/Publikationen/Studien/Politik\\_und\\_Gesellschaft/2010/EWI\\_2010-08-30\\_Energieszenarien-Studie.pdf](http://www.ewi.uni-koeln.de/fileadmin/user_upload/Publikationen/Studien/Politik_und_Gesellschaft/2010/EWI_2010-08-30_Energieszenarien-Studie.pdf)

<sup>vi</sup> Edinburgh University, 2015 interview with an analyst who managed production of one of the scenarios used by the Federal Government in drawing up the Energiekonzept.

<sup>vii</sup> [http://www.bmwi.de/Redaktion/EN/Publikationen/energy-efficiency-strategy-buildings.pdf?\\_\\_blob=publicationFile&v=4](http://www.bmwi.de/Redaktion/EN/Publikationen/energy-efficiency-strategy-buildings.pdf?__blob=publicationFile&v=4)

<sup>viii</sup> [https://www.prognos.com/uploads/tx\\_atwpubdb/20151220\\_Prognos\\_Hintergrundpapier\\_EES.pdf](https://www.prognos.com/uploads/tx_atwpubdb/20151220_Prognos_Hintergrundpapier_EES.pdf)

<sup>ix</sup> BMUB (2014) The German Government's Climate Action Programme 2020: Cabinet Decision of 3 December 2014, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, available: [http://www.bmub.bund.de/fileadmin/Daten\\_BMU/Pool/Broschueren/aktionsprogramm\\_klimaschutz\\_2020\\_broschuere\\_en\\_bf.pdf](http://www.bmub.bund.de/fileadmin/Daten_BMU/Pool/Broschueren/aktionsprogramm_klimaschutz_2020_broschuere_en_bf.pdf) [accessed 15 Jul 2015].

<sup>x</sup> BMWi (2014) Making More out of Energy: National Action Plan on Energy Efficiency, Federal Ministry of Economics and Technology, available: <http://www.bmwi.de/EN/Service/publications,did=701906.html> [accessed 19 Jun 2015].

- <sup>xi</sup> <http://www.tagesspiegel.de/politik/deutschlands-klimabilanz-vom-selbst-gesteckten-ziel-weit-entfernt/10271678.html>, <http://www.tagesspiegel.de/politik/streit-zwischen-barbara-hendricks-und-sigmar-gabriel-deutschlands-probleme-mit-dem-klimaziel/10971650.html>
- <sup>xii</sup> DENA (2015) Der Dena-Gebäudereport 2015. Statistiken Und Analysen Zur Energieeffizienz Im Gebäudebestand., Deutsche Energi-Agentur, available: <https://www.dena.de/themen-projekte/projekte/gebaeude/dena-gebaeudereport/> [accessed 13 Jan 2017].
- <sup>xiii</sup> BMWi (2015) A Good Piece of Work --- the Energy of the Future: Fourth 'energy Transition' monitoring Report Summary, German Federal Ministry for Economic Affairs and Energy, available: <https://www.bmwi.de/EN/Service/publications,did=746824.html> [accessed 19 Jun 2015].
- <sup>xiv</sup> [https://unfccc.int/files/focus/long-term\\_strategies/application/pdf/161114\\_climate\\_action\\_plan\\_2050\\_en\\_bf.pdf](https://unfccc.int/files/focus/long-term_strategies/application/pdf/161114_climate_action_plan_2050_en_bf.pdf)
- <sup>xv</sup> Prognos AG, Institute of Energy Economics at the University of Cologne & Gesellschaft für wirtschaftliche Strukturforchung (2014) Entwicklung der Energiemärkte – Energiereferenzprognose. [Online]. Available from: <http://www.bmwi.de/BMWi/Redaktion/PDF/Publikationen/entwicklung-der-energiemaerkte-energiereferenzprognose-endbericht,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf> [Accessed: 19 June 2015]. Table 4.4.2.2-1
- <sup>xvi</sup> Energiekonzept 2010, page 29 (of English translation at <http://cvi.se/uploads/pdf/Master%20Literature/Wind%20Resource/Energy%20Concept.pdf>).
- <sup>xvii</sup> Mallaburn, P.S., Eyre, N. (2013) 'Lessons from energy efficiency policy and programmes in the UK from 1973 to 2013', *Energy Efficiency*, 7(1), 23–41, available: <http://link.springer.com/article/10.1007/s12053-013-9197-7> [accessed 6 Aug 2015].
- <sup>xviii</sup> By contrast, UK Government guidance on valuing energy efficiency takes a macroeconomic perspective, and by stripping out fixed costs of energy networks leads to lower levels of energy efficiency being deemed optimal.
- <sup>xix</sup> BMWi (2015), Press Release for the Building Efficiency Strategy, at <https://www.bmwi-energiewende.de/EWD/Redaktion/Newsletter/2015/20/Meldung/topthema-gebaeude.html>
- <sup>xx</sup> BMWi (2015), Press Release for the Building Efficiency Strategy, at <https://www.bmwi-energiewende.de/EWD/Redaktion/Newsletter/2015/20/Meldung/topthema-gebaeude.html>
- <sup>xxi</sup> BMWi (2015), Building Platform, summary at <https://www.bmwi.de/Redaktion/EN/Artikel/Energy/gebaeude-plattform-gebaeude.html>
- <sup>xxii</sup> BMWi (2015), Building Platform, summary at <https://www.bmwi.de/Redaktion/EN/Artikel/Energy/gebaeude-plattform-gebaeude.html>
- <sup>xxiii</sup> BMWi (2014), the National Action Plan on Energy Efficiency, [https://www.bmwi.de/Redaktion/EN/Publikationen/nape-national-action-plan-on-energy-efficiency.pdf?\\_\\_blob=publicationFile&v=1](https://www.bmwi.de/Redaktion/EN/Publikationen/nape-national-action-plan-on-energy-efficiency.pdf?__blob=publicationFile&v=1)
- <sup>xxiv</sup> BMWi (2014) Making More out of Energy: National Action Plan on Energy Efficiency, Federal Ministry of Economics and Technology, available: <http://www.bmwi.de/EN/Service/publications,did=701906.html> [accessed 19 Jun 2015].
- <sup>xxv</sup> The first objection was to lost income tax revenue. The Federal government included a compensation mechanism in its next attempt to pass the legislation, and this was the basis of (other) Länder's objections.
- <sup>xxvi</sup> Eurobarometer 2015 survey found 65% of people living in Germany rank climate change in the top four most serious problems facing the world, compared with 47% across Europe and 46% in the UK. [http://ec.europa.eu/clima/citizens/support\\_en](http://ec.europa.eu/clima/citizens/support_en)
- <sup>xxvii</sup> A 2016 opinion poll conducted by an association of energy industries found 93% of the population consider the Energiewende to be important or very important. <https://www.bdew.de/internet.nsf/id/20160503-pi-energiewende-weiterhin-top-thema-fuer-die-bevoelkerung-de>.

<sup>xxviii</sup> Hall, S., Foxon, T.J., Bolton, R. (2016) 'Financing the civic energy sector: How financial institutions affect ownership models in Germany and the United Kingdom', *Energy Research & Social Science*, 12, 5–15, available: <http://www.sciencedirect.com/science/article/pii/S2214629615300748> [accessed 21 Jun 2016].

<sup>xxix</sup> Hall et al. (2016) 'Financing the civic energy sector'

<sup>xxx</sup> The wide range of fiscal benefits reflects the range of assumptions that can be made, e.g. about additionality and employment impacts.

<sup>xxxi</sup> Kuckshinrichs, W., Többen, J., Hansen, P. (2015) Wirkungen Der KfW-Programme 'Energieeffizient Bauen', 'Energieeffizient Sanieren' und 'Energetische Stadtsanierung – Energieeffizient Sanieren (IKK/IKU)' auf Öffentliche Haushalte Im Förderjahr 2013 (Effects of the KfW 'Energy Efficiency Building', 'Energy Efficiency Improvement' and 'Energy Efficiency Building Renovation - Energy Efficiency Improvement (IKK / IKU)' on public budgets), Forschungszentrum Jülich, available: [https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-alle-Evaluationen/KfW-Studie-FJ-2013\\_07-Mai\\_1-\(2\).pdf](https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-alle-Evaluationen/KfW-Studie-FJ-2013_07-Mai_1-(2).pdf) [accessed 28 Aug 2015].