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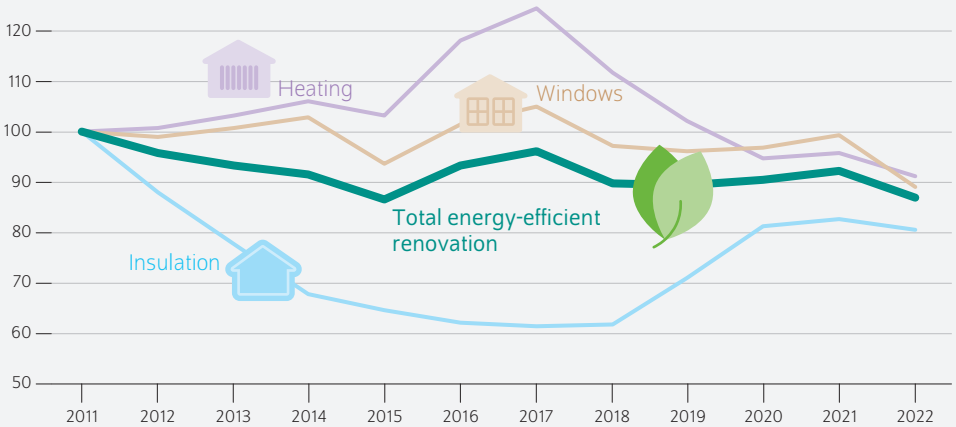
AT A GLANCE

Investments in energy-efficient building renovation are on a downward slide

By Martin Gornig and Katrin Klarhöfer

- Building sector has a high potential to reduce greenhouse gas emissions, but regularly fails to meet targets
- Combining the DIW Berlin construction volume calculation and the Heinze modernization volumes show development of investments in increasing the savings potential in the building sector
- First calculations on real development show that instead of catching up, investments in energy-efficient renovation are on a rapid downward slide
- Despite initial policy measures, subsidies are too low in view of price increases

Investments in energy-efficient building renovation are on a downward slide; potential for reducing green house gas emissions is not being met



13%

Adjusted for price effects, investments are 13 percent lower than in 2011.

Sources: DIW Construction Volume Calculation, Heinze GmbH Modernization Volume, and authors' calculations. Note: Index 2011 = 100.

FROM THE AUTHORS

"Not only does the building sector, where there is really great potential to reduce greenhouse gas emissions, regularly fail to meet its policy targets, but in real terms, there is not even progress. In contrast: Investments in energy-efficient renovation have been rapidly declining for years."

— Martin Gornig —

MEDIA

Audio Interview with Martin Gornig (in German)
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Investments in energy-efficient building renovation are on a downward slide

By Martin Gornig, and Katrin Klarhöfer

ABSTRACT

According to the latest review report of the Council of Experts on Climate Change, the German building sector failed to meet its greenhouse gas emission reduction targets in 2022. This is in part because investments in energy-efficient building refurbishment—supported by all kinds of policy measures—has neither been low nor shown a consistently positive trend over the past ten years. Furthermore, data from the DIW Berlin construction volume calculation and the Heinze GmbH modernization volume show the price-adjusted development of investments in energy-efficiency building renovation for the first time. There have been significant declines in investments in insulation, the replacement of windows and exterior doors, and the renewal of heating systems in many years. Although policymakers are currently making funds available to provide more support for such investments again, the subsidy volume is likely to be too low considering current and likely further price developments. However, a coordinated expansion of production as well as installation capacities is required to prevent additional funding from being canceled out by price effects.

The most recent review report of German greenhouse gas emissions from the Council of Experts on Climate Change has determined that the building sector did not meet its reduction targets in 2022.[1] In addition, the energy price increases as a result of the Ukraine war have made energy conservation an increasingly higher priority for policymakers.

Reducing heating energy consumption in the building stock is one way to significantly reduce greenhouse gas emissions. For over a decade, there have been calls to improve the energy condition of the building stock by increasing building envelope insulation (walls, windows, roof) and installing more efficient heating systems.[2] Politicians attempted to provide incentives for energy-efficient renovation through energy performance certificates and stricter immission control ordinances as well as various subsidy programs. For example, the *Kreditanstalt für Wiederaufbau* spent a total of around 43 billion euros in funding for the *Energieeffizient Sanieren* program alone between 2011 and 2021.[3]

This Weekly Report presents the development of the renovation market[4] as well as the successes and failures of previous policy measures. However, it is difficult to evaluate the extent to which these measures can improve the energy condition of the building stock. Detailed studies on the energy condition of buildings are extremely complex and only available for individual years.[5] Rough trends in the development of

1 Expertenrat für Klimafragen, *Prüfbericht zur Berechnung der deutschen Treibhausgasemissionen für das Jahr 2022* (2023) (in German; available online. Accessed on July 28, 2023. This applies to all other online sources in this report unless stated otherwise).

2 Jürgen Blazejczak, Dietmar Edler, and Wolf-Peter Schill, "Steigerung der Energieeffizienz: ein Muss für die Energiewende, ein Wachstumsimpuls für die Wirtschaft," *DIW Wochenbericht* no. 4 (2014): 47-60 (in German; available online).

3 Kreditanstalt für Wiederaufbau, *Neuzusagen Inlandsfinanzierung, KfW Förderreport* (in German).

4 The results presented here are based on analyses that are funded by the *Forschungsförderung Zukunft Bau* (File: 10.08.17.7-20.11), the Federal Ministry for Housing, Urban Development and Building, and the *Ressortforschungsplan* (Research code: 3718 14 100 0) of the Federal Ministry for for Environment, Nature Conservation and Nuclear Safety.

5 Holger Cischinsky and Nikolaus Diefenbach, *Datenerhebung Wohngebäudebestand 2016. Forschungsbericht* (Darmstadt: Institut Wohnen und Umwelt, 2018) (in German; available online); Michael Hörner, Markus Rodenfels, and Holger Cischinsky, *Der Bestand der Nichtwohngebäude in Deutschland ist vermessen. Projektinformationen* (Darmstadt: Institut Wohnen und Umwelt, 2021) (in German; available online).

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energy-efficient renovation measures can be identified using small samples, but only in the case of residential building stock. According to this data, the energy-efficient renovation rate, which is the share of a building's surface area that has undergone energy-efficient renovation in a certain year, has hardly changed since 2000 and is estimated to be less than one percent for 2017.[6]

Energy-efficient renovation can also be quantified differently

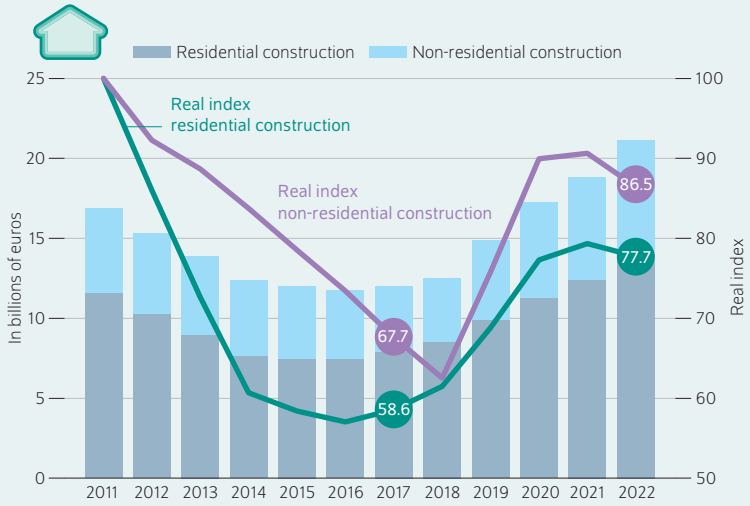
An alternative approach for measuring energy-efficient renovation is based on the amount of money invested in this type of renovation instead of using physical indicators. How much has been spent on energy-efficient renovation can be estimated by observing construction activity. However, it is not possible to determine the specific additional amount spent on improving energy efficiency that results, for example, from installing a triple-glazed window compared to a double-glazed window. Nonetheless, it is possible to determine the total cost of window installation, including preparatory and finishing work. These gross costs are much higher than the additional spending specifically related to energy-efficient renovation.[7] Previous studies on residential construction suggest that the investment costs are twice as high as the specific additional spending.[8]

The total amount invested in energy-efficient building renovation can be estimated by breaking down aggregate statistical official evaluations that are a part of DIW Berlin's construction volume calculation and by extrapolating survey results from the construction service provider Heinze GmbH's modernization volume (Box). The Federal Institute for Research on Building, Urban Affairs and Spatial Development[9] and the Federal Environment Agency[10] regularly publish these results on the investment volume in the energy-efficient renovation of residential and non-residential buildings. In the following sections, a differentiated evaluation of three energy-efficient renovation sectors is presented.

In response to the strong price increases over the past years, the real development of investments in energy-efficient renovation are also presented here for the first time. In spite of that, the official price statistics do not directly reflect the individual energy-efficient renovation sectors. Roof/wall insulation, windows/doors, and heating/air conditioning are thus assigned to price indices for suitable product areas and economic classes. Real values are calculated as a volume index at constant reference year (2015) prices.

Figure 1

Investments in roof, basement, and exterior wall insulation
In billions of euros at current prices, as an index of price-adjusted values, 2011 = 100



Sources: DIW Construction Volume Calculation, Heinze GmbH Modernization Volume, and authors' calculations.

Investments experienced strong growth again after 2018, but have not reached the 2011 level again in price-adjusted terms.

Real investments in energy-related renovation declined from 2011 to 2022

Wall and roof insulation have only recovered slightly after slowdown

A significant share of energy-efficient renovation is in improving the building envelope insulation. At current prices, nearly 12 billion euros were invested in insulating roofs, basement ceilings, and facades of residential buildings in 2011. In addition, roughly five billion euros were spent on insulating commercial and public non-residential buildings (Figure 1). In terms of value, insulation was thus the most important sector of energy-efficient renovation for both residential and non-residential buildings.

After 2011, the nominal amount invested in insulation, especially of residential buildings, declined strongly. In 2016, only a little more than seven billion euros was spent on insulating the facades and roofs of residential buildings. One reason for the slump in investment is likely to have been the fledgling debate on the fire safety of insulation materials. Since 2017, however, investments have been

6 Puja Singhal and Jan Stede, "Wärmemonitor 2018: Steigender Heizenergiebedarf, Sanierungsrate sollte höher sein," *DIW Wochenbericht*, no. 36 (2019) (in German; available online).

7 However, such general costs, such as for building equipment, can only be allocated proportionally to energy-efficient renovation if other modernization measures are carried out at the same time.

8 Institut der deutschen Wirtschaft, *Energetische Modernisierung des Gebäudebestandes: Herausforderungen für private Eigentümer. Untersuchung im Auftrag von Haus & Grund Deutschland* (2012) (in German; available online); prognos, *Ermittlung der Wachstumswirkungen der KfW-Programme zum Energieeffizienten Bauen und Sanieren. Untersuchung im Auftrag der KfW-Bankengruppe, Berlin* (2013) (in German).

9 Including photovoltaics: Martin Gornig, Claus Michelsen, and Hannah Révész, "Strukturdaten zur Produktion und Beschäftigung im Baugewerbe – Berechnungen für das Jahr 2020," *BBSER-Online-Publikation* 32 (2021) (in German; available online).

10 Without photovoltaics: Jürgen Blazejczak et al., "Ökonomische Indikatoren von Maßnahmen zur Steigerung der Energieeffizienz – Materialien Berichtsjahr 2019," *DIW Politikberatung kompakt*, no. 174 (2021) (in German; available online).

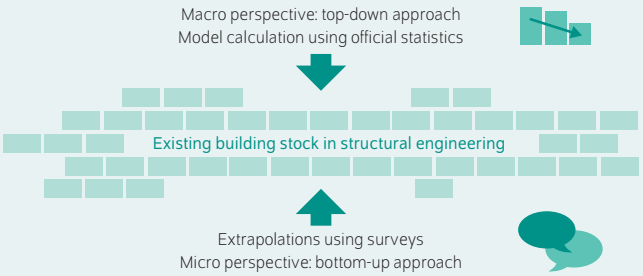
Box

Determining the value invested in energy-efficient building renovation

The total amount of money invested in energy-efficient building renovation is estimated by breaking down aggregate statistical official evaluations from DIW Berlin's construction volume calculation as well as using extrapolations of survey results from constuction service provider Heinze GmbH's modernization volume (Figure).

Figure

Analytical approach for determining investments in the building stock



Source: Authors' depiction.

The extent of construction measures on the building stock is narrowed down by statistical model calculations and survey-based extrapolations.

The DIW Berlin construction volume contains the total of all services that are involved in the construction or maintenance of buildings and structures. In this respect, the calculation goes beyond the construction investments figures of the Federal Statistical Office because their figures do not take into account consumable construction services, which are primarily repairs that do not increase in value (i.e., maintenance services provided by the main construction and finishing trades). Unlike in the official statistics, the DIW Berlin construction volume differentiates between construction services on the existing building stock and on new buildings.

Existing measures, or rather the volume of existing construction measures are estimated from a macro perspective by looking at the differences between total construction output according to construction statistics and new construction output derived from construction activity statistics.[1] This has the advantage of allowing consistent comparisons over time. However, the model calculations using the difference in differences approach lack structural information.

To identify structural information, the extrapolation results on the modernization volume, which is based on survey results, are used.

The extrapolation results are based on special analyses on the years 2010, 2014, 2018, and 2020 by Heinze GmbH.[2]

In Heinze GmbH's studies, the modernization volume is calculated by linking secondary statistical market data with survey results from target groups relevant to the modernization market. The main source of housing market data is a survey of representatively selected tenant and owner households. In addition, commercial housing developers are surveyed. The results for non-residential construction are based on evaluations of questionnaires on modernization measures run by architects. In addition, surveys of tradespeople are used. Using these sources, the existing measures can be differentiated by sector. Insulation measures (roofs, facades, etc.); replacement of windows and exterior doors; and the renewal of heating, air conditioning, and ventilation systems are considered components of energy-efficient renovation.

Structural information on the importance of the above sectors from a micro approach is consistently integrated into DIW Berlin's construction volume calculation.[3] A prerequisite for this is that the results of the two methods correspond with each other. This applies to the quantitative total result as well as the specific definition of construction services. Thus, investment construction services are the focus of the Heinze GmbH survey results. Due to its connection to the architect survey, this applies to non-residential construction especially. In the case of residential construction, on the other hand, work performed by the occupant, including neighborhood assistance and undeclared work, is not valued, unlike in the construction volume calculation.

The structural information gleaned from the Heinze GmbH surveys is therefore not directly related to the construction volume as a whole, but only to the investment part. A model calculation to separate construction services into investment and non-investment measures is required to integrate the values from the Heinze structural information. For this purpose, DIW Berlin specifically evaluated the structural information on repair measures from the Heinze surveys and made corresponding extrapolations for the average maintenance measures. The measures were differentiated over time by linking them to the development of gross fixed assets in structural engineering, for which DIW Berlin developed special model calculations.[4]

1 Martin Gornig, Claus Michelsen, and Hannah Révész, "Strukturdaten zur Produktion und Beschäftigung im Baugewerbe."

2 Christian Blanke and Katrin Klarhöfer, "Bestandsinvestitionen 2020. Struktur der Investitionstätigkeit in den Wohnungs- und Nichtwohnungsbeständen," *BBSR-Online-Publikation*, no. 39 (2022) (in German; available online).

3 For more on the method, compare with Gornig, Michelsen, and Révész, "Strukturdaten zur Produktion und Beschäftigung im Baugewerbe."

4 Susanne Hotze et al., "Struktur der Bestandsinvestitionen 2014. Investitionstätigkeit in den Wohnungs- und Nichtwohnungsbeständen," *BBSR-Online-Publikationen*, no. 03 (2016) (in German; available online).

increasing; in 2022, investments were nearly 2.5 billion euros higher in nominal terms than in 2011. In any case, when considering the enormous price increases over the past few years, the real value of investments in the insulation of residential buildings in 2022 was more than 20 percent less than the value in 2011.

The insulation of non-residential buildings developed only slightly more favorably. By 2018, expenditure on the insulation of roofs, basements, and facades declined to below four billion euros and was thus 25 percent below the 2011 value. Since 2019, however, marked nominal increases have been observed. In 2022, investments in the insulation of non-residential buildings were below the reference year value as well by nearly 15 percent in price-adjusted terms.

Little growth in window and exterior door replacements

The development of window and exterior door replacement in residential buildings has been markedly more stable than the development of roof and facade insulation (Figure 2). In current prices, spending increased almost across the board from nearly 12 billion euros in 2011 to 17 billion euros in 2022, with only one brief interruption in growth in 2015. Nevertheless, growth in real investment in window/exterior door replacement was in decline over the entire observation period. The total nominal growth from 2011 to 2022 was more than canceled out by price increases. In real terms, overall investment in replacing windows and exterior doors of residential buildings was temporarily even markedly higher than currently: For example, it is 15 percent lower than in 2017.

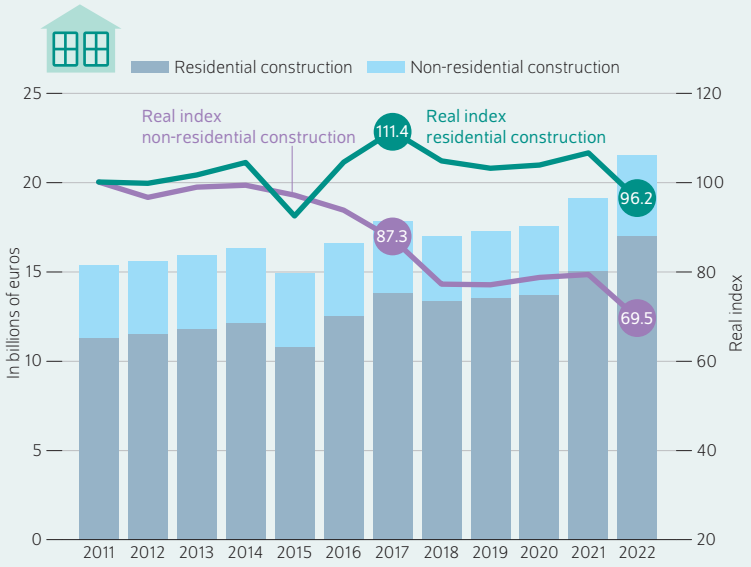
In price-adjusted terms, investments in the replacement of windows and exterior doors of commercial and public non-residential buildings declined even more markedly during the observation period. In 2022, real investments were 30 percent lower than in 2011. In nominal terms, about four billion euros are spent on window and exterior door replacements by commercial and public building owners today, as in 2011.

Renewal of heating systems remains below previous peak values

In contrast to energy-efficient retrofitting of building envelopes via insulation or the replacement of windows and exterior doors, spending on renewing heating systems, at least for residential buildings, has experienced strong growth (Figure 3). In 2011, nearly ten billion euros were spent on renewing heating systems in residential buildings. In 2022, in contrast, the amount was significantly over 17 billion euros. Even though heating construction prices rose even more sharply than prices for energy-saving measures on the building envelope, the increases in spending were still sufficient to increase real investments in the renewal of heating systems in residential buildings. In 2022, the total investments were around ten percent higher than the 2011 level

Figure 2

Investments in the replacement of windows and exterior doors
In billions of euros at current prices, as an index of price-adjusted values, 2011 = 100



Sources: DIW Construction Volume Calculation, Heinze GmbH Modernization Volume, and authors' calculations.

Spending measured in current prices changed very little between 2011 and 2020. The nominal increases in 2022 were lower than the price increases.

in price-adjusted terms. Nonetheless, investment activity has declined compared to 2016 to 2018. For example, nearly 20 percent less was invested in the renewal of heating systems in residential buildings in real terms compared to 2017.

Investments in heating and air-conditioning (AC) technology for non-residential buildings have been on a positive upward trend for many years. From 2011 to 2017, spending on heating and AC technology increased annually from roughly six billion euros in 2011 to nearly nine billion in 2019. Moreover, because the increase in expenditure outpaced price increases in this sector, real investment rose as well. Since 2018, however, commercial and public building owners' spending has declined and, as of 2022, was barely above the 2011 values. As heating and AC technology prices increased strongly at the same time, real investments declined by nearly 40 percent compared to 2011.

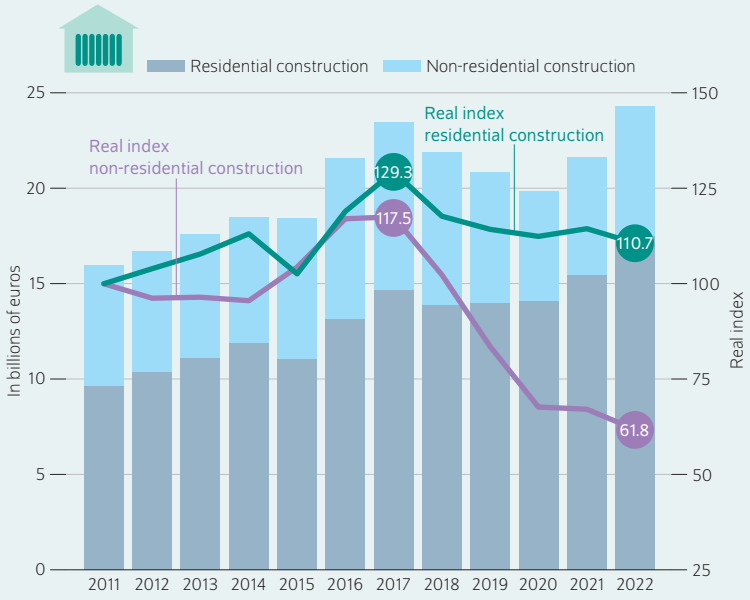
Energy-efficient renovation as a whole has not made any headway for years

A sobering picture emerges when combining the results for investments in the individual sectors of energy-efficient building renovation. From 2011 to 2022, annual spending on energy-efficient renovation increased by nearly 40 percent to 67 billion euros. However, considering the recent significant price increases, the real investment overall is well below the level of the early 2010s (Figure 4). The first nadir of real

Figure 3

Investments in the renewal of heating and air conditioning systems

In billions of euros at current prices, as an index of price-adjusted values, 2011 = 100



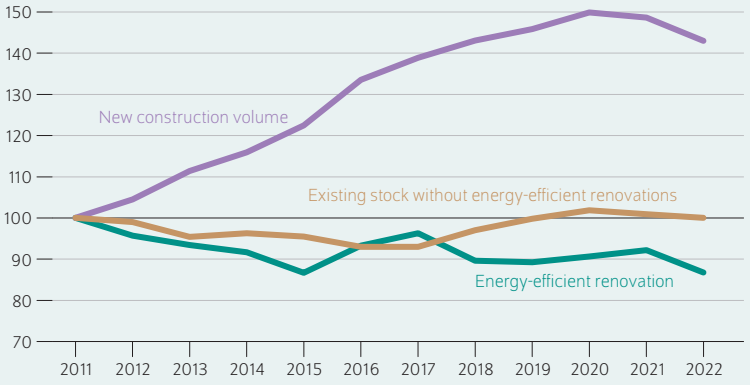
Sources: DIW Construction Volume Calculation, Heinze GmbH Modernization Volume, and authors' calculations.

Price-adjusted investments in non-residential construction collapsed after 2017. In residential construction, the decline was more moderate.

Figure 4

Development of real investments in energy-efficient building renovation, in existing building stock, and newly constructed buildings

Index 2011 = 100



Sources: DIW Construction Volume Calculation, Heinze GmbH Modernization Volume, and authors' calculations.

Real investments in energy-efficient renovation have developed less favorably than that in new construction and less than other measures in the existing building stock.

investments in energy-efficient renovation was in 2015 and was followed by a significant recovery in investment activity. Since 2018 the annual amount invested in real terms has remained well below the level of the reference year. A new nadir was reached in 2022 due to the strong price increases; the real investment volume is now 13 percent lower compared to 2011.

Investment activity in energy-efficient renovation developed markedly worse than in other structural engineering sectors. Construction of new housing and non-residential buildings in particular experienced strong growth despite the current weak phase. Investments in new construction increased from 2011 to 2022 by over 43 percent in price-adjusted terms. Other measures on existing buildings besides energy-efficient renovation, such as the modernization of sanitary facilities or general maintenance, could result in slight real growth over the entire period at the very least. Following a weak phase in the early 2010s, investments are picking up noticeably: For example, the amount invested in 2022 was seven percent higher compared to 2017.

In recent years, there have been many discussions on the necessity of improving the energy efficiency of the building stock. Policymakers have repeatedly attempted to stimulate investment activity through relevant subsidy programs. Overall, however, energy-efficient building renovation has not made any headway in the last decade. The data available cannot determine which reasons are decisive when deciding to invest in energy-efficient renovation or not in individual cases. Nevertheless, the time course in particular offers indications of possible decisive determinants.

The diverse regulations for residential building construction are frequently cited as a reason for the low growth in energy-efficient building renovation.[11] In the case of rented residential property, the landlord incurs the costs but the tenant generates the income (user-investor dilemma). In this case, energy-efficient renovation is financed by a rent surcharge. Whether this surcharge is permitted depends on a few factors, such as the conditions of the respective local rental market and rental regulations. Accordingly, new models for a heating cost tax or carbon tax to be borne by the tenant are being discussed again and again.[12] However, when observing the distribution of the investment shares of renters and owner-occupiers in the last ten years, it has barely changed (Figure 5). This suggests that the user-investor dilemma on its own is not responsible for the fluctuations in investment volume and thus has not decisively hindered the development of investments in energy-efficient building renovation.

11 Blazejczak, Edler, and Schill, "Steigerung der Energieeffizienz," Institut der deutschen Wirtschaft, *Energetische Modernisierung des Gebäudebestandes*.

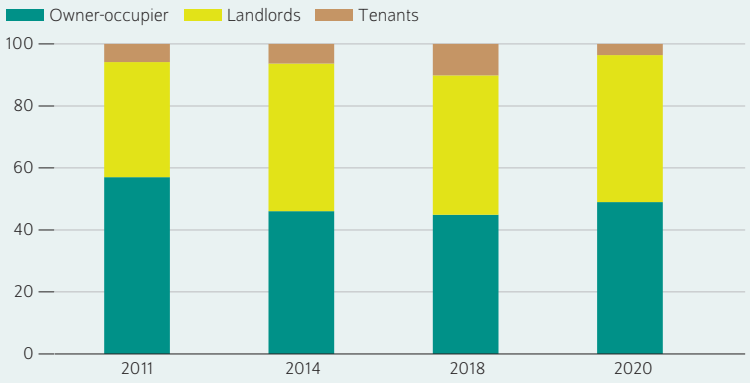
12 Ralph Henger et al., "CO2-Kosten-Stufenmodell: Richtige Logik, aber falsche Bemessung," *IW-Kurzbericht*, no. 43 (2022) (in German; available online).

In contrast, fluctuations in energy prices seem to correlate clearly in some cases with changes in investments in energy-efficient building renovation. For example, the weighted prices of gas and oil declined noticeably from 2014 to 2017.[13] At the same time as energy prices were in decline, investments in building envelope renovations in non-residential construction in particular fell sharply. With energy price increases starting as early as 2021, spending on energy-efficient building renovation picked up across the board.

In recent years, however, these increases in spending have been eroded to a large extent by price rises. Price-adjusted, total investments in energy-efficient renovation from 2019 to 2021 only increased moderately; in 2022, there was even a decline. High capacity utilization in the structural engineering sector is a key reason as to why this additional spending has been canceled out by price increases. New residential construction in particular tied up more and more capacity in the construction industry in the years leading up to 2021. In 2022, partial material shortages and price explosions led to production losses.[14]

Figure 5

Owner-occupiers and tenants as investors in energy-efficient building renovation
Shares in percent



Sources: DIW Construction Volume Calculation, Heinze GmbH Modernization Volume, and authors' calculations.

The shares of the investing groups have not changed significantly over the years.

Conclusion: Energy-efficient renovation must gain momentum again

In response to the review report by the Council of Experts on Climate Change, the German Federal Government has developed approaches for speeding up the reduction of greenhouse gas emissions in the building sector.[15] The Federal Ministry for Housing, Urban Development and Building's climate change mitigation emergency program focuses on the energy-efficient renovation of municipal buildings.[16] At the same time, a sharp increase in subsidies for energy-efficient renovation in the residential sector is planned. The Federal Ministry for Economic Affairs and Climate Action plans to use annual subsidies of around 13 billion euros for this purpose,[17] which is over three times as much as the average for the past 12 years. Moreover, the plans to transition to renewable energy sources for heating technology are also likely to stimulate the investment activity.[18]

The framework conditions for increasing investments in energy-efficient renovation of the building stock seem to be rather favorable to some extent. Energy prices are likely to remain high for the medium term, which is motivating private building owners in particular to invest in energy-efficient building renovation. New construction of residential and non-residential buildings is declining and is unlikely to quickly return to the level of the early 2020s,[19] leaving more capacity that could be used for the energy-efficient renovation of existing buildings.

However, the challenge remains enormous. In view of the weak real investment activity in recent years, energy-efficient building renovation activity needs to be quadrupled. For example, an increase in the renovation rate from an average of around one percent over the last decade to a target of four percent is considered necessary.[20] If the goal is to quadruple the renovation rate, nominal increases would need to be even greater to compensate for rising construction and financing costs. The interest on construction loans has nearly tripled. Since 2020, construction prices have risen by around 20 percent.[21] Accordingly, significantly higher subsidies could be required than are currently planned.

Capacity constraints also remain a problem despite the lull in new residential construction. To prevent further additional subsidies from being canceled out by price effects, an expansion of production and installation capacities is required with the goal of coordination between producers

13 Singhal and Stede, "Wärmemonitor 2019."

14 Martin Gornig and Laura Pagenhardt, "Construction boom coming to an end; change in policy strategy needed," *DIW Weekly Report*, no. 1/2 (2023): 3-14 (available online).

15 BMWK, *Entwurf eines Klimaschutzprogramms 2023 der Bundesregierung* (June 13, 2023) (in German).

16 BMWSB, "Klimaschutzsofortprogramm des Bundesbauministeriums ist Teil der Klimaschutzprogramms der Bundesregierung," press release from July 18, 2023 (in German; available online).

17 Bundesregierung, "Förderprogramm hilft bei der energetischen Sanierung. Gebäudeförderung für Sanierungen," press conference (2022) (in German; available online).

18 Deutscher Bundestag, "Gesetzentwurf zur Änderung des Gebäudeenergiegesetzes," *Bundestags-Drucksache* 20/6875 2023 (in German; available online).

19 Martin Gornig und Claus Michelsen, *Wohnungsbaupolitik auf dem Drahtseil* (Makronom: 2022) (in German; available online).

20 Sophie M. Behr, Merve Kücük, and Karsten Neuhoff, "Energetische Modernisierung von Gebäuden sollte durch Mindeststandards und verbindliche Sanierungszielebeschleunigt werden," *DIW aktuell*, no. 87 (2023) (in German; available online).

21 Martin Gornig and Laura Pagenhardt, "Abwärtstrend im Wohnungsbau: Kein Grund zur Panik, aber Handlungsdruck auf die Politik wächst," *Ifo Schnelldienst* (2023): 25-28 (in German; available online).

of intermediate goods such as insulation or windows, construction companies, and public and private investors. In this case, a coordination office could be set up to ensure subsidies are used efficiently in creating material and craftsman capacities, following the example of the United States' approach to building vaccination capacity during the coronavirus pandemic.[22]

22 Heike Belitz and Martin Gornig, "Industriepolitik: Technologieorientierte öffentliche Investitionsfonds als neues Element," *DIW aktuell*, no. 71 (2021) (in German; available online).

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