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277 **Report** by Martin Gornig and Katrin Klarhöfer

Energy-efficient building renovation: Price-adjusted investments declining; trend reversal needed to reach climate targets

- Energy-efficient building renovation investments have increased in nominal terms but declined in price-adjusted terms since 2013
- Not enough energy-efficient building renovation has occurred to achieve climate targets in building sector
- German Federal Government must provide more funding to reverse the trend

LEGAL AND EDITORIAL DETAILS

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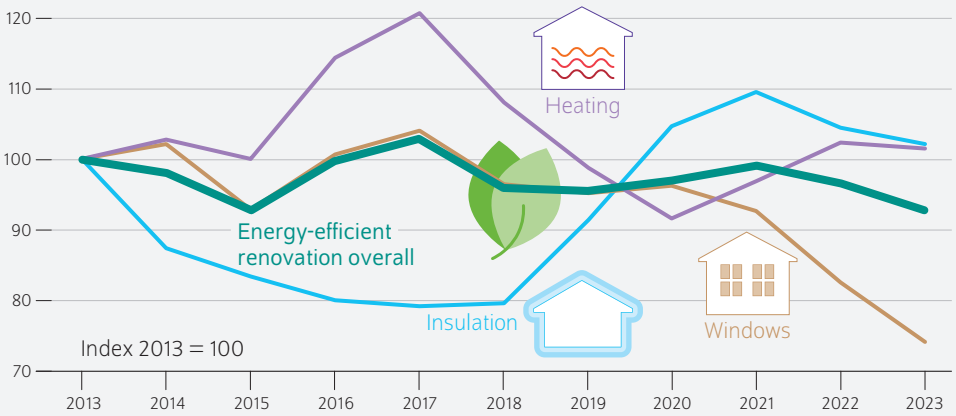
AT A GLANCE

Energy-efficient building renovation: Price-adjusted investments declining; trend reversal needed to reach climate targets

By Martin Gornig and Katrin Klarhöfer

- Investments in energy-efficient building renovation in Germany increased by 12 billion euros to 72 billion euros between 2021 and 2023, in part due to rising energy prices
- However, investments fell by over six percent in price-adjusted terms because due to the simultaneous increase in construction prices
- To achieve climate targets, considerably more real investments in insulation, new windows, heating, and other measures are needed
- Also needed are corresponding framework conditions as well as investment aid in Germany and across Europe
- German Federal Government increased funding for 2024 to 16.7 billion euros, but more is needed to reverse the trend in energy-efficient renovation

Excluding price increases, property owners have been investing less in energy-efficient renovation in 2024 compared to 2014



7%

less was invested in energy-efficient renovation measures in real terms in 2023 compared to 2013

Sources: DIW Berlin Construction Volume; Heinze GmbH Modernization Volume; authors' calculations.

FROM THE AUTHORS

"Most energy-efficient renovation is performed on residential buildings. However, commercial and public buildings also hold an enormous amount of potential. Sometimes these buildings are so poorly insulated that larger investments could possibility reduce heating emissions in this area faster."

— Martin Gornig —

MEDIA

Audio Interview with Martin Gornig (in German)
www.diw.de/mediathek

Energy-efficient building renovation: Price-adjusted investments declining; trend reversal needed to reach climate targets

By Martin Gornig and Katrin Klarhöfer

ABSTRACT

In light of rising oil and gas prices, investments in energy-efficient building renovation in Germany have risen recently in nominal terms. In 2023, around 72 billion euros were spent on the energy-efficient renovation of residential, public, and commercial buildings, about 12 billion more than in 2021. Nevertheless, investments declined by over six percent in price-adjusted terms, as construction prices rose sharply during this time as well. To reach climate targets, however, significantly more real investments in energy-efficient building renovation are needed, as are framework conditions in Germany and Europe. Investment aid for energy-efficient renovation measures also plays an important role. The German Federal Government increased funding for these measures for 2024 to 16.7 billion euros. However, policymakers will need to provide even more funding in the future due to rising financing and construction costs if they actually want to increase the rate of energy-efficient building renovation.

In its most recent report, the Council of Experts on Climate Change warned that much more progress needs to happen in the building sector than has occurred to date to reach the greenhouse gas reduction targets in Germany.[1] 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]

Energy-efficient renovation is difficult to measure, but there are suitable indicators

It is difficult to evaluate the extent to which energy-efficient renovation measures have actually improved the energy condition of the building stock over the past years. Detailed studies on this topic are extremely complex and only available for specific years.[3] Studies based on smaller samples can only determine rough trends in the development of energy-efficient building renovation over a few years. Moreover, they are limited to the existing residential building stock. According to the available data, the annual 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.[4]

An alternative approach for measuring energy-efficient renovation is based on the amount of money invested in this type of renovation instead of focusing on physical indicators.

1 Expert Council on Climate Change, *Review of Projection Data: Compliance with climate target for 2021 to 2030 not confirmed. Special Report in accordance with Section 12 (4) KSG* (2024).

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). Accessed on November 4, 2024. This applies to all other online sources in this report unless stated otherwise).

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

4 Puja Singhal and Jan Stede, "Wärmemonitor 2018: Steigender Heizenergiebedarf, Sanierungsrate sollte höher sein," *DIW Wochenbericht* no. 36, 519–628 (in German; available online).

DOI: https://doi.org/10.18723/diw_dwr:2024-46-1

Box

Determining investments in energy-efficient building renovation

Investments in energy-efficient building renovation are estimated by combining aggregate statistical official evaluations from the DIW Construction Volume that have been broken down with extrapolated survey results from the construction service provider Heinze GmbH's Modernization Volume (Figure). The DIW Construction Volume contains the total of all services that are involved in the construction or maintenance of buildings and structures. In this respect, the Construction Volume goes beyond the construction investment 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 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 approach lack structural information.

To identify such structural information, the results from the model calculations based on official statistics are considered. These are then compared with extrapolations of modernization volumes based on surveys. The extrapolation results are based on special analyses on the years 2014, 2018, 2020, and 2022 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 construction volume calculation. 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.

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 structural information from Heinze. 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.[3]

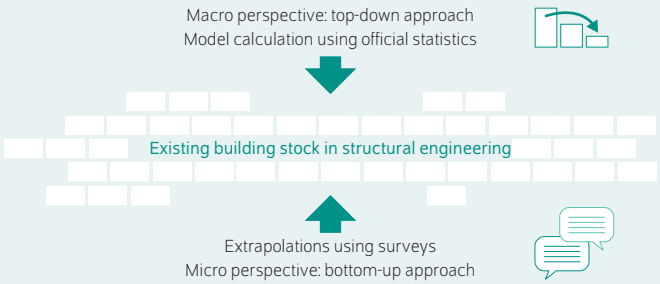
1 Martin Gornig, Claus Michelsen, and Hannah Révész, "Strukturdaten zur Produktion und Beschäftigung im Baugewerbe. Berechnungen für das Jahr 2020," *BBSER-Online-Publikation* 32 (2021) (in German; available online).

2 Katrin Klarhöfer, Christopher Kramp, and Christian Tiller, "Bestandsinvestitionen 2022. Struktur der Investitionstätigkeit in den Wohnungs- und Nichtwohnungsbeständen," *BBSR-Online-Publikation* 80 (2024) (in German; available online).

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

Figure

Analytical approach for determining investments in the building stock



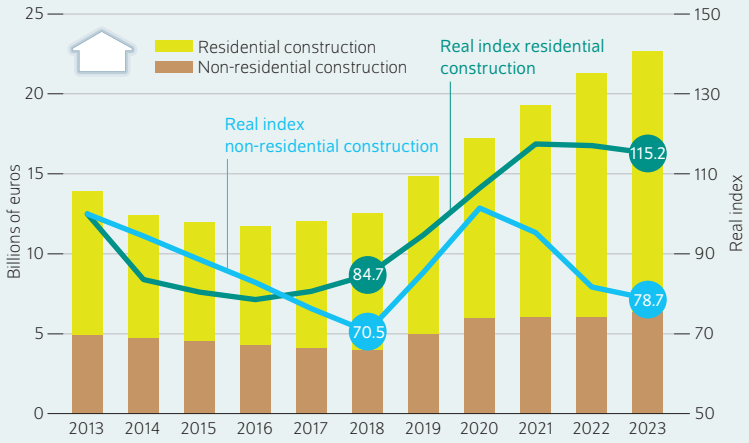
Source: Authors' depiction.

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

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 one. Nevertheless, it is possible to determine

Figure 1

Investments in roof, basement, and exterior door insulation
In billions of euros at current prices, as an index of price-adjusted values, 2013 = 100

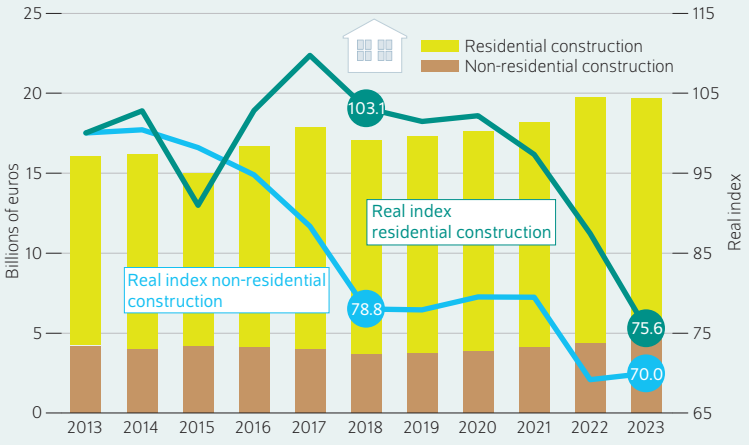


Sources: DIW Berlin Construction Volume; Heinze GmbH Modernization Volume; authors' calculations.

Investments in the insulation of residential buildings have not increased in real terms since 2021.

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, 2013 = 100



Sources: DIW Berlin Construction Volume; Heinze GmbH Modernization Volume; authors' calculations.

When accounting for the enormous price increases of recent years, investments in windows and doors have declined considerably.

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. Previous studies on residential construction suggest that the investment costs are twice as high as the specific additional spending.[5]

The total amount invested in energy-efficient building renovation is estimated by breaking down aggregate statistical official evaluations that are a part of the DIW Construction Volume and by extrapolating survey results from the Modernization Volume of the construction service provider Heinze GmbH (Box). The Federal Institute for Research on Building, Urban Affairs and Spatial Development (*Bundesinstitut für Bau-, Stadt- und Raumforschung*, BBSR[6]) and the Federal Environment Agency (*Umweltbundesamt*, UBA[7]) regularly publish these results, which are based on the DIW Construction Volume and the Heinze Modernization Volume, on the investment volume in the energy-efficient renovation of residential and non-residential buildings.

Furthermore, this Weekly Report presents a differentiated evaluation of three energy-efficient renovation sectors: roof/wall insulation, window/door replacements, and heating/air conditioning system renewal.[8] In addition, the real development of investments in energy-efficient renovation are presented here to account for the strong price increases of recent years. A mix of price indicators are used to measure deflation, as 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.

Roof/wall insulation stagnating following growth

A significant share of expenditure on energy-efficient renovation is spent on improving the insulation of the building envelope. At current prices, over 16 billion euros were invested in insulating roofs, basement ceilings, and facades of residential buildings in 2023. Once again, roughly six billion euros were spent on insulating commercial and public non-residential buildings (Figure 1).

The nominal amount invested in insulation, especially of residential buildings, increased significantly over the past years. For example, the amount invested in the insulation of residential facades and roofs in 2023 was nearly twice as high as in 2018. However, when considering the enormous price increases since 2021, the real value of investments in the insulation of residential buildings did not increase in 2022 or 2023.

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

6 Including photovoltaics: Martin Gornig, Claus Michelsen, and Hannah Révész, *Strukturdaten zur Produktion und Beschäftigung im Baugewerbe. Berechnungen für das Jahr 2020* (Bundesinstitut für Bau-, Stadt- und Raumforschung: 2024) (in German; available online).

7 Without photovoltaics: Jürgen Blazejczak et al., "Ökonomische Indikatoren von Maßnahmen zur Steigerung der Energieeffizienz – Materialien Berichtsjahr 2019," *Umwelt, Innovation, Beschäftigung* no. 3 (2020) (in German).

8 The 2023 values are based on preliminary calculations.

The insulation of non-residential buildings developed considerably less dynamically. Spending on building insulation in the commercial and public sectors rose again from 2019. However, only in 2020 were the nominal increases sufficient enough to reach the real investment level of 2013. Investments in the insulation of non-residential buildings, in contrast, were only around 80 percent of the initial level in 2024.

Window and exterior door replacements trending downward

The amount spent on window and exterior door replacements in residential buildings has barely changed over many years (Figure 2). For example, around 13.5 billion euros were spent on window and exterior door replacements from 2017 to 2020. Only recently has spending increased noticeably. However, the nominal increases were considerably lower than the high price increases due to the extremely high costs of glass production. Accordingly, real investments in window/exterior door replacements in the past three years have declined sharply: In 2023, the real investment level was nearly 25 percent lower than it was in 2013.

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 2023, real investments were 30 percent lower than in 2013. In nominal terms, about five billion euros have been spent on window and exterior door replacements by commercial and public building owners in 2024.

Renewed growth in heating system renewal since 2020

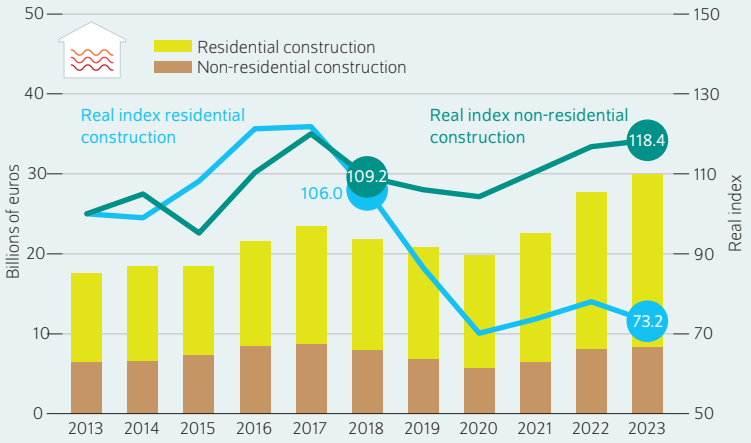
Compared to energy-efficient retrofitting of building envelopes via insulation or the replacement of windows and exterior doors, spending on heating system renewal has experienced stronger growth (Figure 3). Spending on heating system renewal in the residential housing stock has nearly doubled in nominal terms over the last 10 years. Although heating construction prices rose even more sharply than prices for energy-saving measures on the building envelope, the increases in spending were enough to maintain a high level of real investments in the renewal of heating systems in residential buildings. It is assumed that households are also investing in new gas heating systems before they become subject to strict regulations. However, investments narrowly missed reaching the peak value of real investments from 2017 in 2023.

Investments in heating and air conditioning (AC) technology for non-residential buildings have been on an upward trend for many years. From 2011 to 2017, spending on heating and AC technology increased from roughly six to nearly nine billion euros. Moreover, because the increase in spending outpaced price increases in this sector, real investments rose as well. Compared to 2017, however, commercial and public building owners' spending has declined considerably. As heating and AC technology prices experienced a strong increase at the same time, real investments declined by nearly 30 percent compared to 2013.

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, 2013 = 100



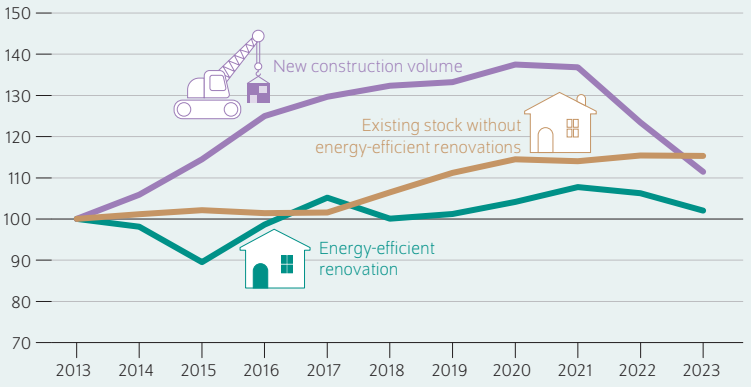
Sources: DIW Berlin Construction Volume; Heinze GmbH Modernization Volume; authors' calculations.

The development of real investments in heating and air conditioning systems differs greatly between residential and non-residential buildings.

Figure 4

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

Index 2013 = 100

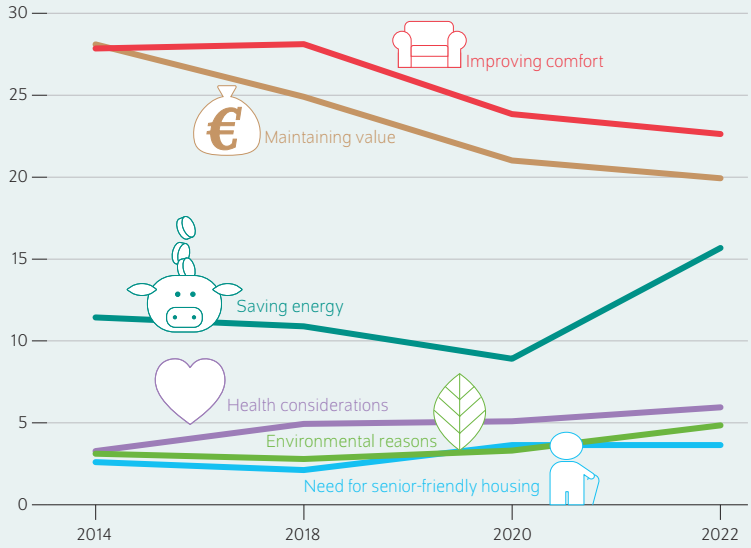


Sources: DIW Berlin Construction Volume; Heinze GmbH Modernization Volume; authors' calculations.

Overall, real investments in the energy-efficient renovation of residential buildings were marginally higher in 2024 compared to 2014.

Figure 5

Reasons for modernizing residential buildings
Shares in percent



Note: This information was provided by property owners who live in their own property as well as owners who rent out their property.

Sources: Heinze GmbH; authors' calculations.

While saving energy is still not the most important reason for modernizing, it has increased in significance recently.

Energy-efficient renovation of residential buildings losing momentum overall

Overall, a bleak picture emerges when looking at investments in the energy-efficient renovation of residential buildings: Over the past 10 years, annual spending on this type of renovation increased by more than 65 percent to nearly 53 billion euros. However, when considering price increases, real investments in 2023 were barely higher than in 2013 (Figure 4). The first low point of real investments in energy-efficient renovation of residential buildings was in 2015 and was followed by a significant recovery in real investment activity. It had reached its previous peak value in 2021, when the annual total investment amount was about eight percent greater than the base year value. However, the considerable price increases in 2022 and 2023 almost canceled out the real growth in investments entirely.

Investments in the energy-efficient renovation of buildings thus developed markedly worse than in other areas of residential construction. Construction of new housing in particular experienced strong growth until 2020. Despite the current weak phase, investments in new construction were around 11 percent higher in price-adjusted terms in 2023 than in 2013. Other measures on existing buildings, such as the modernization of sanitary facilities or general maintenance, also resulted in real growth over the entire period. In price-adjusted terms, such spending was 15 percent higher in 2023 than in 2013.

There are diverse reasons for this investment restraint.[9] For many years, comparatively low oil and gas prices, which reduced pressure to undertake energy-efficient renovation, were a significant factor. Due to the climb in energy prices since 2021, saving energy has increased in importance as a reason for modernizing owner-occupied or rented residential buildings (Figure 5).[10] While only nine percent of investors cited energy savings as a reason for modernizing buildings in 2020, the figure had risen to 16 percent in 2022.

The parallel sharp rise in financing costs and construction prices is likely why the change in reasons for modernizing has not been reflected in a real increase in investments in energy-efficient renovation of residential buildings. In addition, the survey on modernization reasons shows that even in 2022, increasing comfort and maintaining value were still seen as more important investment reasons, with response rates of 23 percent and 20 percent, respectively.

Energy-related renovation in commercial and public structural engineering continuing its downward slide

Combining the results for investments in the individual sectors of energy-efficient public and commercial building renovation results in a concerning picture. In 2023, nearly 20 billion euros were spent on the energy-efficient renovation of non-residential buildings, around 25 percent more than in 2013. However, as prices for construction work rose by over 50 percent during the same period, one quarter less is being invested in the energy-efficient renovation of public and commercial buildings in real terms compared to 10 years ago (Figure 6).

Investment activity in energy-efficient renovation developed markedly worse than in other sectors of public and commercial structural engineering. In particular, the construction of new buildings increased considerably. In 2023, investments in new construction were about 25 percent higher than in 2013 in price-adjusted terms despite the current weak phase. Measures other than energy-efficiency measures on existing buildings also suffered real losses. In price-adjusted terms, spending was 17 percent lower in 2023 compared to 2013. The decline was thus noticeably lower than in energy-efficient renovation.

For many years, public and commercial investors were hesitant to renovate buildings to improve energy efficiency, likely due to comparatively low oil and gas prices. In addition, the structural change in the non-residential housing stock is occurring more strongly in new construction than in residential construction. Currently, it should also be noted that public authorities in particular are tied to nominal investment

9 Martin Gornig und Katrin Klarhöfer, "Investments in energy-efficient building renovation are on a downward slide," *DIW Weekly Report* no. 32/33 (2023): 225-232 (available online).

10 Katrin Klarhöfer, Christopher Kramp, and Christian Tiller, "Bestandsinvestitionen 2022. Struktur der Investitionstätigkeit in den Wohnungs- und Nichtwohnungsbeständen," *BBSR-Online- Publikation* no. 80 (2024) (in Germna; available online).

budgets and have only been able to partially adjust their budget estimates to the sharp rise in construction prices.

Conclusion: Trend reversal in energy-efficient building renovation urgently needed

There is no doubt that the energy efficiency of the building stock needs urgent improvement. In light of the weak real investment activity in recent years, energy-efficient renovation of the existing building stock must be quadrupled. Binding minimum standards and renovation targets must be set to reverse the trend in renovation activities.[11] The long-term expected development of energy prices is a decisive factor for the willingness to invest in energy-efficient renovation. Political decisions on carbon pricing play a key role here irrespective of fluctuating raw materials prices. A reliably foreseeable path of further energy cost increases is essential for creating investment incentives to reach the climate targets.

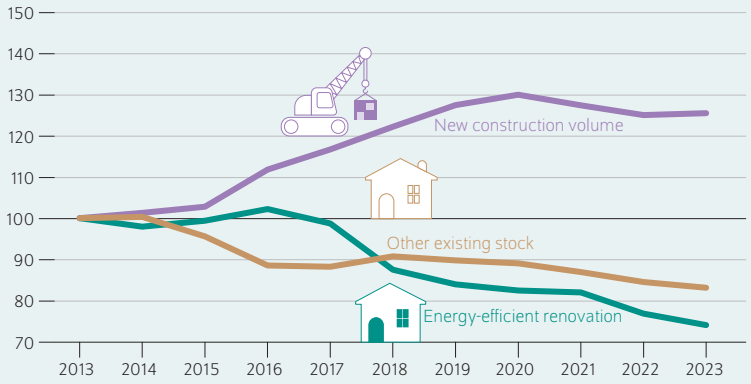
Furthermore, there must be appropriate funding conditions to achieve a noticeable increase in investments in the energy-efficient renovation of existing buildings. At the end of 2023, the German Federal Government reorganized the funding measures in the building sector as part of the Climate Action Program. The Federal Funding for Efficient Buildings program is the main approach to energy-efficient improvements in the building stock.[12] Since the beginning of 2024, the *Kreditanstalt für Wiederaufbau* and the Federal Office of Economics and Export Control (*Bundesamt für Wirtschaft und Ausfuhrkontrolle*) have made newly structured funding programs available for the energy-efficient renovation of residential and non-residential buildings.

The new focus of the funding programs has been accompanied by a sharp increase in funding for energy-efficient renovation. Funds in the amount of 16.7 billion euros for 2024 have been earmarked in the *Klima- und Transformationsfonds* for Federal Funding of Efficient Buildings.[13] This represents an increase of almost 50 percent compared to the funding for 2023.[14] Compared to the long-term average, the subsidies are even over three times as high.[15] However, the higher funding will likely not be enough to provide the strong impetus needed for renovation activities. The increase in nominal funding is offset by higher construction and financing costs in particular. Interest charges are likely to be almost three times higher compared to the end of the 2010s, even after the European Central Bank's further interest rate cuts. Construction costs have risen by an average of more than 40 percent in the same period. If policymakers really want to provide a strong impetus for energy-efficient renovation activities in existing residential buildings, they must be prepared to invest significantly higher amounts of funding in the coming years.

When designing the subsidy programs, care should be taken to ensure that the approved measures can be implemented in a flexible manner. Although the decline in new residential construction has significantly reduced construction capacity utilization,[16] there are still partial bottlenecks in individual trade services.

Figure 6

Development of real investments in energy-efficient renovation of non-residential buildings, in existing building stock, and newly constructed buildings
Index 2013 = 100



Sources: DIW Berlin Construction Volume; Heinze GmbH Modernization Volume; authors' calculations.

Real investments in non-residential construction are characterized by lots of new construction and little energy-efficiency renovation.

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

12 Deutscher Bundestag, "Klimaschutzprogramm 2023 der Bundesregierung," Drucksache 20/8150 (2023) (in German; available online).

13 Bundesregierung, "Der Klima- und Transformationsfonds 2024," (2023) (in German; available online).

14 Deutsche Industrie- und Handelskammer, "Weiterhin langsamer Mittelabfluss beim Klima- und Transformationsfonds," May 3, 2024 (in German; available online).

15 Gornig and Klarhöfer, "Investments in energy-efficient building renovation are on a downward slide."

16 Martin Gornig and Laura Pagenhardt, "Decline in nominal construction volume expected for the first time since the financial crisis; residential construction situation worsening," *DIW Weekly Report* no. 1/2 (2024) (available online).

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