

Germany on the pathway to climate neutrality – around EUR 6 trillion need to be invested

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The amount of money that Germany needs to invest to achieve climate neutrality by the year 2045 is now estimated at around EUR 6 trillion – equivalent to around EUR 290 billion per year. In the years 2018 to 2023, Germany invested EUR 110 billion on average in climate action each year. That leaves an annual gap of around EUR 180 billion, which means the current investment level needs to more than double. But it is not the gross investment level that is decisive. If we look at only the additional investments compared with a conventional (fossil) reference technology, the figures are much smaller. Only around EUR 65 billion per year must be additionally mobilised. That is less than 2% of Germany's GDP – an ambitious but achievable task.

At the same time, the necessary annual investment volumes are now higher than just five years ago. This is partly due to price increases. Another reason is that not enough was invested in recent years, leading to an investment backlog. This trend must be reversed. In particular, new investments in fossil technologies that threaten to create lock-in effects must be avoided, for example in gas and oil heating systems.

The benefits of climate action investments are multi-dimensional and go beyond the prevention of climate damage. A key benefit, particularly in times of geo-economic tensions, is reduced dependence on fossil fuel imports, which most recently averaged EUR 81 billion per year. Furthermore, rapid decarbonisation in the building and transport sectors, which so far have not been included in the European emissions trading system, reduces potential compensation payments due at European level. Besides, transitioning to climate-neutral economic management significantly reduces energy demand and enables participation in growing green markets.

Private capital in particular must be mobilised for the investments. The public sector accounts for a total of 12% of investment needs, with a somewhat higher public share in the energy sector of around 20%. Public investment is essential for a successful transformation because it acts as a catalyst for private climate investment - for example, by supporting charging infrastructure for electric vehicles or electricity distribution networks. Businesses must make nearly EUR 3 trillion in climate-friendly investments in Germany by 2045. That is around EUR 140 billion annually, a good three quarters more

than before. Large enterprises and SMEs will undertake around half of the upcoming investments.

At sectoral level, transport will require the highest investment sums, accounting for nearly half the required investment. Here, the level of investment will need to increase fivefold, representing the biggest rise. This is followed by the energy and buildings sectors. The industrial sector will need to mobilise the smallest investment amounts, although these usually consist in large-volume investments and profound conversions that often present major challenges for enterprises.

Germany's pathway to climate neutrality

Germany has set itself the goal of becoming climate neutral – reducing net emissions to zero – by 2045. Already by 2030, greenhouse gas emissions are to be reduced by 65% compared with the 1990 baseline. Germany is not alone with its ambitious goal of climate neutrality. Around the world, 139 nations have set themselves net zero targets, together accounting for around 74% of all greenhouse gas emissions and representing 77% of global value creation.¹

Transitioning to a climate-neutral economy is possible with technologies that are already largely known, but it requires significant adjustments and investment by both private and public-sector actors. Besides technological challenges, considerable adjustments need to be made in value creation, sectoral structure and supply chains.

The study "Investitionen für Klimaschutz – Notwendige Investitionen zur Erreichung von Klimaneutralität in Deutschland" (*Investments in climate action – investment required to achieve climate neutrality in Germany* – in German) conducted on behalf of KfW (see Box 1) updates and expands existing findings on the investments required to achieve climate neutrality by 2045. The study based the calculation of these investments on **different** technical and economic **transformation scenarios**. It derived and compared the requirements in the various scenarios using a uniform investment concept. The study thus provides a more robust estimate of the upcoming investment needs in the various sectors and groups of actors.

Table 1: Transformation scenarios

Scenario	Focus	Population in 2045	Electricity demand in 2045	Efficiency improvement	Use of fossil fuels
Roadmap	Energy efficiency, buildings	81.1 million	Approx. 1,100 TWh	-33% final energy	< 100 TWh
KNDE (Climate-neutral)	System-wide, industry/ commerce, trade and services	84.5 million	Approx. 1,250 TWh	-26% final energy	< 100 TWh
LFS/O45	Total energy system	84.5 million	> 1,300 TWh	-27% final energy	< 200 TWh
Ariadne	Technology mix	84.5 million	1,037–1,423 TWh	-35% final energy	< 100 TWh

Source: Prognos (2026).

Underlying scenarios

The scenarios used refer to similar observation periods and ambitious greenhouse gas (GHG) reduction targets with climate neutrality accounted for in 2045. The industrial sector remains structurally unchanged. Production methods, however, are significantly modified. In all scenarios, the shift away from fossil fuels is very strong, and energy supply becomes largely renewable and electric. Differences exist with a view to the database, technology prioritisation (efficiency vs. electrification/ hydrogen), policy instruments and degree of detail in the modelling of sectors and infrastructures.

Roadmap energy efficiency 2045 ("Roadmap")

This scenario is based on a bottom-up approach and is strongly oriented towards measures to improve energy efficiency. It was initiated by the Federal Government in 2020, contains a catalogue of technical and policy measures and was calculated by Prognos. Its main features are a strong reduction in energy consumption enabled by high efficiency gains and a focus on technology-driven solutions. The scenario heavily focuses on electrification of final energy consumption, particularly in the buildings sector and for process heat, with ambitious GHG reduction targets. Electricity demand rises to around 1,100 TWh by 2045.

Klimaneutrales Deutschland 2045 – KNDE (*Climate-neutral Germany 2045*)

This scenario maps the entire energy system and, additionally, non-energy-related greenhouse gas emissions. It is based on current conditions and very ambitious climate targets. Besides electrification, it refers to the use of electricity-based energy sources (including hydrogen) and carbon capture and storage (CCS). Electricity demand grows to around 1,250 TWh by 2045, imports and exports remain largely balanced. The scenario assumes technological innovations across many sectors.

Long-term scenarios – electrification variant O45-Strom ("LTS/O45")

The long-term scenarios focus on the entire energy system including electricity, heating and gas network infrastructure as well as agriculture and land use. The scenario LTS O45 assumes significant electrification of the energy system. Gross

electricity consumption grows to more than 1,300 TWh by 2045, of which 145 TWh is imported. Electrification is particularly pronounced. Primary energy consumption drops by 28%, final energy consumption by 27%. Electricity-based energy sources are between 220 and 340 TWh in the year 2045.

Ariadne – Technology mix scenario ("Ariadne")

Ariadne is a Kopernikus project supported by the German Federal Ministry of Education and Research (BMBF).² The aim of the Ariadne project – just as in the other scenarios examined – is to define both ecologically and economically sound transformation pathways to climate neutrality. It uses various energy models to work out robust transformation pathways. In this study we examine the main scenario "Technology mix", which represents a medium, technology-neutral scenario that deliberately allows for the complete range of technological options.

More in-depth analyses are largely based on the scenarios Roadmap and KNDE, as they are the only ones that provide detailed information that allows a more granular analysis of the investment requirements.³

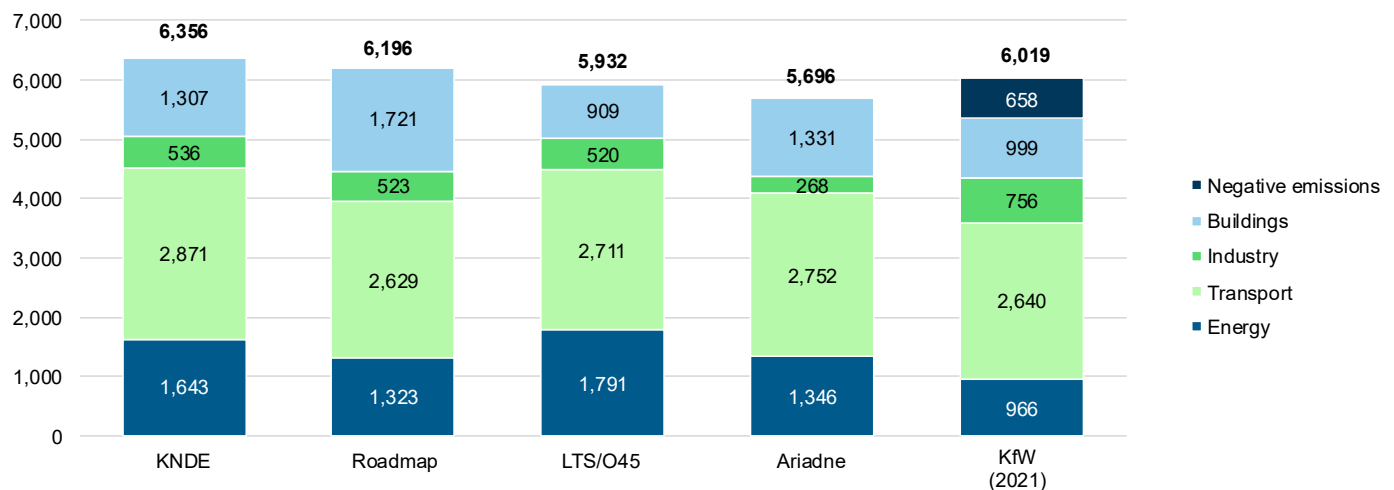
Box 1: Study "Investments for climate action – investment required to achieve climate neutrality in Germany"

On behalf of KfW Research, Prognos AG has prepared a study to estimate investment needs for achieving climate neutrality in Germany. To this end, the most prominent current transformation scenarios were used and the resulting investment paths were quantified. Specifically, climate protection investments, net investments compared with a fossil reference technology and total investments were also quantified, differentiating by sectors and groups of actors. This means that, for the first time, a comprehensive picture of investment needs on the road to climate neutrality is developed. By analysing the investment logic pursued by the actors involved, it is also possible to identify drivers and obstacles for effective climate protection and to delineate the role that private capital can play in financing the climate transition.

The study is available for download in German at www.kfw.de/research.

Figure 1: Investment required to achieve climate neutrality by 2045

Cumulative investment in the 2025–2045/2050 period, EUR in billions, prices of 2024



Note: In the scenario for KfW (2021) the investments for the H₂ infrastructure and the negative emissions and CO₂ infrastructure were calculated retroactively and reported separately. In the other scenarios described, these investments are predominantly contained in the energy sector. No investments for the industrial sector could be estimated for LTS/O45, and no investments in new buildings could be estimated in the buildings sector for LTS/O45 and Ariadne; in order to ensure comparability, the median value of the remaining scenarios was used in the presentation in both cases.

Source: Prognos (2026).

Climate investment of around EUR 6 trillion needed

For all scenarios considered, four major investment areas or sectors were distinguished: industry (conversion of industrial processes, efficient energy and resource use), transport (conversion to alternative drive technologies, mass public transport, rail transport), energy (energy generation and networks) and buildings (heat, energy upgrades, energy-efficient new buildings). The necessary climate investments in the 2025–2045 period range from around 5.7 to 6.4 trillion euros. That means annual climate investments of around 270–300 billion euros.⁴

Despite the different focus areas of the scenarios, a very homogeneous picture emerges. On average, around EUR 6 trillion needs to be invested across all scenarios. The identified investment needs have not materially changed since the predecessor study (KfW, 2021)⁵. When these needs are expressed in current prices of 2024, they also indicate climate investments of around EUR 6 trillion, although with minor shifts in individual sectors.⁶ On average, around EUR 290 billion would thus have to be invested annually up until 2045.

Only half the climate investments are net investments compared with fossil reference technologies

If one looks at net investments compared with a fossil reference technology, the figures are significantly smaller. Only just under half of this needs to be invested additionally because fossil investments can be rolled back at the same time. Thus, only around EUR 145 billion in net investments is required, or EUR 130–150 billion depending on the scenario.

In addition to the status quo, only EUR 65 billion is needed each year

In the years 2018 to 2023, EUR 110 billion on average was invested in climate protection in Germany each year. That leaves a climate investment gap of around EUR 180 billion. Of the current investment volume, around EUR 80 billion per annum is net investment because climate technologies are still

significantly more expensive than fossil alternatives. To achieve the necessary net investment of around EUR 145 billion, an increase of only around EUR 60–70 billion per year is therefore necessary, depending on the scenario. On average, that is an additional EUR 65 billion per year or 1.5% of the gross domestic product of the reference year 2024. In the same year, however, gross fixed capital formation in Germany amounted to 20.5% of GDP – and was even significantly higher shortly after unification, at around 25% of GDP. The necessary expansion is therefore a substantial but manageable task.

Box 2: Investment concepts

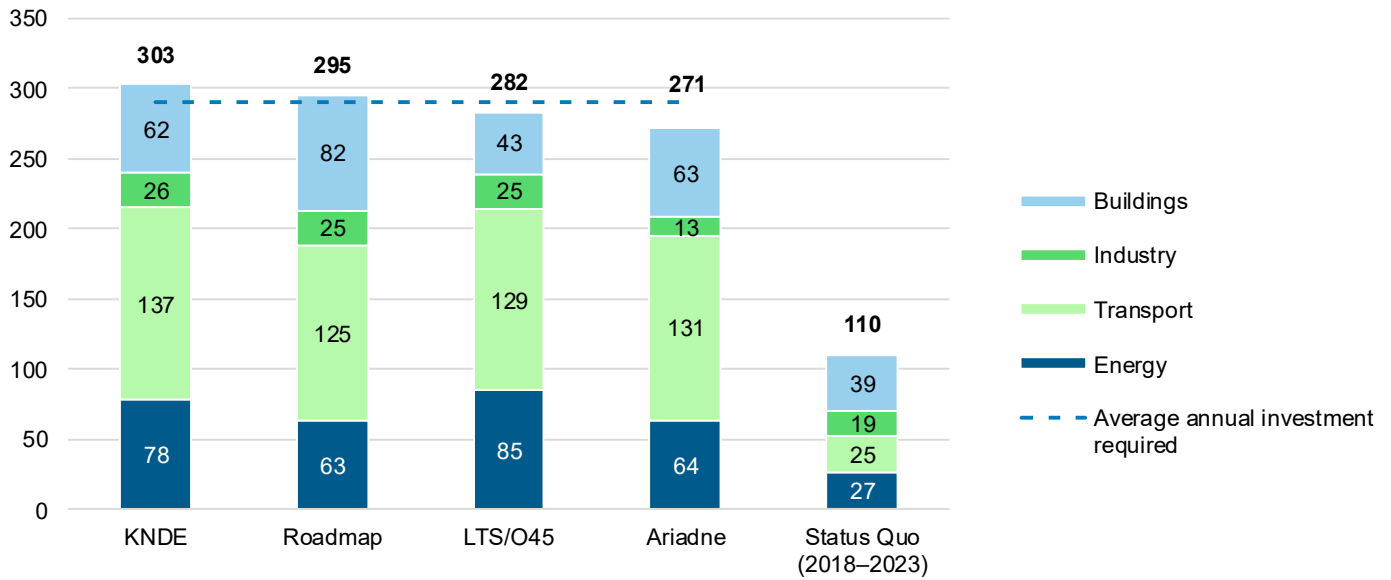
Climate investments are defined as investments in “green” technologies or goods. They involve the prevention, containment and removal of greenhouse gas emissions. They include the sum of investments in a climate technology, for example a heat pump or electric vehicle. What they do not include are investments in natural or human capital as well as climate adaptation measures.

In addition, “**net investments**” are also specified, i.e., investments that must be made additionally compared with a fossil reference technology. These are, for example, the incremental costs of a heat pump compared with a gas condensing boiler. Replacement investments are usually undertaken only after the end of the service life of the equipment (no early decommissioning).

The analysis also includes as a reference the **overall investments**, which go well beyond climate investments and include all gross fixed capital formation, that is, investments in physical assets and intellectual property, for example investments in equipment such as vehicles and machinery, but also in research and development as well as software or copyrights. The **status quo** for climate-friendly investments is likewise presented, based on the climate protection investments that were already made in the years 2018–2023.⁷

Figure 2: Annual investment required to achieve climate neutrality by 2045

Average annual investment in the period of 2025–2045/2050, EUR in billions, prices of 2024



Note: Investment in the industrial sector could not be estimated for LTS/O45, and investments in new buildings could not be estimated in the buildings sector for LTS/O45 and Ariadne; in order to ensure comparability, the median value of the remaining scenarios was used in the presentation in both cases.

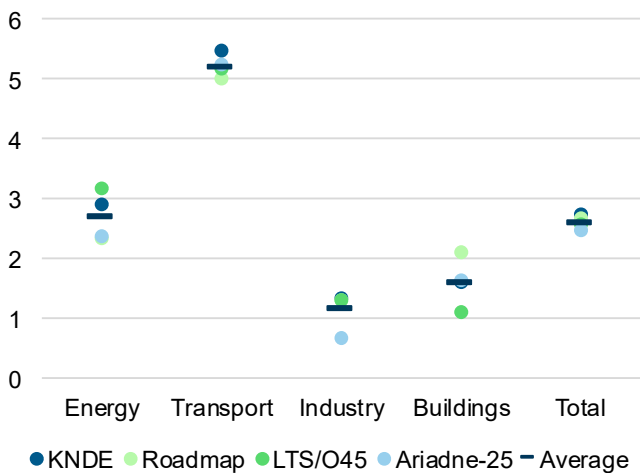
Source: Prognos (2026)

More than twice the current investment is required

If we look at annual averages (Figure 2), between EUR 270 and 300 billion per year needs to be invested in the scenarios. A comparison with the status quo, which indicates the average investments in the years 2018 to 2023, reveals the need for a major increase. Depending on the scenario, investment needs to be increased by a factor of 2.4 to 2.8. Figure 3 also shows the range of the necessary increase factors by sector.

Figure 3: Necessary increase in current investment

Rates of increase, calculated as the quotient of necessary climate investment and average investment in the years 2018–2023 (status quo)



Source: Prognos (2026).

Different investment needs across sectors

Investment needs differ from one sector to another. This applies not just to the necessary sums (Figure 1) and the rate of increase of current investment (Figure 3) but also to the share of net investment and the share in the overall investment of the

relevant sector (Figure 5). The overall picture provides indications of the effort required in each case to achieve climate neutrality.

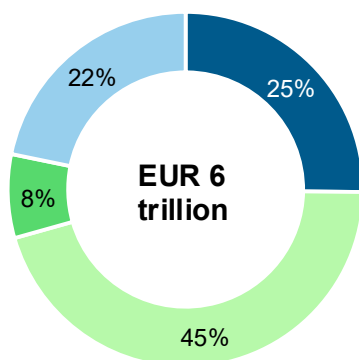
The greater part of the necessary climate action investment – around EUR 2.6-2.8 trillion – will be incurred in the **transport sector**. The average is around EUR 2.7 trillion, nearly half the necessary investment (45%, Figure 4). This essentially comprises the extensive adoption of passenger vehicles with alternative powertrains. By far the largest sum, it is also high when viewed in terms of its share in total investments in the sector: around two thirds of total investments in the sector need to be aligned with climate-friendly requirements. This highlights the major transition expected in the sector and its high energy intensity. The transport sector also requires the highest rate of increase. Investment here must increase more than fivefold from currently EUR 25 billion. Looking at the net investments, figures are significantly lower at only around 19% of climate protection investments (Figure 4). This is mainly due to the closing price gap between electric and combustion engine vehicles. In the long term, investments in electric vehicles could turn out even lower due to the rapid cost degression of batteries⁸ (negative net investment). The current ramp-up of electric mobility promises momentum – and at the same time opportunities for the German automobile industry.⁹

The sector with the second largest climate investment needs is **energy** with 1.3-1.8 trillion euros. On average across all scenarios, that is around EUR 1.5 trillion or one quarter (25%) of the necessary investment. In this sector, nearly all of the investments planned need to be used to align with climate protection more consistently – which demonstrates how closely the sector is tied to the issue of climate change. Unlike transport, the share of net investment here is significantly larger, driven by a comprehensive transition of the energy

system to decentralised renewables-based generation. That will cause additional investment particularly in grid infrastructure, with almost half of all net investment incurred in this area.

Figure 4: Average sectoral shares

Shares as averages across all four scenarios being examined, in per cent



■ Energy ■ Transport ■ Industry ■ Buildings

Source: Prognos (2026).

The **buildings sector** accounts for a further EUR 0.9 to 1.7 trillion, comprising both residential and non-residential buildings (corresponding with the sectors “households”, and “commerce, trade and services” in the energy balances)¹⁰. On average, this amounts to just over EUR 1.3 trillion or a little under a quarter (22%). A further breakdown of building investments is only possible for the KNDE and Roadmap scenarios. On this basis, the two subsectors are estimated and described below for the other scenarios as well.¹¹

The estimated investment in the **residential buildings** sector averages EUR 1.0 trillion (between EUR 0.7 and 1.3 trillion depending on the scenario). Most of this is investment in the existing residential building stock. Under the Roadmap scenario with a focus on energy efficiency and technology, investment is higher yet again as it requires a correspondingly greater effort to upgrade energy systems and more efficient heat pumps are used. In terms of total investments as well, this is the third-highest share. More than 80% of this is net investment. This is the highest share of all sectors and shows that residential buildings require substantial investment compared with the fossil reference world. What is more, the ability to invest depends heavily on the individual situation of households. Investment needs are often highest particularly in households that have the least financial resources.¹² Against this backdrop, the ambitious energy efficiency pathway of the Roadmap scenario for the buildings sector appears particularly challenging.

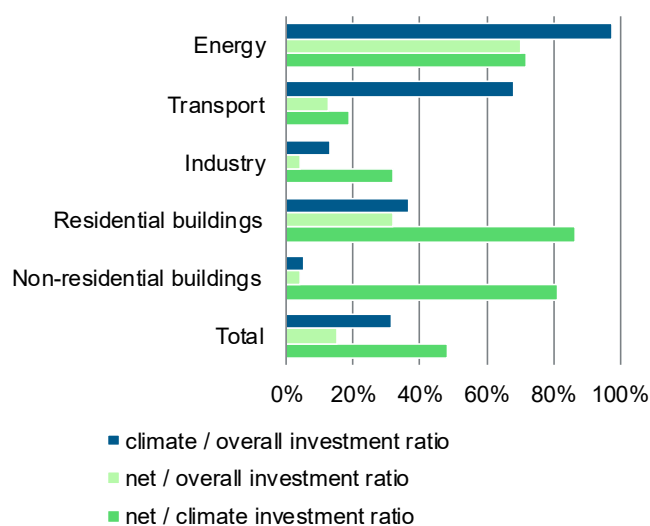
The **non-residential buildings** sector requires the lowest investment volume in absolute terms, with EUR 0.3 trillion on average (EUR 0.2 to 0.4 trillion depending on the scenario). As with residential buildings, the share of net investment is very high here and exceeds 80%. However, this sector generally has a lower energy focus, which is also reflected in the small share of climate investment in overall investment (Figure 5). For this reason, specific incentives are required to bring the hitherto

often neglected topic into the focus and stimulate necessary investments.

The **industrial sector** needs significantly lower climate investment of around EUR 300 bis 500 billion. The bottom of this range stems from the Ariadne scenario and is sharply lower. On average, investments amount to around EUR 450 billion or 8% of total climate investments. This investment also makes up the lowest share of overall investment compared with all other sectors. Around one third of investment is net additional investment. These rather low values, however, obscure the fact that significant burdens still arise as a result. Investments are concentrated in a limited number of particularly energy-intensive companies. They often also involve profound modifications to production processes and the business model. Individual businesses must invest very high sums in new production facilities. Many of them also compete internationally. As a result, higher investment costs cannot always be passed on in the form of higher product prices. Furthermore, the changeover from fossil fuels to electricity, hydrogen or biomethane can increase production costs despite energy efficiency improvements. This is particularly true so long as the carbon price, which was around EUR 80 per tonne in the European Emissions Trading System in August 2026, fails to reflect the social costs of the emissions. According to current meta-analyses, these average USD 283 per tonne of CO₂,¹³ have been rising for years¹⁴ – and were recently estimated to be as high as USD 1,200 per tonne of CO₂¹⁵ and more¹⁶.

Figure 5: Average percentages of the various investment concepts in the sectors

Shares as averages across the scenarios KNDE and Roadmap, in per cent



Source: Prognos (2026).

Shares in overall sectoral investment

To better assess the importance of climate protection investments, their share of total gross fixed capital formation in the sector is also shown. Overall, around 31% of investments can be viewed as climate investment, that is, around one third of the investments are investments in climate protection or energy efficiency. There are clear differences between sectors (Figure 5).

The share of climate investments is particularly high in the energy sector (including energy infrastructure). In the target scenarios, investments are almost exclusively in climate-friendly technology (98% in each case). By contrast, non-residential buildings account for a share of only 5% in each scenario. The share is also comparatively low in the industrial sector, with 13% in each scenario. In the residential buildings sector the share of climate investment in overall investment averages 37% (Roadmap: 43%, KNDE 31%). In the transport sector the share averages 68% (Roadmap: 65%, KNDE 71%), which is primarily due to the large number of vehicles to be acquired that must now be climate-neutral.

Private actors need to invest the most

Besides the level of required investment by sector, the study also examined which actors must invest. A key actor is the public sector.

For the public sector, the predecessor study¹⁷ had identified a share of 10% in overall investment, but more than half of that would have to be invested in any case to replace or renew existing infrastructure.¹⁸ The current study has determined a similar scale of around 12% for the public share in necessary investment. However, the public sector will have to play a slightly larger role in the next five years as significant public investment, for example in the energy sector, must be made in order to advance electrification in other sectors. Accordingly, the public sector share in overall climate investment is estimated to be 13% by 2030 and only 11% in the subsequent years from 2031 to 2045. Depending on the scenario applied, that represents an amount between EUR 203 and 257 billion up to the year 2030 and between EUR 465 and 547 billion in the following 15 years – or EUR 33 billion per year on average.¹⁹

The public sector will have to act primarily in the energy sector

While no climate investment in the industrial sector can be attributed to the public sector, public-sector investment in the energy sector is estimated between EUR 260 and 350 billion by the year 2045, which according to the study represents 19.3% of the required investment in this area (Figure 6). The largest sums fall on electricity distribution networks²⁰ and district heating²¹, two areas that are mostly under the responsibility of the states and municipalities. At the same time, public-sector investment in these very areas is the prerequisite for further climate investment and the decarbonisation of the remaining sectors.

In the area of **transport**, 10.5% of total climate investment can be attributed to the public sector. Here, the public-sector shares are particularly high in rail infrastructure and trains, which are predominantly under the responsibility of the Federal Government, and in local public transport, for which municipalities also have responsibility. The highest amounts, however, are those expected for public-sector investment in the charging infrastructure for electric and hydrogen-powered vehicles. Public-sector investment is expected to range between EUR 30 and 39 billion over the next five years and as much as EUR 61 to 122 billion over the subsequent 15 years, depending on the scenario. This investment will have to be made primarily by municipal and

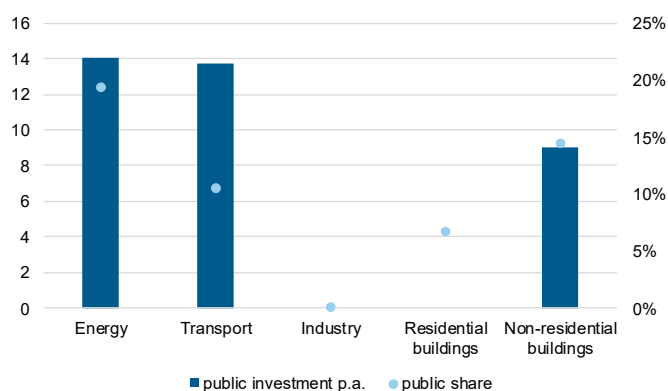
state energy utility companies.²² In this area the public sector also has a pioneering role to play that makes relevant private investment possible in the first place, for example in electric vehicles. By contrast, the public sector's own investments in electric vehicles account for only a relatively small amount.

In **non-residential buildings** the public-sector share is 14.4% and thus lower than in the predecessor study²³ because the underlying attribution was amended. The predecessor study used the share of the state in gross fixed assets relating to buildings, which is reported at replacement cost value. This statistic was therefore subject to significant price changes in recent years. For this reason, in the current study indicators for the existing non-residential building stock of the Federation, Länder and municipalities were used.

In the **residential buildings** sector, on the other hand, the public-sector share rose to 6.6%.²⁴ In the predecessor study that share was still below 1%, but here, too, the variation is due to the fact that the calculation was now based on other statistics.²⁵ In both segments of the buildings sector, public-sector climate investments result primarily from the need to upgrade the energy performance of buildings and convert their heating to climate-neutral technologies.

Figure 6: Public-sector investment needs by sector

Average annual investment across all scenarios in the 2025–2045 period, EUR in billions, prices of 2024 (left side) and shares in percent (right side)

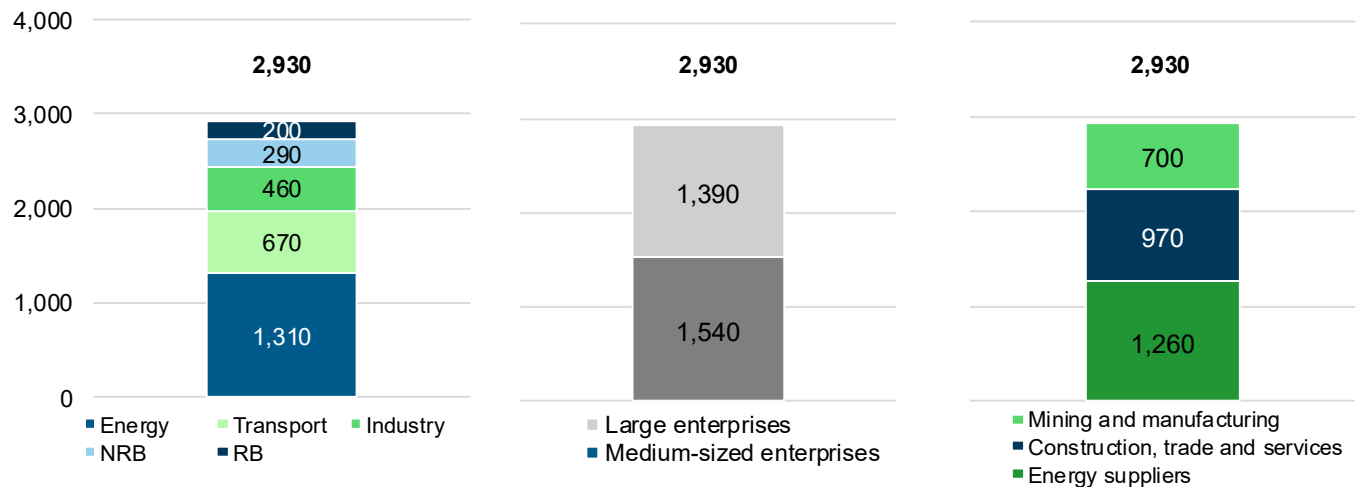


Source: Prognos (2026).

With a view to direct and indirect burdens on public budgets, the public investment needs can be further broken down. According to the National Accounts classification, direct climate investment by the state includes primarily public non-residential buildings such as schools and administrative buildings, as well as vehicles of the public administration. Also included is rail infrastructure, which formally belongs to the corporate sector but is very predominantly financed from the federal budget. By contrast, energy utilities, local public transport, railroad vehicles and municipal housing companies fund their investments from user fees and transport agreements and are counted as public-sector enterprises. As a result, only just under 2% of total climate investment, just under 6 billion of the roughly EUR 33 billion per year is to be financed directly from budgets – plus incentive programmes for private investment and financial support for public-sector enterprises.

Figure 7: Necessary investment in the corporate sector by climate sector, size class and economic sector

Cumulative investment needs of businesses in the 2025–2045/2050 period as averages across all scenarios, EUR in billions, prices of 2024



Note: NRB: non-residential buildings, RB: residential buildings. For the scenarios LTS/O45 and Ariadne, where data was missing the study used the average shares from the KNDE und Roadmap scenarios as an alternative.²⁶

Source: Prognos (2026).

The entire corporate sector is called upon to meet the needs of the transformation

The state and public enterprises are not the only ones called upon to act. Germany cannot become climate neutral without the green transformation of its entire economy. Businesses have a particular responsibility in this regard. Not only do they make a considerable contribution to greenhouse gas emissions, but they are also the driving force behind innovations, production processes and infrastructure. The transition to a climate-neutral economy cannot be realised without their active engagement and corresponding investments. This is particularly obvious in the example of industrial enterprises, which account for just under one fourth of all national emissions, placing them among the largest greenhouse gas emitters. But other business sectors such as trade, services and construction also face major challenges and must make their contribution to significantly reducing carbon emissions and achieving the target of climate neutrality.

The findings of the present study corroborate this view and for the first time provide a precise quantification of the amounts which enterprises as a group of actors need to invest specifically in the individual climate sectors.²⁷ Thus, the corporate sector is responsible for around 48%²⁸ of the total investment required for the transformation. However, there are significant differences between the individual climate sectors. Thus, the investment requirements in the **industrial sector** must be attributed entirely to the corporate sector. Relevant investments are mainly concentrated in the conversion of industrial processes and the use of energy- and resource-efficient technologies. Businesses account for the lion's share of investment for **non-residential buildings**, too. Only state administrative buildings are excluded, which make up around 14% of the sector, so that around 86% of the investment in non-residential buildings remains with businesses. The focus here is on measures aimed at reducing heating requirements and converting heating systems of commercial buildings to climate-neutral sources.

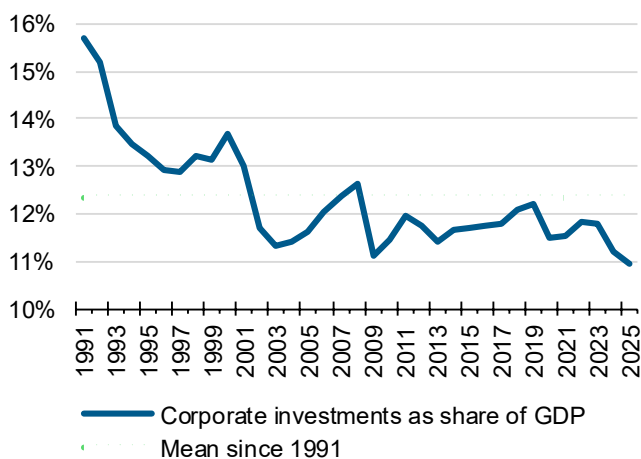
Businesses must also invest in other climate sectors. In the **transport sector** a share of around 25% of investment requirements can be traced back to businesses. Besides electrifying corporate vehicle fleets – with around 20% of company cars and 2% of commercial vehicle fleets so far electrified –²⁹, investments are necessary in the climate-friendly restructuring of freight transport, particularly by rail. In the climate sector **energy** businesses must even bear around 86% of the necessary investment requirements. This is mainly due to the fact that establishing extensive renewable energy facilities and expanding grid infrastructure (energy and district heating) falls under the purview of energy companies.³⁰ For companies in other sectors, photovoltaics on commercial roofs and home storage are also playing an increasingly important role. Businesses are also called upon to invest in residential buildings. The corporate sector accounts for around 21% of necessary investment here. This is because part of the residential building stock is owned by public or private companies, which must carry out the necessary measures for decarbonisation.

Overall, these figures mean that depending on the underlying scenario, between EUR 2.8 and 3.2 trillion must be raised by the corporate sector alone by 2045. On average, that is a good EUR 2.9 trillion (see Figure 7). Extrapolated to the remaining years, that represents an annual investment requirement of around EUR 140 billion (EUR 132 to 150 billion) or around 3.2% of GDP. The fact that the decarbonisation process has already begun in many businesses is cause for optimism. According to the KfW Climate Barometer, German companies invested around EUR 80 billion in national climate action in 2024.³¹ This survey response comprises businesses' gross investment and is not directly comparable with the scenario-based values of this study, but it does illustrate the current level – and shows that it still needs to rise significantly.

At the same time, a corresponding increase seems possible. After all, only half the necessary climate investment is additional. The other half can be achieved by reducing investment in fossil technologies. The survey data shows that in the corporate

sector the difference to the current level of investment sits at around EUR 60 billion. Of that, some EUR 30 billion would need to be mobilised additionally per year. Assuming the higher share of net investment from the aggregate in the status quo, the impetus additionally required actually turns out slightly lower still.³² That is less than 1% of GDP. Business investment has averaged around 12% of GDP since 1991 and amounted to just under 11% in 2025 (Figure 8). This shows that a corresponding increase is possible – and has already been achieved in the past.

Figure 8: Corporate investment in Germany



Source: Federal Statistical Office, Macrobond.

Business investment needs differ significantly by size class and industry

The study also shows clear differences between company size classes and industries. In terms of investment by company size, nearly half the business investment needs are attributable to large enterprises with an annual turnover exceeding EUR 500 million. Depending on the scenario, this group accounts for between 44% (Roadmap) and 49% (KNDE) of the required investment – even though Germany has only around 1,800 large enterprises compared with around 3.8 million small and medium-sized enterprises. The particular economic weight of large enterprises is also evident in that they account for around half of all gross fixed capital formation in Germany each year also outside the climate context.³³

Furthermore, large enterprises are disproportionately represented in the manufacturing industries and the energy supply industries. These industries have significantly higher investment requirements in the large climate sectors of industry and energy. Small and medium-sized enterprises, on the other hand, are more likely to operate in commerce, trade and services which for their part must invest relatively often in residential and non-residential buildings.³⁴ In total, depending on the scenario, large enterprises must invest between around EUR 1.3 trillion (Roadmap) and EUR 1.6 trillion (KNDE) by the year 2045. On average, that is around EUR 1.4 trillion (see Figure 7), or some EUR 66 billion per year. The remaining EUR 1.5 trillion or around EUR 73 billion per year have to be mobilised by SMEs.

One expected finding was that in terms of sectoral distribution, energy supply companies have the highest investment requirements. These enterprises must mobilise around EUR 1.3 trillion by the year 2045 – with EUR 1.2 trillion under the Roadmap scenario and EUR 1.4 trillion under the KNDE scenario. The focus here is on extensive investment in energy infrastructure such as electricity grids and district heating networks, as well as in extensive renewable energy facilities. They are followed by enterprises in the construction, trade and services sectors. Around EUR 1 trillion in total is required here by 2045 (under both scenarios) in order to achieve the target of climate neutrality in Germany. The focus in these sectors lies mainly on numerous “smaller” investment projects, for example to improve energy efficiency and for heating in (commercial) buildings, as well as on electrifying road transport. As nearly 90% of all enterprises are situated in these three sectors, many relatively small projects add up to a comparatively high total investment volume. Not least, businesses in the manufacturing and extractive sectors are also called upon to invest. These enterprises must invest around EUR 0.7 trillion (under both scenarios) to become climate-neutral by 2045. Of particular importance here are the relevant climate investments to be undertaken by the industrial sector, for example the decarbonisation of production processes currently running on fossil fuels as well as investment in carbon capture and storage.

Climate investment as driver of prosperity

Climate investment will enable Germany to not only achieve its climate targets but gain economic advantages.

Moving away from fossil energy imports saves costs and reduces dependencies. Recently, fossil fuels worth an average of around EUR 81 billion have been imported each year.³⁵ This amount leaves the country permanently, and its level depends on prices which Germany can hardly influence. Owing to geo-political tensions and rising prices of oil and natural gas, even higher import costs can be expected this year. The high dependence on fossil imports poses a great risk for Germany's economic growth. Climate investment, however, provides the opportunity to continue creating value within the country's borders.

Furthermore, decarbonisation avoids compensation payments that may be owed at EU level for missing emission targets. Based on current projection data, Germany will exceed its emissions allocations for the years 2021 to 2030 by 255 million tonnes of CO₂ equivalents and would need to close this gap by purchasing allocations from other member states. Depending on the price, that could cost EUR 15 to 38 billion – funds that would then not be available for investment.³⁶

This is compounded by an often overlooked effect: Climate-neutral technologies use energy much more efficiently. Heat pumps and electric vehicles require only a fraction of the final energy of fossil alternatives for the same performance. Combined with efficiency measures, this leads to a 26% to 35% lower final energy consumption in the analysed scenarios up until 2045 compared with today (Table 1).

Not least, the transition to climate-neutral economic activity gives rise to a green growth market. The market for clean technologies has recently grown globally by a notable 9.6% per annum – and would thus double in less than 10 years. With a share of 13% in global green export volume, Germany is currently still well positioned.³⁷

Starting points towards a successful transformation

To be successful, climate investment must be stimulated across all sectors. At the same time, each sector faces different challenges and offers specific starting points.

In the **transport sector**, to which the largest investment amounts must be allocated, success will be decided by the electrification of vehicle fleets. What works in its favour is that the additional costs compared with fossil alternatives are lowest here and will continue to decrease with falling battery prices. As the greatest portion of this investment by far will be borne by households and businesses, having a reliable enabling environment will be crucial: a clear regulatory pathway for new registrations, a charging infrastructure that is reliable and has broad coverage, as well as competitive electricity prices at the charging point. In freight transport and local public transport, additional investment in rail infrastructure and vehicle fleets will be necessary, most of which will be funded from public budgets.

The **energy sector** must ensure the expansion of renewable generation, network expansion, the integration of battery storage and the flexibilisation of demand. Most of the investment here will be in energy supply companies and network operators, many of which are municipally owned. It is therefore crucial that these enterprises have the necessary equity. At present, many municipalities are sustaining their utility companies primarily with guarantees and by waiving profit distributions. Given the tight municipal budget situation, there is limited scope for this. Reliable regulations, adequate returns on capital and broad access to external financing are just as important here as planning and approval procedures that keep up with the pace of expansion.

What will be crucial in the **buildings sector** is the decarbonisation of heating: a rapid ramp-up of heat pumps, the expansion of district and local heating, and energy upgrades to building envelopes. Given the large number and heterogeneity of owners, support programmes that provide planning certainty, the removal of practical hurdles such as in multi-family dwellings and social support mechanisms are key conditions for success. Information services and installer training can also be helpful. Similar technical mechanisms apply to non-residential buildings, supplemented by tailor-made programmes for small

and medium-sized enterprises. Public buildings play a particular role here. Schools, administrative buildings and sporting facilities are an area in which the state itself must invest directly. At the same time, energy upgrades must be undertaken by municipalities that already face an investment backlog of more than EUR 230 billion, with nearly EUR 70 billion in school infrastructure alone. Here, the need to maintain building substance and upgrade energy performance compete for the same funds and planning capacities, so they should be considered and financed together.

In **industry** the focus is on the technical conversion of energy-intensive processes, for example the conversion of steel production to hydrogen-based processes and the electrification of process heat. These need to be supplemented by the broad use of efficiency and recycling measures. Here, the real challenge is not so much the economic scale of the investment – it is the smallest of all sectors – but the heavy burden on individual enterprises and economic sectors. Initiating the necessary investments requires reliable carbon prices, targeted financial support, protection against carbon leakage and the timely availability of a hydrogen and carbon infrastructure.

Across sectors, stable political conditions, international coordination, an adequate supply of skilled labour, fast planning and approval procedures, and broad access to financing are key prerequisites so that the sector-specific transformation paths can in fact be implemented

On the **financing** side it will be decisive that the vast majority of investments are carried out by the private sector and refinanced over their usable lifespan. Where public funds are necessary, plannable volumes are reliably available from the Special Fund for Infrastructure and Climate Neutrality and the Climate and Transformation Fund. What will be decisive is that these funds are used in a way that they incentivise private investments instead of replacing them – for example through tailor-made support, guarantees and risk sharing as well as the expansion of the infrastructures that make private investments possible in the first place. Revenue from national and European carbon pricing can additionally be used. And finally, removing subsidies that are harmful to the climate can create funding scope in the double-digit billions each year³⁸ – while at the same time improving the incentives for the use of climate-friendly alternatives.

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- ¹ Cf. Lang, J. et al. (2025): [Net Zero Tracker](#), Energy and Climate Intelligence Unit, Data-Driven EnviroLab, NewClimate Institute, Oxford Net Zero. The OECD has reported even higher shares (2025): [The Climate Action Monitor 2025](#). Legally binding regulations exist in the 30 countries and the EU and for a total of 28% of all greenhouse gas emissions. Besides Germany, countries aiming to achieve climate neutrality before 2050 include, among others, Finland (2035), Sweden (2040) and Austria (2045).
- ² Kopernikus projects are energy research projects supported by the BMBF. Their aim is to make a significant contribution to achieving Germany's climate targets by 2045. Besides Ariadne, further Kopernikus projects include P2X, ENSURE and SynErgie. <https://www.kopernikus-projekte.de/startseite>.
- ³ The necessary investments in the LTS/O45 scenarios are estimated on the basis of published data on physical quantities (e.g. stocks of plants, vehicles, power plant fleet and infrastructure) and assumptions on the specific technology costs. Owing to data availability, however, this approach is not viable for all technology areas. The calculation bases are scant for the industrial sector in particular. The differences in the coverage of technological areas need to be taken into account when interpreting the findings. The documentation on the Ariadne scenarios 2025 is used for the Ariadne scenario, particularly the data on investments for specific technologies of the relevant sectors.
- ⁴ The Ariadne scenario forms the lower end of the range. This is likely due to a moderate deviation in the coverage of the industrial and buildings sectors. In the industrial sector, for example, the Ariadne scenario did not fully capture investments aimed at improving energy efficiency. In the buildings sector, the Ariadne scenario and LTS/O45 did not include investments in new buildings and commercial processes; these were imputed on the basis of the other scenarios. For the sectors in which the investments could be estimated for all relevant items in a similar quality of coverage (transport, energy), the quantities of the scenarios correspond very well.
- ⁵ Cf. Brand, S., Römer, D. and Schwartz, M. (2021): [Investing EUR 5 trillion to reach climate neutrality – a surmountable challenge](#), Focus on Economics No. 350, KfW Research, and Prognos/Nextra/NKI (2021): [Beitrag von Green Finance zum Erreichen der Klimaneutralität in Deutschland](#) (*Contribution of green finance to achieving climate neutrality in Germany – in German*), study commissioned by KfW.
- ⁶ The predecessor study did not explicitly report the buildings sector, but this can be derived by adding households and the industry, trade and services sector. Compared with the predecessor study, the investment needs in the buildings sector have grown. This is also due to increased building prices and, thus, higher investments for improving thermal insulation and efficient buildings. The requirement for climate investment in the industrial sector is now estimated moderately lower. The estimated investment needs for the transport sector have not significantly changed.
- ⁷ To identify the investments made under the status quo, the climate investments of the scenarios Roadmap and KNDE made in the 2018–2023 period were taken and averaged at the level of individual technological areas. During this period, the scenarios are generally based on the real development. For example, the scenarios in these ex-post years map the effective addition of PV and wind energy capacity, heat pumps and electric vehicles. The investments derived from the scenarios are therefore a good estimator of the climate investments effectively undertaken in these years.
- ⁸ Cf. Hannah R. and Rosado, P. (2026): ["Battery costs have declined by 99% in the last three decades, making electrified transport a reality"](#), published in OurWorldinData.org.
- ⁹ Cf. Rode, J. and Römer, D. (2025): [Growing demand for electric cars – German exports are also picking up](#), Focus on Economics No. 511, KfW Research.
- ¹⁰ The sectoral distribution follows the energy balance that underlies the analysed scenarios. There, "residential buildings" is attributed to the households sector, "non-residential buildings" to the sector industry, trade, services (ITS) including public buildings. Industrial buildings are attributed to the industrial sector. The sector of non-residential buildings also includes minor amounts of investment in process technology (a good 7%). The sectors identify the purpose of the investment, not the investing actors; accordingly, a portion of the investments in residential buildings is attributed to housing enterprises.
- ¹¹ The analysis addresses the average ratio of residential to non-residential buildings under the KNDE and Roadmap scenarios: On average, 74.8% of the building investment required there goes to residential buildings; under KNDE it is 72.8% of building investment and under Roadmap it is 76.8%.
- ¹² Cf. Römer, D. and Rode, J. (2025): [KfW Energy Transition Barometer 2025](#), KfW Research.
- ¹³ Cf. Moore, F. C. et al (2024): [Synthesis of evidence yields high social cost of carbon due to structural model variation and uncertainties](#), Proceedings of the National Academy of Sciences.
- ¹⁴ Cf. Tol, R. S. J. (2023): [Social cost of carbon estimates have increased over time](#), Nature Climate Change.
- ¹⁵ Cf. Bilal and Känzig (2026): [The Macroeconomic Impact of Climate Change: Global Versus Local Temperature](#), Quarterly Journal of Economics.
- ¹⁶ Cf. Burke, M. et al. (2026): [Quantifying climate loss and damage consistent with a social cost of carbon](#), Nature.
- ¹⁷ Prognos/Nextra/NKI (2021): [Beitrag von Green Finance zum Erreichen der Klimaneutralität in Deutschland](#) (*Contribution of green finance to achieving climate neutrality in Germany – in German*). Study commissioned by KfW.
- ¹⁸ Brand, S. and Römer, D. (2022): [Öffentliche Investitionsbedarfe zur Erreichung der Klimaneutralität in Deutschland](#) (Public investment required to achieve climate neutrality in Germany – in German), Focus on Economics No. 395, KfW Research.
- ¹⁹ The EUR 33 billion is the total average public sector investment needs in the individual sectors (Figure 6). The ranges for the years 2025–2030 and 2031–2045, however, cannot be added up as they resulted from different studies in which the investment volumes are not evenly distributed across the overall period. In the predecessor study the public sector climate investments to be made by 2045 were estimated at EUR 484 billion in total. Most of the increase can be explained by price effects, but a changed basis of calculation, particularly for buildings, leads to higher municipal investment amounts.
- ²⁰ Cf. also PwC (2025): [Wie lässt sich die Energie- und Wärmewende finanzieren? Finanzierungsbedarf aus Sicht der Energieversorgungsunternehmen](#) (*How can the energy and heating transition be financed? Financing needs from the viewpoint of energy utilities – in German*), study commissioned by KfW Group. No distinction is made here between public and private investment, however.
- ²¹ Cf. also PwC (2025). PwC estimates an investment requirement of EUR 62 billion for district heating networks and EUR 217 billion for heat generation by 2045. Other studies have identified an overall investment demand for heating of around EUR 200 billion by 2045, cf. Agora Energiewende (2025): [Investitionen in eine zukunftsfähige Daseinsvorsorge](#) (*Investing in viable public services – our title translation, in German*).
- ²² The figures on charging infrastructure were taken from reports to the Federal network agency (2025) and information from the Association of Local Utilities (2024).
- ²³ In the predecessor study the public-sector share in the sector non-residential buildings and industry, trade and services was 23.6%.
- ²⁴ Of this, 6.2% is purely municipal investment.
- ²⁵ The predecessor study used a statistic on fixed assets, whereas this study used the census on the building and housing stock released in 2024 to map the ownership structure.
- ²⁶ The attribution to the corporate sector followed Prognos (2026) and was broken down by economic sector, vehicle owner and ownership structure. Thus, it also comprises public-sector enterprises such as utilities, municipal housing companies, transport operators and Deutsche Bahn; the shares of enterprises and the public sector therefore overlap and are not additive. Investments that are to be attributed to the public sector according to the national accounts definition have been deducted from the calculation. Specifically, public-sector non-residential buildings such as schools and residential buildings, official vehicles of the public administration and the rail infrastructure were fully attributed to the state. Although the latter formally belongs to the corporate sector, is very predominantly financed from the federal budget. These investments will amount to just under EUR 120 billion in total by 2045. Compared with Prognos (2026), corporate investment will decrease by around 4% as a result.
- ²⁷ On the basis of the predecessor study KfW Research already performed an initial estimate of corporate investments but without attributing individual investment requirements directly to businesses. At the time, the assumption was that around 90% of the necessary investment would have to be shouldered by the private sector. Businesses traditionally account for roughly 70% of this private investment. This resulted in the assumption that around 63% of the necessary investment would have to be made by the corporate sector. In the present study the investment requirements have now been allocated to businesses and separately itemised for the individual climate sectors, which enables the investment needs to be estimated more precisely.
- ²⁸ This lists the average investment sums in all four scenarios on the basis of the averaged shares of the corporate sector in the individual investment needs under the Roadmap and KNDE scenarios. The shares differ only minimally between the two scenarios mentioned. Further details can be found in: Prognos (2026). [Investitionen für Klimaschutz](#). Notwendige Investitionen zur Erreichung von Klimaneutralität in Deutschland (*Investments for climate action – investment required to achieve climate neutrality in Germany – in German*).
- ²⁹ Grewenig, E., Römer, D. and Rode, J. (2024): [Jeder fünfte Pkw im Unternehmensfuhrpark fährt inzwischen elektrisch – weitere Impulse nötig](#) (One in five cars in company fleets are now electric – further impetus needed – in German), Focus on Economics No. 470, KfW Research.
- ³⁰ Some energy companies are publicly owned, to be sure, but they are usually organised under private law and, unlike the core administration, operate commercially and can therefore be attributed to the corporate sector.
- ³¹ Cf. Brüggemann, A., Grewenig, E., Rode, J. and Schwartz, M. (2025): [KfW Climate Barometer 2025](#). Climate investment by businesses has dropped by nearly 8% in real terms to EUR 80 billion – decline driven by large enterprises, KfW Research.
- ³² Under this assumption, only an additional investment impetus of around EUR 22 billion per year would actually be required. But it needs to be taken into account that the EUR 80 billion from the survey data is not directly comparable with the status quo of investments.
- ³³ Cf. Gerstenberger, J. and Schwartz, M. (2025): [Steady course, but headwinds loom: KfW SME Panel 2025](#). Steady course but headwinds loom: SMEs were stable in recession year, trade conflicts on the horizon, KfW Research.

³⁴ The shares of large enterprises in the investment requirement in the individual climate segments under the KNDE scenario are, by way of example: 67% in the energy sector, 61% in industry, 27% in transport, 20% in non-residential buildings (industry, trade and services, ITS) and 8% in residential buildings (households). Further details can be found in: Prognos (2026): Investitionen für Klimaschutz. Notwendige Investitionen zur Erreichung von Klimaneutralität in Deutschland (*Investments for climate action – investment required to achieve climate neutrality in Germany* – our title translation, in German).

³⁵ Cf. Rode, J. (2025): Jedes Jahr importiert Deutschland fossile Brennstoffe im Wert von Ø 81 Mrd. EUR (Germany imports fossil fuels worth an average of EUR 81 billion each year – in German), Economics in Brief No. 251, KfW Research.

³⁶ Cf. German Federal Environment Agency (UBA) (2026): Treibhausgas-Projektionsdaten 2026 (*Greenhouse gas projection data 2026* – in German); cost estimate by the Handelsblatt Research Institute based on an assumed price of 60 to 150 euros per tonne in the year 2030. The price is fraught with considerable uncertainty because the EU as a whole is also likely to miss the ESR targets and the supply of surplus allocations might therefore be tight.

³⁷ Cf. Kohn et al. (2025): The economic benefits of climate action, Deloitte and KfW Research.

³⁸ There are different estimates about potential savings: The German Federal Environment Agency estimates the environmentally harmful subsidies allocated in the year 2018 at more than EUR 65 billion; cf. German Federal Environment Agency (2021). A study by the Ökoinstitut, Fraunhofer ISI, Prognos, GWS, ifeu and IREES commissioned by the Federal Ministry for Economic Affairs and Climate Action in 2024 identified EUR 7.3 billion in subsidies in 2020 that increased emissions and around EUR 30 billion in further benefits that were harmful to the climate, particularly the diesel privilege (EUR 9.6 billion) and the company car privilege (EUR 6 billion). cf. Plötz, P. et al. (2024): Quantifizierung der Treibhausgaswirkung von staatlichen Begünstigungen in Deutschland (*Quantification of the greenhouse gas impact of state benefits in Germany* – our title translation, in German).