DIW Economic Bulletin

ECONOMY. POLITICS. SCIENCE.

38 2017

2016 Heat Monitor

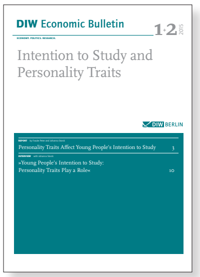
DIW BERLIN

DIW BERLIN

DIW Berlin — Deutsches Institut für Wirtschaftsforschung e. V.
Mohrenstraße 58, 10117 Berlin
T +49 30 897 89 -0
F +49 30 897 89 -200

Volume 7
September 20, 2017

Sale and distribution
DIW Berlin
ISSN 2192-7219



The DIW Economic Bulletin contains English-language versions of selected articles and interviews from the DIW Wochenbericht in English. As the institute's flagship publication, the DIW Wochenbericht provides an independent view on the economic development in Germany and the world, addressing the media as well as leaders in politics, business ,and society.

The DIW Economic Bulletin is published weekly and is available as a free download from DIW Berlin's website.

THE NEWSLETTER FROM THE INSTITUTE

DIW's English-language newsletter offers a summary of the Institute's latest news, publications, and events on a bi-weekly basis. "New Issue Alerts" for the DIW Economic Bulleting and the DIW Roundup are also available.

>> Subscribe to DIW Newsletter in English at: **www.diw.de/newsletter_en**

NEXT ISSUE OF DIW ECONOMIC BULLETIN

Regulation of renewable energies

2016 Heat Monitor: “second rent” lower despite higher heating energy consumption

By Claus Michelsen and Nolan Ritter

Residential heating is responsible for one-fifth of Germany’s energy consumption. Heating costs were around 562 euros per year for an average apartment in 2016, which is more than a 13th month’s rent minus heating costs (Kaltmiete). These are the findings of the 2016 Heat Monitor, published by the German Institute for Economic Research and ista Deutschland GmbH. The report presents evaluations based on an extensive database of heating bills for apartment buildings in Germany. Apartment buildings constitute almost one-half of the total housing stock in Germany. Adjusted for climate and weather, their heating energy consumption rose by around two percent in comparison to 2015. However, a further drop in energy prices provided relief to private households once again. Throughout Germany energy prices decreased by around six percent compared to 2015. But this trend will not continue: energy prices are expected to remain constant or to rise slightly in upcoming heating periods. In the light of these developments and alongside climate policy considerations, it would be shortsighted to reduce effort in retrofitting buildings. After all, energy costs are the major determinant of the “second rent.”

At the recent G20 summit in Hamburg, the German government reaffirmed its commitment to the targets of the Paris Agreement, reinforcing the country’s energy transition agenda in the process. The agenda’s main thrust is to reduce heating consumption in residential buildings. By 2020, the energy needs of residential buildings[1] must be 20 percent lower and by 2050, 80 percent lower than consumption in baseline year 2008.[2] In addition to its significance for climate policy, a housing stock with greater energy efficiency would also relieve private households in the long term—particularly if energy prices rise.[3] Given this situation, the federal government, states, and municipalities have adopted programs to fund energy-efficient construction and renovation. They include: multi-billion euro credit subsidies and grants from KfW Group, the market incentive program of the Federal Office for Economic Affairs and Export Control (*Bundesamt für Wirtschaft und Ausfuhrkontrolle*, BAFA), and local initiatives such as the Stuttgart grant program for energy-efficiency upgrades.[4]

After plateauing for years, expenditures for energy-efficiency upgrades rose again last year. In line with the increase in the overall volume of housing stock renovation, building owners expended more to raise energy

1 Around three-quarters of private households’ energy demand is expended on heating living space. The remainder is divided up equally between heating water and the power required to run household devices. See Federal Ministry for Economic Affairs and Energy (*Bundesministerium für Wirtschaft und Energie*, BMWi) energy data. The climate policy target refers to heating living space and water.

2 Federal Ministry for Economic Affairs and Energy and Federal Ministry for the Environment, “Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung,” (PDF, Federal Ministry for Economic Affairs and Energy, Berlin, 2010).

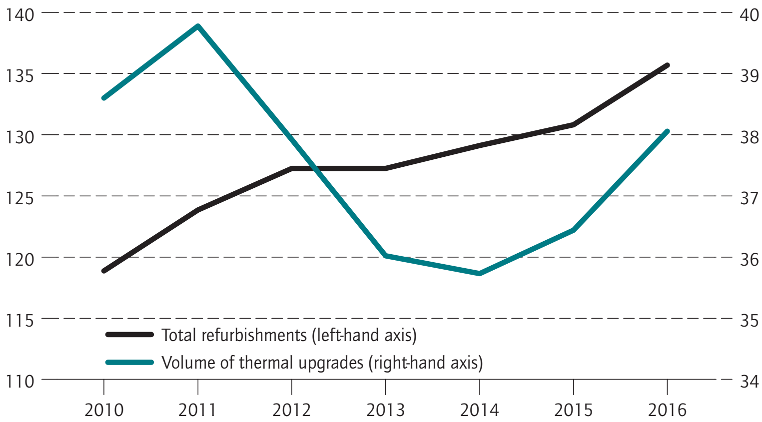
3 Jürgen Blazejczak, Dietmar Edler, and Wolf-Peter Schill, “Improved Energy Efficiency: Vital for Energy Transition and Stimulus for Economic Growth,” *DIW Economic Bulletin* no. 4 (2014): 3-15 (available online, accessed September 5, 2017).

4 For a comprehensive overview of the many support programs, consult databases such as https://www.energiefoerderung.info.

Figure 1

Volume of refurbishments of existing residential buildings

Billion Euros in current prices



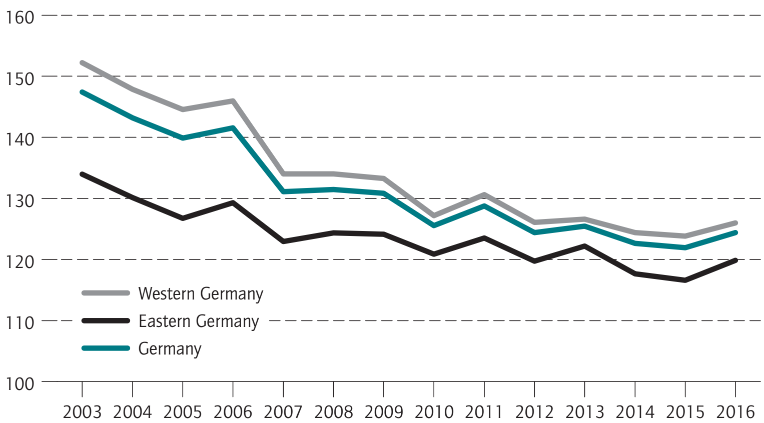
Source: Construction volume calculation of DIW Berlin.

Expenditures for thermal upgrades increased

Figure 2

Annual heating energy requirements in apartment buildings

In kilowatt-hours per square meter living space; adjusted for climate and weather



Source: ista Germany GmbH; authors' own calculations.

Energy demand rose again

efficiency, expanding rooftop photovoltaic systems and modernizing heating systems by around 4.5 percent in comparison to 2015 (see Figure 1).[5] Measured against the required increase in expenditure for energy-efficiency upgrades,[6] this can only be viewed as a first step in the right direction—the investment level is still simply too low to achieve the target. Despite extremely favorable general conditions, current efforts—in particular, the low interest rate and numerous funding programs—are unlikely to be enough by 2020.

Recent rise in heating energy consumption

The evaluations in the *2016 Heat Monitor* (see Box 1 for the database and calculation methodology) show that the energy demand of apartment buildings—again, virtually half of the total housing stock in Germany—is not dropping quickly enough to achieve the 20-percent target. Since 2008, heating energy consumption throughout Germany has fallen by around ten percent. In eastern Germany it fell by 8.75 percent and in western Germany by 10.5 percent (see Table 1 and Figure 2). In the most recent heating period, energy demand rose again by around two percent nationwide, adjusted for climate and weather conditions. In order to still reach the 20-percent target, the country would require an annual reduction in heating energy consumption of 2.9 percent.

The state of Bremen recorded a slight decrease in heating energy consumption, and there were only slight increases in Bavaria, North Rhine-Westphalia, Saarland, and Thuringia. In all other federal states, consumption rose by more than two percent in comparison to the 2015 heating period. Overall during the 2016 heating period, heating energy consumption fell in only 16 of the 96 planning regions in Germany in comparison to the previous billing period.

The east-west and north-south gaps in energy demand have proven to be persistent. Households in eastern Germany are still reaping the benefits from the wave of renovations in the 1990s, during which most of the housing stock received modern energy systems and a thermal upgrade. As a result, energy demand is around five percent lower in eastern Germany than in the western

5 Measures involving products such as insulation (roof, facade, etc.), replacing windows and outer doors, heating system renewal and solar thermal energy/photovoltaics are all considered energy-efficiency upgrades. See Martin Gornig et al., "Strukturdaten zur Produktion und Beschäftigung im Baugewerbe—Berechnungen für das Jahr 2015," (PDF, available online, accessed September 5, 2017).

6 Martin Gornig, Hendrik Hagedorn, and Claus Michelsen, "Bauwirtschaft: Zusätzliche Infrastrukturinvestitionen bringen zunächst keinen neuen Schwung," *DIW Wochenbericht* no. 47 (2013): 3-14. (PDF, available online, accessed September 5, 2017)

part of the country. The gap between the north and the south is also noteworthy. In many regions of Bavaria and Baden-Württemberg, households consume significantly less heating energy than those in the northwestern regions, specifically Schleswig-Holstein, Lower Saxony, and North Rhine-Westphalia (see Map). The more vivid construction activity in the southern states in recent years—leading to a more modern housing stock—is one explanation for the observed gap.

Sharply falling energy prices

In the 2016 heating period, the Germany-wide energy price per kilowatt hour (kWh) fell sharply on average: by roughly eight percent in comparison to the previous year. That was the third year in a row in which prices of heating energy decreased perceptibly. The price per kilowatt hour of heating energy was one-fifth less expensive than in 2013 (see Figure 3). In eastern Germany, one kWh cost around 4.5 percent less than in western Germany. Hamburg residents paid the most for heating energy: 0.781 euros per kWh. Households in the Allgäu region of Bavaria enjoyed the lowest heating energy prices. At 0.485 euros per kWh, they paid around one-third less than Hamburg residents.

Lower energy prices could be one reason for the increase in energy consumption during the 2016 heating period. Landlords charge their tenants a monthly flat rate for heating (rent plus heating) and bill for actual consumption in retrospect, long after the heating period is over. This means that households receive their price signal with a delay. In line with economic theory,[7] this could explain why lower energy prices did not lead to higher energy consumption until 2016.

But the days of falling prices for heating energy may soon be history. Most notably, the price of oil has risen again since the beginning of 2016. And the commodities market anticipates another moderate increase in the price of oil in the near future.[8]

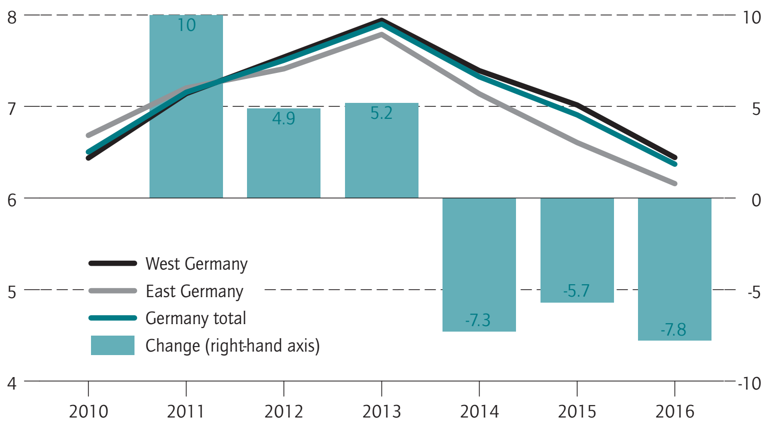
"Second rent" has dropped markedly

Despite the increase in energy demand in the 2016 billing period, the burden of household heating costs has

Figure 3

Energy prices

Weighted median of gas and oil prices per kWh; eurocent, change in percent



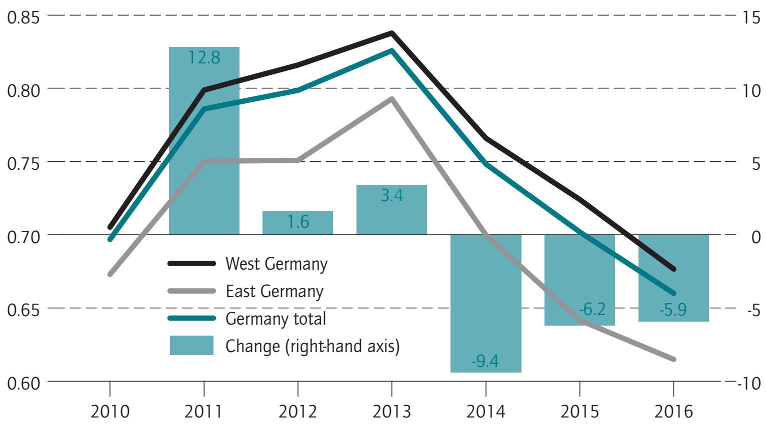
Sources: ista Germany GmbH; authors' own calculations.

In the past three years, prices for heating energy declined substantially.

Figure 4

Monthly heating costs

In euro per square meter living space, change in percent



Sources: ista Germany GmbH; authors' own calculations.

The heating costs declined markedly as well in the past three years.

7 For example, Haas and Schipper report a tendency toward low demand elasticity in light of falling energy prices. See Reinhard Haas and Lee Schipper, "Residential energy demand in OECD-countries and the role of irreversible efficiency improvements," *Energy Economics* 20.4 (1998): 421–442.

8 Most observers do not believe that oil prices will rise above 100 dollars per barrel. This is due to the development of new sources—primarily in the US—that are more affordable to exploit. See Aleksandar Zaklan and Claudia Kemfert, "Rohölmarkt: US-amerikanisches Schieferöl schwächt Marktmacht der OPEC," *DIW Wochenbericht* no. 19 (2016): 429-433. (PDF, available online, accessed September 5, 2017).

Box

Heat Monitordatabase and calculation methodology

In partnership with energy service provider ista Deutschland GmbH, DIW Berlin developed *Heat Monitor Germany*, which reports on trends in heating energy consumption and heating costs in apartment buildings by region, on an annual basis. The calculations are based on ista Deutschland GmbH heating bills and information from both the German Weather Service (*Deutscher Wetterdienst*) and the German Federal Statistical Office. The heating bills contain information on energy consumption, billing periods, the energy carrier, energy costs, and the building's location and size.

The billing data only capture apartment buildings. And within this group of buildings, the data are not based on a random sample. Instead, buildings with decentralized heating (e.g., gas heating or tiled stoves) are not included. In apartment buildings decentralized heating plays a subordinate role. According to the microcensus supplementary survey on the living situation in Germany conducted in 2014,1 at least 88 percent of all apartments in this market segment use central or district heating. Larger buildings are overrepresented in the sample. We compensated by weighting the average energy consumption according to the building class's relevant importance in the statistical population. To accomplish this, we used data from the microcensus supplementary survey on the living situation in Germany that indicates the proportions of buildings in defined size classes by planning region.

We calculated energy demand based on real energy consumption adjusted for climate and weather. To ensure comparability along the dimensions of space and time, we used information from the German Weather Service. The available weighting factor normalized consumption to the climate conditions in Potsdam, the reference location. Our procedure followed an established method of the Association of German Engineers (*Verein Deutscher Ingenieure*, VDI): VDI Guideline 3807, "Characteristic consumption values for buildings").

1 German Federal Statistical Office, "Bauen und Wohnen," *Mikrozensus – Zusatzerhebung 2014* series 5, booklet 1 (PDF, German Federal Statistical Office, Wiesbaden, 2016). (available online, accessed September 5, 2017).

Average regional values were calculated in several steps: First, key building-specific values were determined based on the amounts of energy used for heating. This consumption value was multiplied by the heating value for the relevant energy carrier, corresponding to the absolute heating energy consumption specific to a building for one billing period in kilowatt hours (kWh). The values had to be allocated to a specific heating period since the cut-off date for consumption measurement is typically not December 31 of the relevant year. Each heating period contained bills whose billing period began in August of the previous heating period at the earliest and ended in May of the following heating period at the latest. We adjusted the heating energy amount determined in this manner for the climate conditions during the heating period in question and divided it by the amount of living space in the building.

Key values for regional energy were projected as the weighted arithmetic mean for the overall housing and building stock of a planning region. The portions of apartments in the total number of regional living units were used as weights and could be allocated to size classes 3 to 6, 7 to 12, 13 to 20 and over 20.

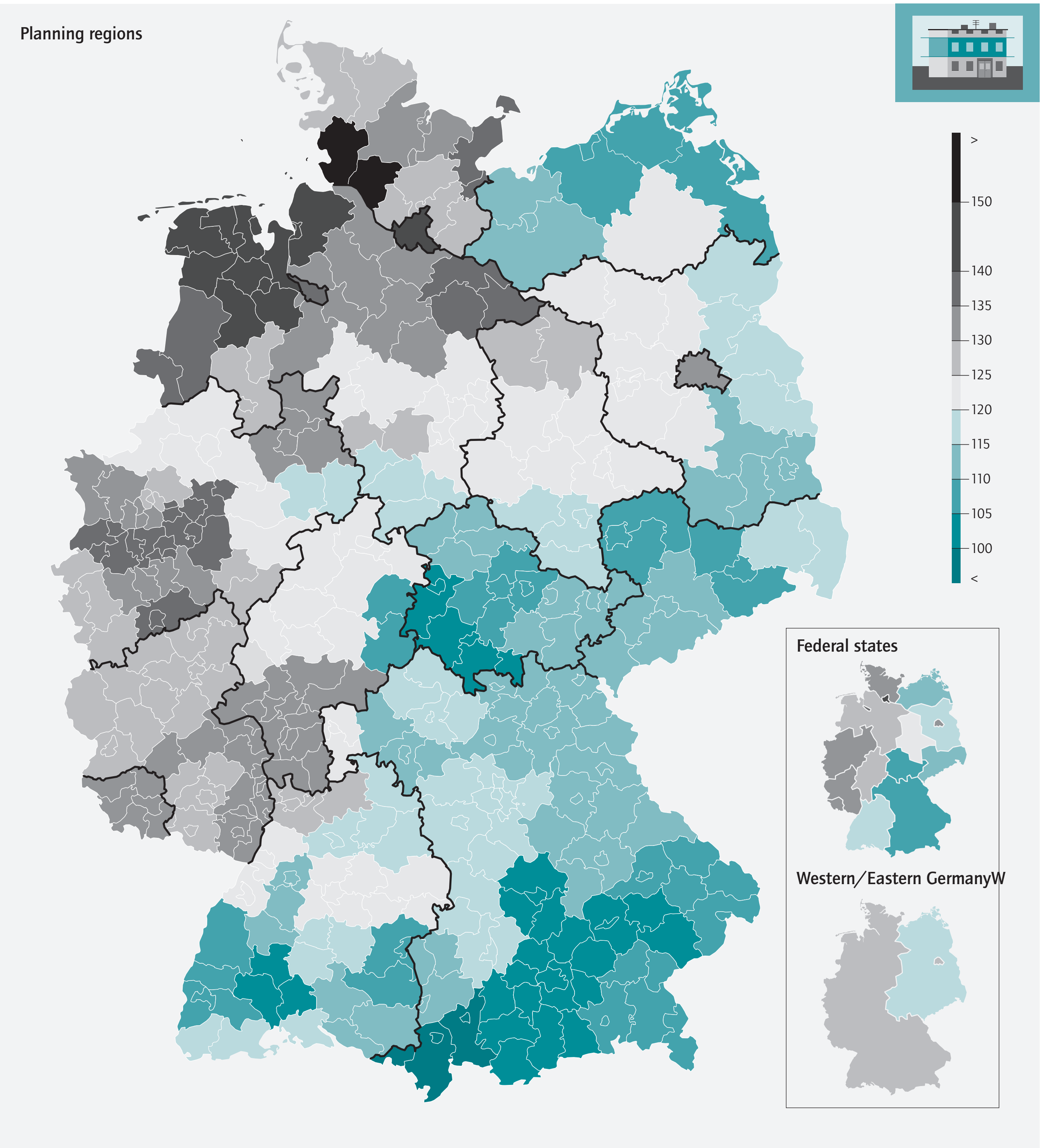
Heating bills are created after a time delay. The earlier the heating period, the more information available about it. The values of the current heating period were calculated based on a smaller sample than the values for earlier years. Therefore, updates may lead to corrections – usually minor – in retrospect.

We calculated heating costs using energy costs per kWh heating energy consumption (excluding hot water). Only the amounts billed for natural gas and heating oil were included. District heating, electric heating systems, and biomass heating were not considered. Instead, we split them proportionately between natural gas and heating oil. The proportions of these types of heating are very low in most regions of Germany. District heating only plays a more major role in eastern Germany. The average regional price per kWh was calculated as a weighted average value. The regional relationship between apartments heated with natural gas and those heated with oil as documented in the microcensus supplementary survey were used for weighting.

Map

Heating energy demand in apartment buildings 2016

In kilowatt hours per square meter living space



Note: Adjusted for climate and weather.

Sources: ista Germany GmbH; authors' own calculations.

Table

Results of the 2016 Heat Monitor

Name of planning region	Number of ROR 2009	Annual heating energy consumption (kWh per squaremeter living space) Average			Heating energy prices (euro-cent per kilowatt hour) Median			Annual heating ernergy costs (euro per squaremeter living space) Average		
		2014	2015	2016*	2014	2015	2016*	2014	2015	2016*
Schleswig-Holstein Mitte	101	128.3	128.5	134.9	7.6	7.1	6.6	9.7	9.1	9.0
Schleswig-Holstein Nord	102	128.4	129.9	126.3	8.4	7.6	6.4	10.8	9.8	8.1
Schleswig-Holstein Ost	103	131.9	126.2	135.9	7.6	6.9	6.2	10.0	8.8	8.5
Schleswig-Holstein Süd	104	129.1	127.0	129.5	7.8	7.2	6.5	10.0	9.2	8.4
Schleswig-Holstein Süd-West	105	152.1	154.0	158.9	9.2	8.3	7.7	14.0	12.8	12.2
Hamburg	201	135.9	140.0	146.1	7.9	8.1	7.8	10.8	11.4	11.4
Braunschweig	301	119.5	122.4	122.1	6.7	6.4	5.9	8.0	7.9	7.2
Bremen-Umland	302	133.4	130.6	134.3	7.3	6.7	6.5	9.7	8.8	8.8
Bremerhaven	303	144.4	140.8	145.8	7.8	6.9	6.7	11.2	9.7	9.9
Emsland	304	130.5	128.2	136.8	6.8	6.6	6.9	8.9	8.5	9.4
Göttingen	305	118.7	122.3	119.4	6.7	6.9	6.0	7.9	8.5	7.2
Hamburg-Umland-Süd	306	130.6	128.3	131.4	7.2	6.7	6.2	9.5	8.6	8.1
Hannover	307	119.5	116.6	122.7	7.0	6.6	6.4	8.4	7.7	7.8
Hildesheim	308	119.6	119.8	126.7	7.2	6.7	6.6	8.6	8.1	8.3
Lüneburg	309	130.3	128.5	138.0	7.0	6.7	6.5	9.1	8.7	9.0
Oldenburg	310	137.0	134.7	142.4	7.0	6.6	6.8	9.7	8.9	9.8
Osnabrück	311	121.6	119.7	126.1	6.9	6.4	6.3	8.4	7.6	7.9
Ost-Friesland	312	152.3	146.8	149.3	8.1	7.6	7.2	12.4	11.2	10.7
Südheide	313	132.6	132.9	134.6	7.8	7.3	6.5	10.3	9.7	8.8
Bremen	401	139.3	136.7	136.2	7.4	7.1	6.3	10.4	9.7	8.6
Aachen	501	129.4	127.4	129.4	8.1	7.6	7.2	10.6	9.7	9.4
Arnsberg	502	115.9	119.5	124.8	6.8	6.8	6.2	7.8	8.1	7.8
Bielefeld	503	130.4	134.0	132.4	7.9	7.7	6.8	10.3	10.3	9.0
Bochum/Hagen	504	134.5	133.3	136.9	7.9	7.7	7.1	10.7	10.2	9.8
Bonn	505	136.6	133.1	135.6	8.0	7.4	6.8	10.9	9.8	9.2
Dortmund	506	134.1	132.5	135.4	7.6	7.1	6.5	10.2	9.4	8.9
Duisburg/Essen	507	137.7	135.9	134.5	8.0	7.6	7.1	11.0	10.4	9.6
Düsseldorf	508	140.5	137.8	137.8	7.7	7.2	6.5	10.9	10.0	9.0
Emscher-Lippe	509	127.8	127.0	128.0	7.5	7.1	6.5	9.6	9.0	8.3
Köln	510	135.8	133.5	134.2	7.7	7.3	6.6	10.5	9.8	8.9
Münster	511	119.3	123.5	123.7	6.9	6.7	5.9	8.2	8.3	7.3
Paderborn	512	113.1	124.4	119.8	7.4	8.1	6.7	8.3	10.1	8.1
Siegen	513	123.1	122.7	125.2	7.1	7.0	6.2	8.8	8.6	7.7
Mittelhessen	601	119.8	119.4	122.5	7.1	6.8	6.4	8.5	8.2	7.9
Nordhessen	602	118.6	119.7	123.9	7.3	6.9	6.4	8.6	8.3	8.0
Osthessen	603	102.2	101.4	107.3	6.2	6.0	5.5	6.3	6.1	5.9
Rhein-Main	604	127.9	126.4	130.7	7.5	7.0	6.5	9.6	8.8	8.5
Starkenburg	605	127.8	126.8	132.2	8.1	7.5	7.0	10.4	9.6	9.2
Mittelrhein-Westerwald	701	123.8	122.6	129.5	7.2	6.9	6.6	9.0	8.5	8.6
Rheinhessen-Nahe	702	134.7	130.3	132.4	8.3	7.6	7.1	11.2	9.9	9.5
Rheinpfalz	703	127.0	126.1	131.3	7.3	7.2	6.8	9.3	9.1	9.0
Trier	704	125.8	124.9	129.3	7.9	7.3	6.7	10.0	9.2	8.7
Westpfalz	705	124.2	124.1	129.3	7.8	7.6	7.4	9.7	9.5	9.6
Bodensee-Oberschwaben	801	109.3	108.1	110.9	6.5	6.3	5.7	7.1	6.8	6.3
Donau-Iller (BW)	802	107.4	110.2	109.0	7.0	6.6	6.0	7.5	7.2	6.5
Franken	803	113.9	113.4	115.8	7.4	7.0	6.3	8.4	7.9	7.3
Hochrhein-Bodensee	804	117.2	115.5	115.5	7.1	6.5	5.8	8.3	7.6	6.7
Mittlerer Oberrhein	805	119.4	118.3	120.3	7.4	7.0	6.4	8.9	8.3	7.8
Neckar-Alb	806	112.0	111.2	115.6	6.9	6.7	6.1	7.7	7.4	7.0
Nordschwarzwald	807	108.5	109.1	113.3	7.0	6.5	6.0	7.6	7.1	6.8
Ostwürttemberg	808	119.0	119.6	124.6	7.3	6.9	6.3	8.7	8.3	7.9
Schwarzwald-Baar-Heuberg	809	102.9	104.1	104.8	6.2	6.1	5.7	6.3	6.3	6.0
Stuttgart	810	119.1	118.6	121.5	7.1	6.8	6.3	8.4	8.0	7.7
Südlicher Oberrhein	811	103.5	103.6	105.4	6.4	6.1	5.6	6.6	6.4	5.9
Unterer Neckar	812	121.4	121.4	125.1	8.3	8.1	7.4	10.1	9.8	9.3
Allgäu	901	97.9	97.8	98.7	6.3	5.5	4.8	6.2	5.4	4.7
Augsburg	902	116.2	115.4	115.6	6.7	6.3	5.5	7.8	7.3	6.4
Bayerischer Untermain	903	113.2	116.9	122.2	6.6	6.5	6.1	7.5	7.6	7.5
Donau-Iller (BY)	904	111.1	110.9	112.2	6.9	6.4	5.6	7.7	7.1	6.3
Donau-Wald	905	105.0	106.3	107.2	6.5	6.1	5.4	6.9	6.5	5.8
Industrieregion Mittelfranken	906	118.6	118.0	119.3	7.1	6.7	6.0	8.4	7.9	7.2

Table (Continuation)

Results of the 2016 Heat Monitor

Name of planning region	Number of ROR 2009	Annual heating energy consumption (kWh per squaremeter living space) Average			Heating energy prices (euro-cent per kilowatt hour) Median			Annual heating ernergy costs (euro per squaremeter living space) Average		
		2014	2015	2016*	2014	2015	2016*	2014	2015	2016*
Ingolstadt	907	109.9	107.8	104.5	6.6	6.3	5.3	7.3	6.8	5.6
Landshut	908	100.5	102.1	100.4	6.1	5.8	5.0	6.1	5.9	5.0
Main-Rhön	909	111.2	110.0	115.6	6.7	6.4	6.2	7.5	7.1	7.1
München	910	104.6	103.8	102.7	6.2	5.7	4.9	6.4	5.9	5.1
Oberfranken-Ost	911	110.4	111.4	111.9	6.9	6.6	5.7	7.6	7.3	6.4
Oberfranken-West	912	106.5	107.2	111.2	6.6	6.2	5.8	7.1	6.7	6.4
Oberland	913	103.0	102.8	100.3	6.7	6.0	4.9	6.9	6.2	4.9
Oberpfalz-Nord	914	109.0	108.7	114.9	6.7	6.0	5.8	7.3	6.5	6.7
Regensburg	915	109.1	109.7	111.0	6.5	6.1	5.3	7.1	6.7	5.9
Südostoberbayern	916	104.4	105.7	105.6	6.8	6.3	5.3	7.1	6.7	5.6
Westmittelfranken	917	114.2	115.6	117.0	7.1	6.5	5.9	8.1	7.5	6.9
Würzburg	918	111.4	110.2	111.3	6.7	6.3	6.0	7.5	6.9	6.7
Saar	1001	129.8	130.2	132.0	8.7	8.3	7.5	11.3	10.8	10.0
Berlin	1101	134.3	130.5	134.4	8.2	7.1	6.2	11.0	9.3	8.3
Havelland-Fläming	1201	117.6	115.8	122.3	7.3	6.9	6.4	8.6	8.0	7.8
Lausitz-Spreewald	1202	110.1	109.6	111.9	6.5	6.2	6.5	7.2	6.8	7.2
Oderland-Spree	1203	117.8	116.3	116.2	7.2	7.2	7.4	8.5	8.4	8.6
Prignitz-Oberhavel	1204	121.9	120.7	123.1	7.7	7.1	6.5	9.4	8.6	8.0
Uckermark-Barnim	1205	121.2	115.7	117.3	6.8	6.9	6.8	8.3	8.0	8.0
Mecklenburgische Seenplatte	1301	112.4	112.1	120.8	6.8	6.3	6.2	7.7	7.1	7.5
Mittleres Mecklenburg/Rostock	1302	101.9	105.7	109.1	5.0	5.0	5.0	5.1	5.3	5.5
Vorpommern	1303	105.2	105.6	106.3	6.4	6.1	5.7	6.7	6.5	6.1
Westmecklenburg	1304	107.6	109.6	112.8	6.8	6.5	6.5	7.3	7.1	7.4
Oberes Elbtal/Osterzgebirge	1401	103.7	103.9	106.9	6.3	6.1	5.8	6.5	6.3	6.2
Oberlausitz-Niederschlesien	1402	110.5	111.7	117.8	6.4	6.1	6.0	7.1	6.9	7.1
Südsachsen	1403	107.5	107.7	110.4	6.3	6.0	5.8	6.8	6.5	6.4
Westsachsen	1404	105.9	106.5	109.6	6.7	6.3	6.0	7.1	6.7	6.5
Altmark	1501	123.9	120.4	127.7	6.6	6.4	6.7	8.2	7.7	8.5
Anhalt-Bitterfeld-Wittenberg	1502	116.5	117.7	124.7	6.9	6.8	6.3	8.0	8.0	7.9
Halle/S.	1503	114.2	116.1	116.8	7.4	7.2	6.5	8.4	8.3	7.7
Magdeburg	1504	117.7	117.9	121.2	7.3	7.0	6.7	8.6	8.3	8.2
Mittelthüringen	1601	106.8	105.6	108.4	6.2	5.8	5.7	6.6	6.2	6.1
Nordthüringen	1602	113.1	112.5	113.7	6.1	6.0	6.0	6.9	6.7	6.8
Ostthüringen	1603	110.0	110.1	110.4	6.4	6.1	5.8	7.0	6.7	6.4
Südthüringen	1604	101.5	102.9	103.8	5.8	5.7	5.5	5.9	5.9	5.7
Federal State										
Schleswig-Holstein	1	130.7	129.3	133.7	7.8	7.2	6.5	10.3	9.3	8.8
Hamburg	2	136.0	140.0	146.1	7.9	8.1	7.8	10.8	11.4	11.4
Lower Saxony	3	125.2	124.3	128.1	7.0	6.7	6.3	8.8	8.3	8.1
Bremen	4	139.4	136.7	136.3	7.4	7.1	6.3	10.4	9.7	8.6
Northrhein-Westfalia	5	133.9	132.9	133.7	7.7	7.3	6.7	10.4	9.8	9.0
Hesse	6	125.1	124.2	128.5	7.5	7.0	6.5	9.3	8.7	8.4
Rheinland-Palatinate	7	127.7	126.0	130.7	7.7	7.3	6.9	9.8	9.2	9.1
Baden-Wuerttemberg	8	115.3	114.9	117.5	7.2	6.8	6.3	8.3	7.9	7.4
Bavaria	9	108.5	108.3	108.7	6.5	6.1	5.4	7.1	6.6	5.8
Saarland	10	129.8	130.3	132.1	8.7	8.3	7.5	11.3	10.8	10.0
Berlin	11	134.3	130.5	134.4	8.2	7.1	6.2	11.0	9.3	8.3
Brandenburg	12	116.8	115.0	118.2	7.1	6.8	6.6	8.3	7.8	7.8
Mecklenburg-Western-Pommerania	13	106.2	107.8	111.3	6.2	5.9	5.8	6.5	6.4	6.5
Saxony	14	106.4	106.8	110.0	6.4	6.1	5.8	6.8	6.5	6.4
Saxony-Anhalt	15	116.7	117.4	120.7	7.2	7.0	6.6	8.4	8.2	8.0
Thuringia	16	108.0	107.7	109.1	6.2	5.9	5.7	6.7	6.4	6.2
Germany		**122.6**	**121.9**	**124.4**	**7.3**	**6.9**	**6.3**	**8.9**	**8.4**	**7.9**
Eastern Germany		**117.7**	**116.6**	**119.9**	**7.1**	**6.6**	**6.1**	**8.4**	**7.7**	**7.3**
Western Germany		**124.4**	**123.8**	**126.0**	**7.3**	**7.0**	**6.4**	**9.1**	**8.6**	**8.1**

** Preliminary.*

Note: Adjusted for climate and weather.

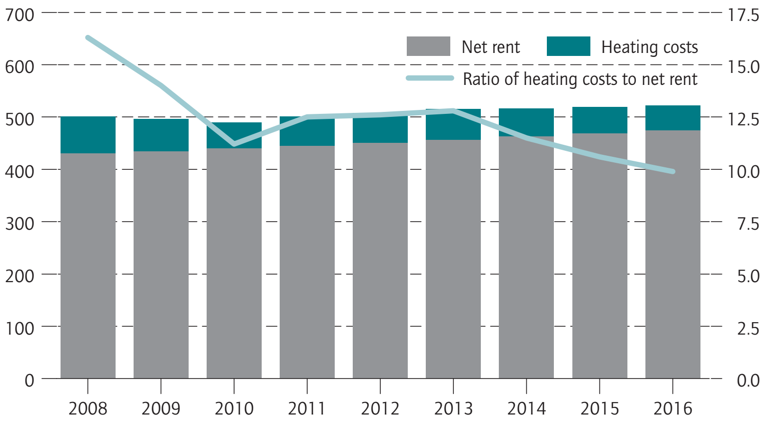
Heating energy prices are calculated as a weighted average of natural gas and oil prices. For some regions, values have been substantially revised for 2015 comapred to the publication from last year.

Sources: ista Germany GmbH; authors' own calculations.

Figure 5

Net rent and monthly heating costs

Costs in euro for an average flat



Source: ista Germany GmbH; Federal Statistical Office; authors' own calculations.

The "second rent" has declined substantially over the past years.

decreased markedly thanks to the significant drop in energy prices. On average, households had to pay about six percent less for heating in the 2016 heating period than they did one year prior (see Figure 4). In comparison to 2013, they experienced cumulative relief of 20 percent.

Overall, monthly heating costs in 2016 accounted for just under ten percent of the average rent minus heating costs, which was 475 euros for an apartment measuring 71 square meters.[9] The average heating costs were around 47 euros per month (see Figure 5). The annual average heating costs were equal to more than rent for a 13th month. This "second rent" is a significant burden for household budgets.

However, the "second rent" that households pay is not nearly as high as it was just ten years ago. In 2008, heating costs were a good 16 percent of the average rent minus heating costs. Back then, households had to spend the equivalent of two months' rent to heat their apartments.

9 The values are based on information from the German Federal Statistical Office. See German Federal Statistical Office and Berlin Social Science Center, "Wohnen," *Datenreport 2016: Sozialbericht für Deutschland* (2016): 259–274.

Limited leeway for rent increase after energy-efficiency upgrades

In the debate surrounding the socially sustainable implementation of the energy transition, many argue that rent increases after comprehensive energy-efficiency upgrades should not exceed the savings on heating costs. However, the current options for raising rents are not oriented toward savings. Instead, a portion of the cost of upgrading can be passed onto tenants following the general method of modernization apportionment. The rule is that annual rent can increase to a maximum of 11 percent of modernization costs eligible for apportionment. In regions with tight housing markets, owners typically take full advantage of this option. Many reports state that increases in rent are significantly higher than the savings on energy costs.[10]

We used the numbers presented here as a starting point, assuming that a building would meet "passive house" standards after comprehensive upgrading, meaning that it would require very little energy for heating or cooling. In this scenario, the apportionable renovation costs for an average apartment of 71 square meters could not exceed 5,112 euros, or 72 euros per square meter. Establishing passive structure standards in an existing apartment building is a very ambitious plan to begin with, and that sum of money appears to be woefully inadequate. The financial incentive for comprehensive upgrading is limited if rental income cannot subsequently increase.

Obviously, modernization apportionment as an instrument for energy-efficiency upgrades is not particularly effective. The interests of tenants and investors can quickly diverge and result in conflict. The situation could be resolved using alternative financing models. For example, as part of energy savings performance contracts (ESPCs), investments in energy efficiency could be financed with the money saved without burdening tenants with any higher costs. This approach could be expanded to include entire city blocks in order to exceed critical project sizes, increase renovation projects' economies of scale, and reduce project risks.[11]

10 See for example: "Mieterverein beklagt teure Modernisierung," (News article, *Süddeutsche Zeitung*, Munich, 2017). (available online, accessed September 5, 2017).

11 ESPCs are models in which a service provider instead of the building owner invests in a building's energy efficiency or system technology. The owner and service provider conclude a contract that ideally is designed to keep tenants' energy costs constant or lower than they were before the investment. The difference between payment and actual energy cost is the service provider's profit, which is usually limited to a period of 10 to 15 years. This refinances the investment without making tenants pay higher costs. For a detailed discussion, see Claus Michelsen, Karsten Neuhoff, and Anne Schopp, "Using Equity Capital to Unlock Investment in Building Energy Efficiency?" *DIW Economic Bulletin* no. 19 (2015): 259–265 (available online, accessed September 5, 2017) or Claus Michelsen, "Wärmemonitor 2015: mit der Erfahrung kommt der Sanierungser-

Conclusions

The success of the energy transition will primarily be achieved by improving the energy efficiency of the housing stock. The plan is to expend a total of 20 percent less energy on heating living space by 2020 than in baseline year 2008. The numbers presented here show that the current trend in heating energy consumption is lower than the level required to achieve the target. In the remaining four years until 2020, energy demand must fall by an additional ten percent. This appears to be unrealistic. At the same time, the trend of continuously decreasing energy demand remains unchanged.

In the past 15 years, Germany has reduced the heating energy households require to heat living space by around 20 percent.

In the absence of that development, the "second rent," which is the basis for determining heating costs, would be much higher. In recent years, households have also benefited from the drop in heating energy prices. The overall situation has led to a cost burden on households that is only around two-thirds of what was expended on heating living space in 2008. Households can permanently plan to use the cost savings for other purposes. It would thus be wrong to reduce the efforts at increasing energy efficiency to short-term relief due to decreasing energy prices. Rather the focus should be on developing affordable solutions and alternative financing models that strike a balance between the interests of investors and tenants.

folg," *DIW Wochenbericht* no. 39 (2016): 880–890 (available online, accessed September 5, 2017).

Claus Michelsen is Research Associate at the Climate Policy and the Forecasting and Economic Policy Department at DIW Berlin | cmichelsen@diw.de

Nolan Ritter is Research Associate at the Climate Policy Departement at DIW Berlin | nritter@diw.de

JEL: R31, Q21, Q40

Keywords: apartment buildings, energy efficiency, residential heating energy demand