International Energy Agency

Energy Efficiency 2025

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Abstract

Energy Efficiency 2025 is the IEA's primary annual analysis on global energy efficiency developments, showing recent trends in energy intensity and demand, investment, employment and policy. The report provides sector-specific analysis on industry, buildings, appliances and transport and explores system-wide themes such as emissions reductions, energy security, affordability and competitiveness. This report is launched in parallel with an update to the IEA Energy Efficiency Progress Tracker, which can be accessed through the IEA website.

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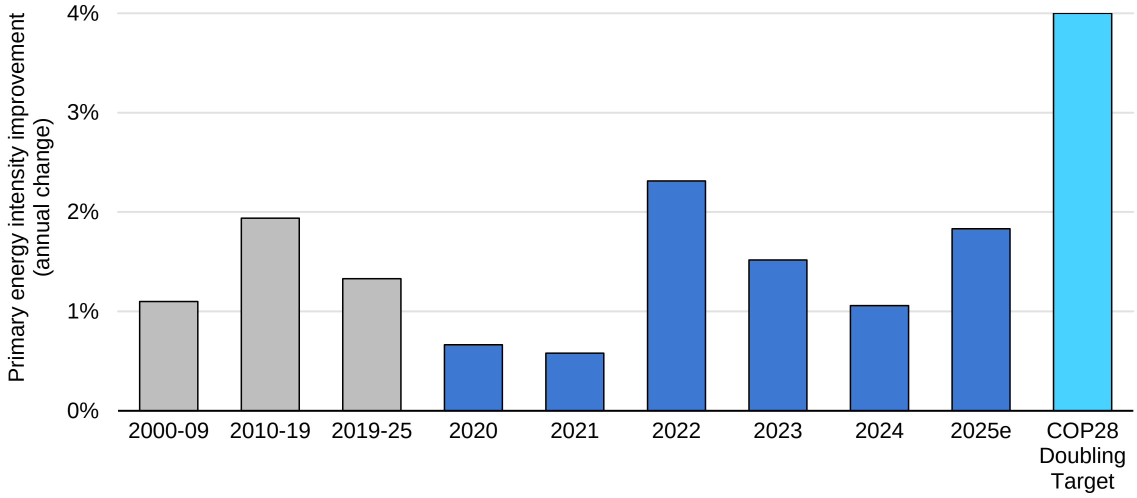
Executive summary

Global energy efficiency progress sees improvement in 2025, but remains off track to meet global goal

Global energy efficiency progress is set to improve by 1.8% in 2025, up from around 1% in 2024. Preliminary estimates indicate that several key regions are showing some signs of stronger progress compared to their average since 2019. For example, energy intensity progress in 2025 is estimated to be over 3% in the People's Republic of China (hereafter "China") and over 4% in India, well above their averages in the years since 2019. In the United States and the European Union (EU), on the other hand, progress in 2025 is set to fall to under 1% after several years of stronger performance following the energy crisis.

The world remains off track to achieve its COP28 ambition for 2030. In 2023, nearly 200 governments agreed at COP28 in Dubai to work together to collectively double the global average annual rate of energy efficiency improvements by 2030. However, global energy efficiency progress – measured by the rate of change in primary energy intensity – has fallen to 1.3% per year on average since 2019. This is just over half its longer-term average of around 2% per year in the period 2010-2019, and well below the COP28 target of a 4% annual improvement by 2030.

Global primary energy intensity improvement, 2000-2025e, COP28 doubling target, 2030



Notes: Primary energy intensity = total energy supply divided by gross domestic product (GDP 2021 purchasing power parity). An improvement is defined as a reduction in energy intensity. Grey bars denote the compound annual growth rate (CAGR) for the indicated timeframes; dark blue bars show annual growth rates in single years. 2025e = estimated values for 2025.
Source: IEA Energy Efficiency Progress Tracker (accessed November 2025).

Four key trends are holding back faster progress

1. **Around two-thirds of global final energy demand growth since 2019 has been concentrated in industry, a sector where energy intensity progress has slowed sharply.** Industrial energy demand growth has accelerated since 2019, while the average annual rate of industrial energy intensity improvement fell to under 0.5% over that same period, compared to almost 2% last decade. This global shift towards more intensive energy use in industry is offsetting gains made in other sectors and is weighing down overall efficiency progress.

2. **Policies have lagged technology progress, leaving significant savings on the table.** Many appliances being sold today are often only half as efficient as the best available models. As technologies have become more efficient in recent years, energy efficiency standards have not progressed at the same pace. For example, the efficiency of best-in-class lightbulbs doubled in the last 15 years, while minimum performance standards have only gone up by 30%.

3. **Increased access to air conditioners has pushed up cooling-related electricity demand.** Higher living standards have allowed more people to afford much-needed cooling technologies such as air conditioners, especially in emerging economies. In fact, energy for space cooling has seen the fastest growth of any end-use in buildings since 2000, growing over 4% per year. However, this increased demand has been met with equipment that is not highly efficient, further straining energy systems at a time of rapid growth. If every air conditioner bought since 2019 had been the most efficient available, the world could have avoided electricity demand growth equivalent to the demand growth from data centres over the same period.

4. **Electricity demand growth has outpaced renewable supply leading to an overall increase in less efficient fossil fuel generation.** Electricity demand has grown two to three times faster than overall energy demand since 2019. In some regions, this rising demand has led to greater use of inefficient generation sources, placing upward pressure on primary energy demand and slowing energy intensity progress.

Efficiency investment and employment have grown, but higher costs and labour shortages remain as challenges

Global energy efficiency-related investment is set to reach almost USD 800 billion in 2025, growing by 6% compared to last year and over 70% compared to 2015. However, in some countries, public support schemes have decreased amid budgetary constraints, while material costs have risen too. For instance, construction prices in the European Union have increased over 20% since 2021. Geographic disparities in investments remain too, with two-thirds of end use investment taking place in China, the United States and the European Union, while the fastest growth in the last 10 years happened in India and Southeast Asia.

Nearly 18 million people were employed in energy efficiency in 2024 around the world, but the sector continues to face labour and skills shortages. Overall efficiency-related employment increased over 6% from 2023 to 2024. Most efficiency workers are in China, the European Union and the United States, but emerging markets like India have seen a rapid increase in recent years. Meanwhile, new IEA surveys in 2025 highlight persistent labour shortages and the need to increase efforts to attract and train workers.

2025 sees a renewed focus on energy efficiency to address global economic and energy policy priorities

New IEA analysis shows the impact energy efficiency policies have had on global energy policy priorities. Notably, without efficiency gains since 2010, today's greenhouse gas emissions would be 20% higher, and energy efficiency remains one of the key drivers to lower emissions in the future.

Efficiency actions since 2000 have reduced household energy bills in advanced economies by up to 20%. In 2025, several major economies put in place efficiency policies specifically linked to enhancing energy affordability. Efficiency has also improved competitiveness, with industries today producing 20% more value per unit of energy consumed than in 2000.

Efficiency gains have also avoided the need for 20% more fossil fuel imports in IEA countries over the same period. New data shows that efficiency actions accounted for two-thirds of the gas demand savings in European households during the energy crisis, enhancing its security and strategic independence.

This role of energy efficiency in wider energy policy goals was also recognised at the 10th Annual IEA Global Conference on Energy Efficiency in June. Participating governments reaffirmed their commitment to stronger energy efficiency action and particularly highlighted its role as a key tool to address energy affordability, quality of life and industrial competitiveness.

To accelerate efficiency progress, governments must raise ambition and close policy gaps

Governments implemented over 250 new or updated efficiency-related policies in countries all around the world in 2025. These countries represent over 85% of global energy demand, compared to countries accounting for 70% of total energy demand taking efficiency-related policy actions in 2024. Ahead of COP30, over 50 countries have also set updated targets for energy efficiency in their Nationally Determined Contributions. These policies form the basis for faster progress, and countries can accelerate efficiency improvements in two ways.

First, governments can move quickly to raise the ambition of existing policies. As technology improves, many policies have not been kept up to date, and policy ambition varies widely among countries. In some countries, for instance, a building that meets the local efficiency standard may in fact be using three times as much energy as one in another country with a similar climate. There is significant room to raise the bar and accelerate progress using existing and well-proven policy tools. When policy frameworks are already in place, this represents the fastest and easiest way to accelerate efficiency progress.

Second, there remain important policy gaps to be filled. There are still many areas where policies are either absent or limited. For example, around half of countries globally still do not have efficiency standards for new buildings, including in regions experiencing rapid growth. Similarly, there are still no mandatory energy performance standards for industrial motors in two-thirds of all countries globally. Identifying and closing specific policy gaps, prioritising where energy use and savings potential are the highest, can help countries accelerate progress.

Chapter 1: Global trends

The world remains off track to meet the COP28 target of doubling energy efficiency improvements by 2030. Global energy intensity progress since 2019 is around 1.3% per year on average, well below the 2010-2019 average of 2% per year. Four key trends help explain why global energy intensity progress this decade is stuck in low gear: strong demand growth and weak efficiency progress in industry; policies lagging technology progress; rising cooling-related electricity demand; and inefficiencies in power generation.

Global energy intensity is set to improve by 1.8% in 2025, up from just over 1% in 2024. Key regions that have shaped global progress this decade are showing signs of potential recovery in 2025. Compared to the previous decade, both China and India have seen average progress this decade slow down to below 2%. Preliminary estimates for 2025, however, suggest a possible recovery, with India set to reach a progress rate just above 4% this year and China around 3.5%.

Governments implemented over 250 new or updated policies related to energy efficiency in countries all around the world in 2025. These countries represent over 85% of global energy demand, compared to countries representing around 70% of total energy demand introducing efficiency-related policy actions in 2024. For COP30, over 110 countries also updated their Nationally Determined Contributions, with over 50 of them setting efficiency-related targets.

End use investment is set to reach almost USD 800 billion globally in 2025, growing by 6% compared to 2024. However, rising costs, such as recent spikes in interest rates and higher material costs, may hide lower levels of activity. Geographic disparities in end use investments remain as well, with about two-thirds of total efficiency-related investment occurring in China, the United States and the European Union.

Nearly 18 million people around the world were employed in energy efficiency in 2024, marking an increase of 6% from 2023. Most efficiency workers are in China, the United States and the European Union, but emerging markets like India have seen a rapid increase in recent years. The efficiency sector continues to face labour and skills shortages, which could worsen in coming years if not addressed through improved training and education.

Key policy actions can help governments accelerate progress. In particular, policy makers can raise the ambition of existing policies and close remaining policy gaps.

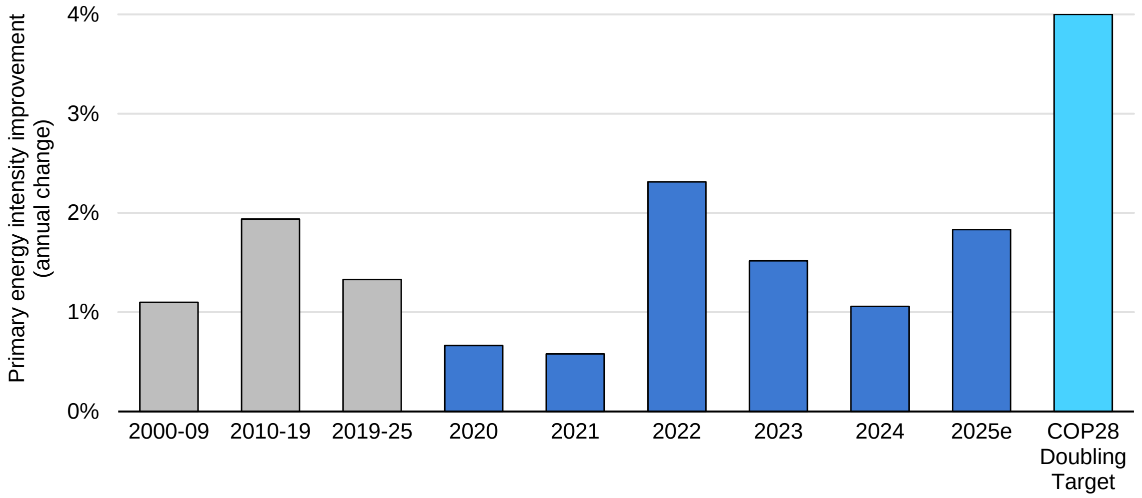
1.1 Current progress

Global energy intensity progress sees improvement in 2025 but remains off track to achieve COP28 ambition

Energy intensity is the amount of primary energy required per unit of economic output (GDP). When energy use grows more slowly than GDP, global energy intensity declines, indicating an improvement. Global primary energy intensity, the main indicator used to track the energy efficiency of the economy, is expected to improve by 1.8% in 2025, an uptick from around 1% in 2024. This year's improvement reflects slowing energy demand growth, from just over 2% in 2024 to 1.3% in 2025, amidst resilient but still relatively subdued economic growth, continuing at just over 3%.

In 2023, at COP28 in Dubai, nearly 200 governments agreed to work together to collectively double the global average annual rate of energy efficiency improvements and triple renewable energy capacity globally by 2030, as part of a just, orderly and equitable transition away from fossil fuels in energy systems. While progress on renewable energy capacity is expected to reach 2.6 times its 2022 level by 2030, overall primary energy intensity progress has fallen to 1.3% per year on average since 2019, just over half its longer-term average (2010-19) of around 2%, instead of accelerating towards 4% per year. As a result, the world is not on track yet to reach its 2030 ambition.

Primary energy intensity improvement, 2000-2025e, COP28 doubling target, world, 2030



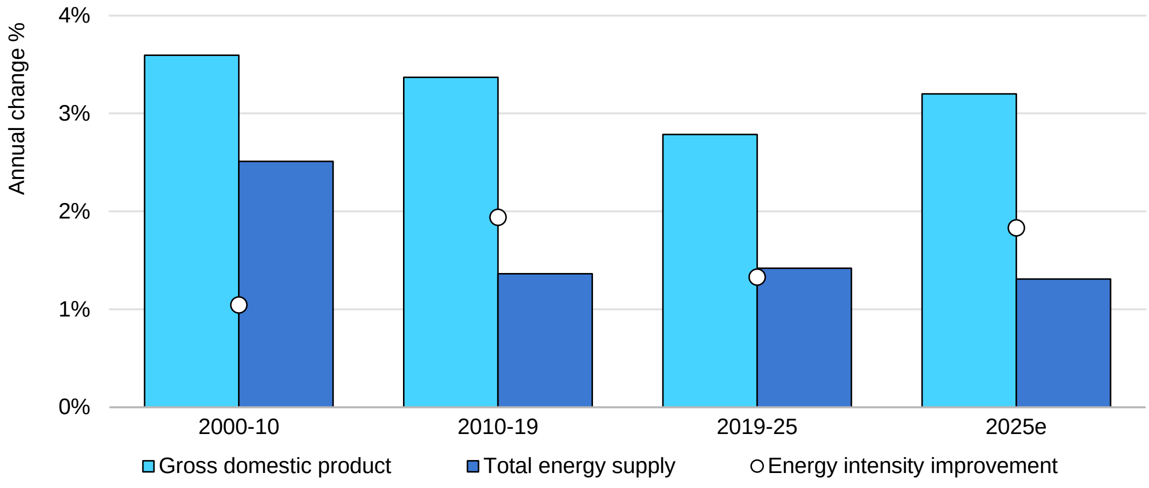
Notes: Primary energy intensity = total energy supply divided by gross domestic product (GDP 2021 purchasing power parity). An improvement is defined as a reduction in energy intensity. Grey bars denote the compound annual growth rate (CAGR) for the indicated timeframes; dark blue bars show annual growth rates in single years. 2025e = estimated values for 2025.
Source: IEA (2025), Energy Efficiency Progress Tracker (accessed November 2025).

Resilient energy demand growth coupled with slowing GDP has pushed down intensity progress this decade

Over the first 20 years of this century, global energy intensity progress followed a steady progression, accelerating from an average of around 1% per year from 2000 to 2010 to about 2% per year from 2010 to 2019. This was driven by slower growth in total energy supply in the period 2010-19 than in 2000-10, while economic growth was relatively similar. This rise in global efficiency progress in 2010-19 saw the amount of primary energy growth needed to fuel each extra 1% of growth in gross domestic product (GDP) fall from 0.7% to 0.4%, a positive trend. This progress led to multiple benefits, such as strengthened energy security and reduced CO_2 emissions.

However, since the Covid-19 pandemic, rather than doubling towards 4%, average global efficiency progress has fallen to 1.3% per year in the period 2019-25. This is the result of the fact that, over this period, the average rate of global economic growth slowed to about 2.8% per year, which is below the 3.4% average annual growth between 2010 and 2019. At the same time, total energy supply continued to grow at 1.4% per year on average in 2019-25, similar to the rate seen in 2010-19. Slower economic growth with resilient total energy supply has put upwards pressure on fossil fuel demand, weakening the efficiency momentum of the previous decade. Preliminary estimates show slightly higher economic growth in 2025 compared to the average since 2019, leading to the uptick of intensity progress to around 1.8%.

Global annual change in total energy supply, GDP and energy intensity improvement, 2000-2025e



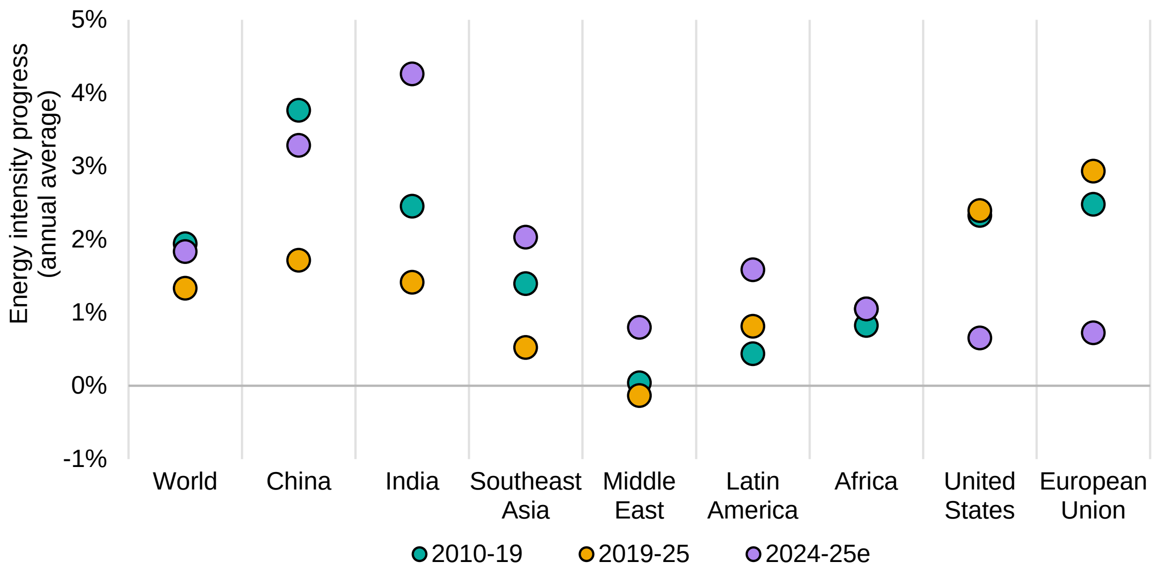
Notes: GDP = gross domestic product 2021 USD purchasing power parity; TES = total energy supply. 2025e estimated values for 2025.
Source: IEA (2025) Energy Efficiency Progress Tracker (accessed November 2025).

Key regions that shaped global progress this decade show signs of a possible recovery in 2025

The slowdown in global energy intensity progress since 2019 was shaped by marked changes in key regions, particularly in Asia. Progress in China pushed up the global average in 2010-2019, averaging an improvement of nearly 4% per year, but progress has slowed to below 2% since 2019. Similar trends can be seen (to a lesser extent) in India and Southeast Asia. Meanwhile, in the United States, average intensity progress has remained at a similar level since 2019 compared to 2010-2019, and progress has slightly increased in the European Union.

Estimates for 2025 suggest a possible recovery in progress in China, India and Southeast Asia compared to the average since 2019, although a single year's figures are not sufficient yet to confirm a shift in trends. Based on preliminary data, India is set to see progress of just over 4% in 2025, while progress in China is expected to be 3.5% this year. In the United States and the European Union, on the other hand, early indicators suggest progress in 2025 is expected to drop below 1%, a shift from longer-term trends. The potential recovery in energy intensity progress in Asia in 2025 is being driven by easing pressures on energy demand growth. In both China and India, preliminary estimates show primary energy demand growing in 2025 at around half the pace of their respective averages in 2010-2019. In the IEA Energy Efficiency Progress Tracker, which is updated in parallel with this report, there is more data and analysis available on regional trends.

Improvement in primary energy intensity, selected countries and regions, 2010-2025e



Note: 2025e = estimated values for 2025.
Source: IEA (2025), Energy Efficiency Progress Tracker (accessed November 2025).

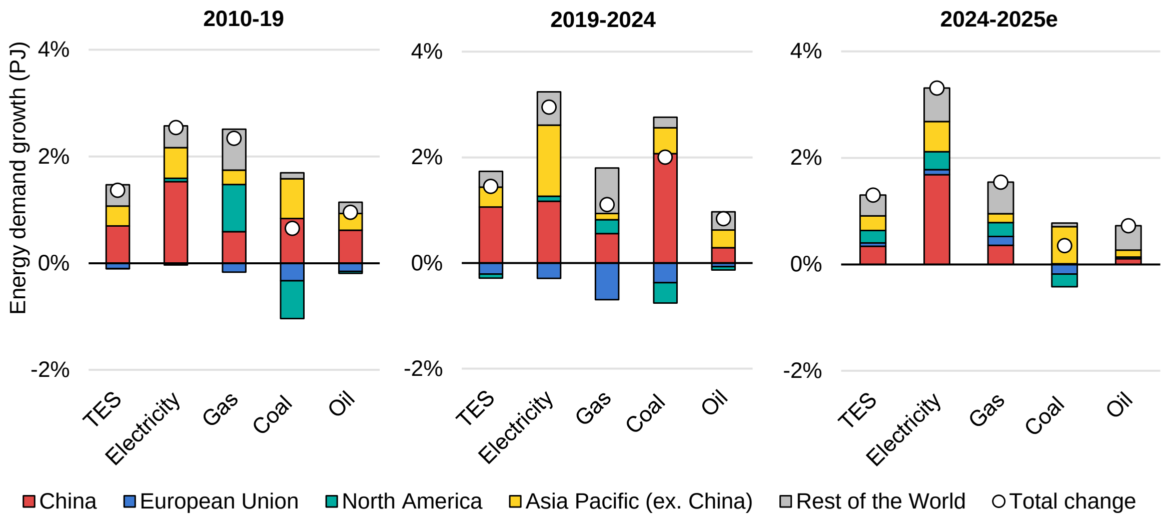
Global electricity demand is growing more than twice as fast as total energy demand in 2025

Electricity demand is set to increase by 3.3% in 2025, over two times the growth rate of overall energy demand this year. This is driven by rising electricity use in industry, higher demand for cooling in buildings, growth in data centres and artificial intelligence, and the electrification of end uses across sectors. The 2025 growth in electricity demand is in line with its average annual growth since 2019, and slightly higher than the average from 2010 to 2019 of around 2.5% per year.

China accounts for the largest share of global electricity demand growth in recent years. Renewable capacity additions are expected to reach a record in 2025 with almost 465 GW expected to be added, driving a slight decline in coal-fired generation, an important milestone in China's energy transition. Yet new coal power plants continue to be built, and one in every three tonnes of coal consumed globally is burned in a Chinese power plant. Older plants are often retained and retrofitted, as operators rely on coal to provide system flexibility and stability.

In contrast to the 3.3% growth in electricity demand, fossil fuel demand is expected to rise much slower this year, growing just over 1% for natural gas and around 0.5% for oil, while coal demand growth is estimated to be near-zero. This compares with average growth rates from 2010 to 2019 of 2.3% for gas, 1% for oil, and 0.7% for coal. In 2025, coal is particularly set to grow slower than the average since 2019, which was around 2% per year, largely driven by China.

Total energy supply and energy demand growth, by fuel, 2010-2025e



Notes: TES = total energy supply.
Sources: IEA (2025), World Energy Balances (accessed October 2025); Gas Market Report Q3 2025; Coal Mid-Year Update 2025; Oil 2025; and Electricity 2025.

Entering the Age of Electricity: The share of electricity in final energy demand has reached just under 22% in 2025

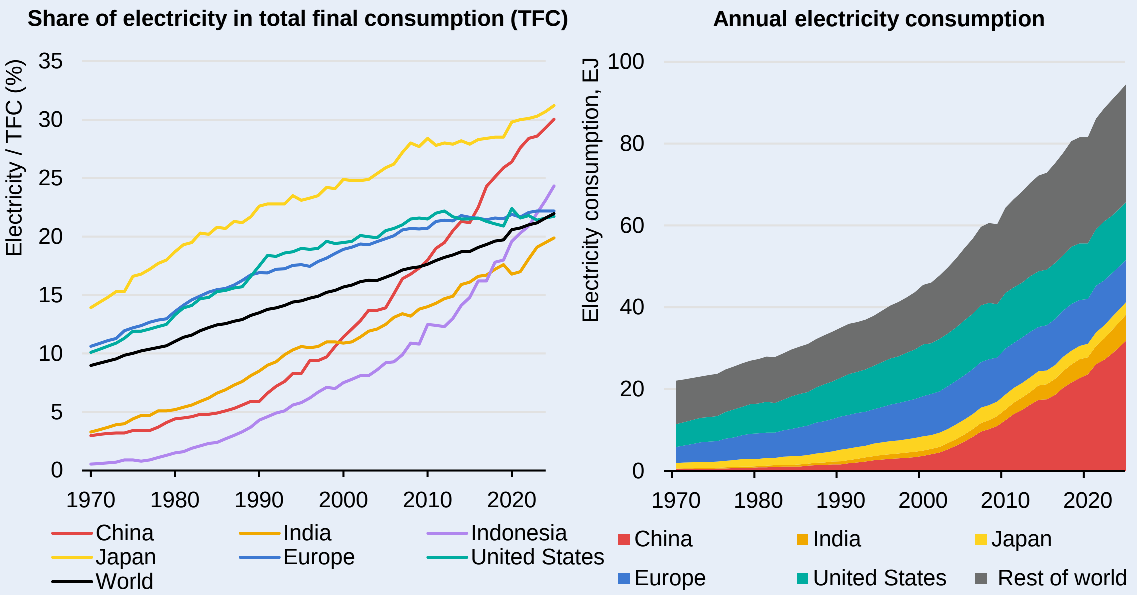
Energy efficiency and electricity demand are closely linked. This year's report therefore explores the role of energy efficiency in the Age of Electricity.

Over the past 50 years, electricity demand has increased fivefold, outpacing all other fuels. Its share in total final consumption has more than doubled since 1975 to reach around 21.5% today, recently growing by about half a percentage point per year. Emerging and developing economies, particularly China and India, have been the main drivers of this growth, with electricity rising from 5% of final energy use in the early 1980s to around 30% in China and 20% in India today.

Advanced economies are also seeing electricity claim a growing share of their energy mix, led by the uptake of electric vehicles, heat pumps, and digital services, such as artificial intelligence. For example, in Japan, 31% of final energy demand is fuelled by electricity today, up from under 20% in the 1980s. In the United States, it has risen to around 21% from 13% in the 1980s.

The Age of Electricity is driven by a high demand for energy services across the world. This includes strong growth in electricity demand related to cooling and other household appliances, data centre, industrial electricity use and electrification of transport. It is also reshaping household energy consumption patterns, which can have important implications for energy affordability as well.

Share of electricity in total final consumption (left) and electricity consumption (right), world and selected countries, 1970-2023



Source: IEA (2025), World Energy Balances (accessed October 2025).

1.2 Recent trends

Four key trends help explain the slow global energy intensity progress since 2019

1. **Around two-thirds of the growth in final energy demand since 2019 has been concentrated in industry, a sector where energy intensity progress has slowed sharply.** Industrial energy demand growth has accelerated since 2019, while the average annual rate of industrial energy intensity improvement fell to under 0.5% over that same period, compared to almost 2% in 2010-2019. This global shift towards more intensive energy use in industry is offsetting gains made in other sectors and is weighing down overall efficiency progress.

2. **Policies have lagged technology progress, leaving significant savings on the table.** Many appliances being sold today are often only half as efficient as the best available models. As technologies have become more efficient in recent years, energy efficiency standards have not progressed at the same pace. For example, the efficiency of best-in-class lighting equipment doubled in the last 15 years, while minimum performance standards have only gone up by 30%.

3. **Increased access to air conditioners has pushed up cooling-related electricity demand.** Higher living standards have allowed more people to afford much-needed cooling technologies such as air conditioners, especially in emerging economies. In fact, energy for space cooling has seen the fastest growth of any end-use in buildings since 2000, growing over 4% per year. However, this increased demand has been met with equipment that is not highly efficient, further straining energy systems at a time of rapid growth. If every air conditioner bought since 2019 had been the most efficient available, the world could have avoided electricity demand growth equivalent to the demand growth from data centres over the same period.

4. **Electricity demand growth has outpaced renewable supply, leading to an overall increase in less efficient fossil fuel generation.** Electricity demand has grown about three times faster than overall energy demand. In some regions, this rising demand has led to greater use of inefficient generation sources, placing upward pressure on primary energy demand and slowing energy intensity progress.

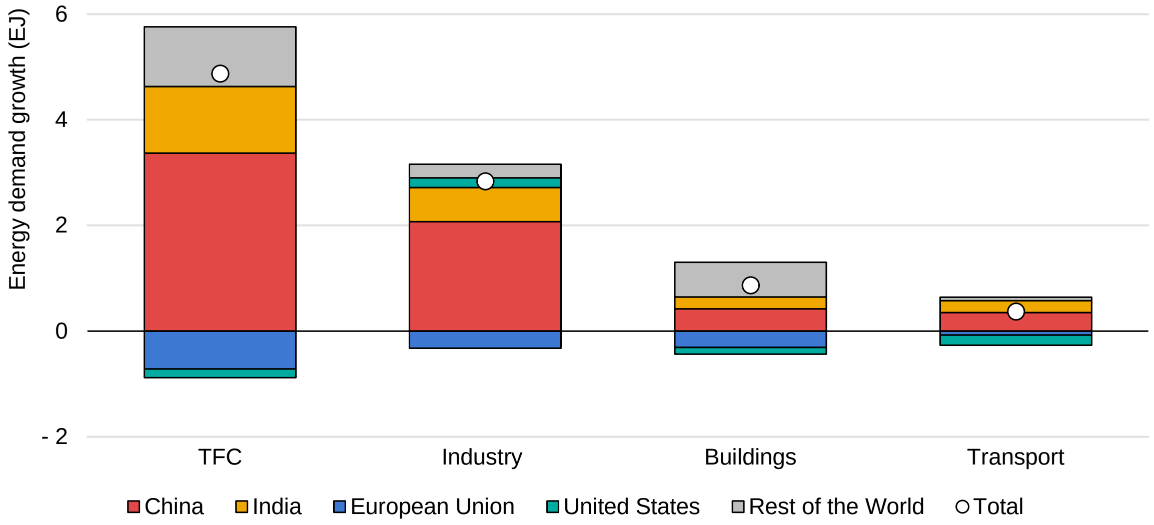
Two-thirds of energy demand growth since 2019 has been driven by industry, particularly in China and India…

Global final energy demand grew by just under 25 EJ between 2019 and 2024. Around two-thirds of this growth was driven by industry, with the buildings sector accounting for the next largest share, responsible for about 20% of the total growth. China has accounted for around two-thirds of the increase in industrial energy demand since 2019, growing at about 3% per year, much faster than its industrial demand growth of just over 1% per year from 2010 to 2019. India contributed to a further 20% of the global growth. In the European Union, industrial energy demand fell, driven in part by the global energy crisis that pushed up energy prices relative to other regions and weighed on industrial activity.

Growth in energy demand in buildings from 2019 to 2024 was around 0.7% per year, slightly lower than the 1.1% average annual growth in 2010-2019. Growth was concentrated in emerging and developing economies, as rising incomes pushed up energy demand from air conditioning and appliances in buildings.

Energy demand in the transport sector experienced significant volatility since 2019, with travel patterns severely disrupted during the Covid-19 pandemic, followed by a rebound in the years after. On average, compared with 2019 levels, transport's contribution to overall energy demand growth has been negligible. This stands in contrast with the previous decade when transport contributed about 40% to final energy demand growth, followed by industry at just over 30% and buildings at 20% (with other uses making up the remainder).

Average annual growth in total final consumption, by sector and region, 2019-2024



Note: TFC = total final consumption, and includes industry, buildings, transport, agriculture, fishing, and non-energy uses.
Source: IEA (2025), World Energy Outlook.

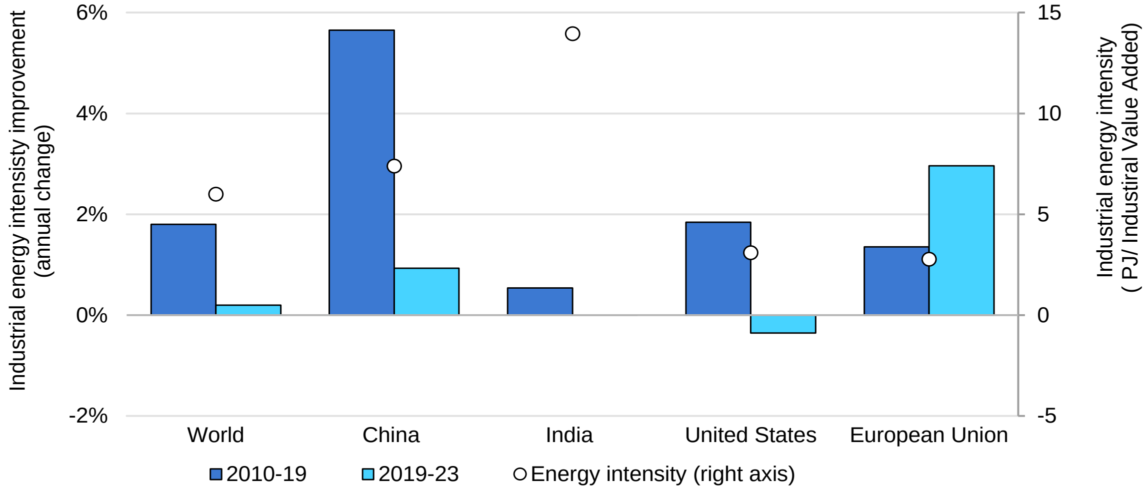
… while intensity progress in industry has slowed in recent years, dropping from 2% per year to under 0.5%

Global industrial energy intensity progress has slowed sharply this decade, improving on average under 0.5% per year between 2019 and 2024. This marks a notable shift from historical trends between 2010 and 2019, when industrial energy intensity improved by almost 2% per year. This was driven by an acceleration in industrial energy demand growth to about 2% per year this decade on average, up from around 1% per year from 2010 to 2019, while at the same time, industrial value-added growth slowed to 2.2% per year from 2019 to 2024, down from 2.8% from 2010 to 2019. The change in industrial energy intensity globally is also affected by shifts in the structure of the industrial sector.

Historically, China has achieved some of the world's fastest industrial energy intensity gains (over 5% per year from 2010 to 2019), thanks to strong efficiency measures, the closure of inefficient facilities and fuel switching away from coal. As a result, the amount of energy needed to fuel industrial value in China halved. Since 2019, however, industrial intensity progress in China has slowed to about 1% per year, and industrial energy demand growth has more than tripled, accelerating to around 3.5% per year, up from 1% the decade before.

In India, industrial intensity progress in 2019-2023 dropped to near zero, compared to progress of just below 1% per year from 2010 to 2019. In the United States, industrial progress also decreased, from nearly 2% per year to a slight deterioration of progress this decade. In the European Union, progress in industry doubled from 1.5% last decade to nearly 3% per year between 2019 and 2023.

Industrial energy intensity progress and absolute level, world and selected countries and regions, 2010-2019 and 2019-2023



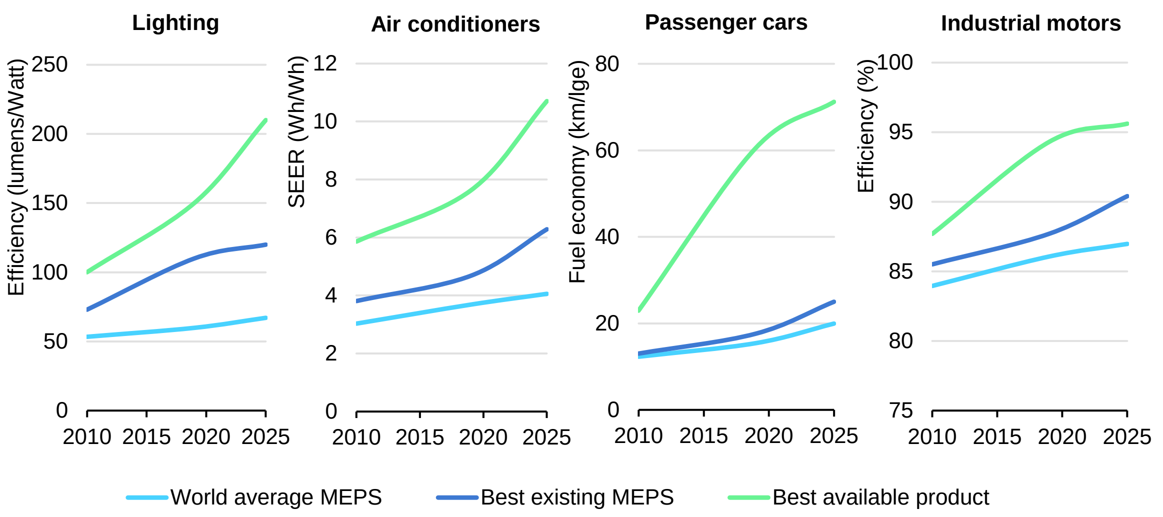
Sources: IEA (2025), Energy Efficiency Progress Tracker, based on IEA (2025), World Energy Balances (energy); UNSTAT and UNIDO data (value added), 2025 (accessed November 2025).

Policies have lagged technology progress, leaving significant savings on the table

Growing populations and rising incomes continue to drive demand for new appliances and equipment, from air conditioners to passenger vehicles. Regulations, such as minimum energy performance standards (MEPS), play a key role in improving energy efficiency by preventing inefficient models from entering the market. By 2025, more than 130 countries have adopted minimum energy performance standards, up from 79 in 2010. However, there are significant differences in the level of stringency among them, and the average stringency has progressed relatively slowly. As a result, new products being sold are often around half as efficient as the most efficient ones available. Similarly, about half the countries in the world have building energy codes, but differences in stringency lead to large disparities in energy demand in new buildings.

This trend is reflected in many end use technologies. For motors, lighting, and air conditioners, the average annual increase in policy ambition from 2010 to 2019 was higher than from 2019 to 2025, and in all cases slower than technology progress. For example, between 2019 and 2025, the average stringency of standards for lighting increased only about 10%, while the efficiency of the best available product rose 40%. Similarly, air conditioner standards have been significantly strengthened in some countries, such as China, but the global average policy ambition has seen a moderate improvement. Passenger cars are an exception, as average policy progress this decade has been faster than the one before, but it has still lagged technology progress.

Energy efficiency levels of selected end-use technologies, 2010-2025



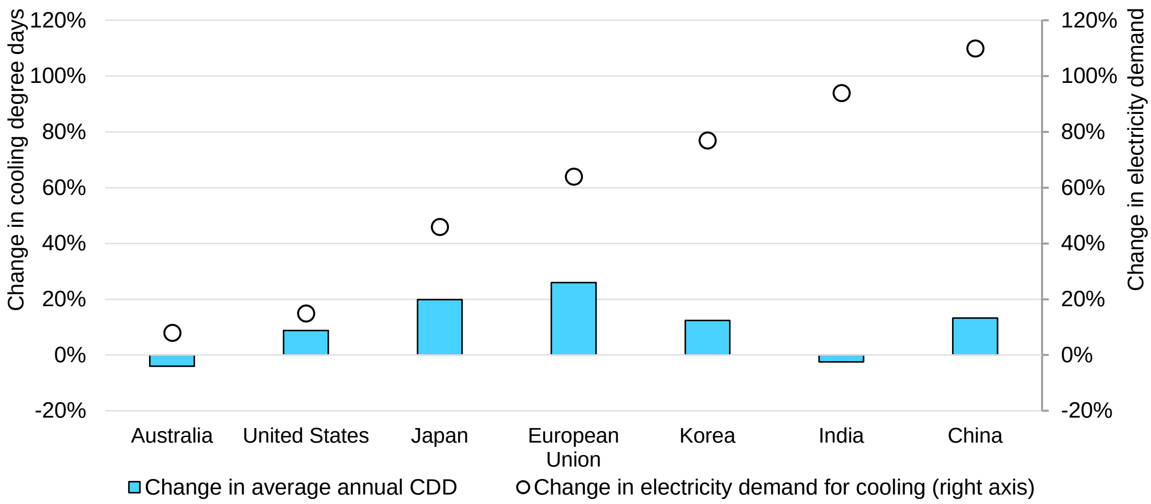
Note: For transport, the levels represent usage phase efficiency (tank-to-wheel).

Increased access to air conditioners has pushed up cooling-related electricity demand

The rapid growth of air conditioner sales in recent years, largely driven by rising incomes in emerging economies, has accelerated the growth of cooling-related electricity demand. Strong growth in sales was seen in India, with up to 30% annual growth since 2021, China and Southeast Asia, where cooling needs are among the highest in the world, but access to cooling technologies had remained low. This is pushing up electricity use even in milder years, adding to the weather effect and amplifying the impact of hotter years. Cooling will continue to be a key driver of electricity demand in coming years, hindering faster progress in energy intensity. If this additional cooling demand since 2019 had been met with the most efficient air conditioners available, these savings would have offset the electricity demand growth from data centres in the same period.

Weather patterns, such as the prevalence of higher temperatures has had a two-sided effect on energy demand, and hence on energy intensity progress, depending on annual variations. Warmer winters have reduced heating demand and contributed positively to improvement in energy intensity, which had a significant impact in 2023 at the global level. On the other hand, hotter summers have pushed up cooling demand, counteracting this effect, as seen in 2024, when about 15% of the total increase in global energy demand was related to cooling and other weather effects, adding 0.3 percentage points to total energy demand growth.

Changes in cooling degree days and electricity demand for cooling between the periods 2010-2019 and 2020-2024



Notes: CDD = cooling degree days (population-weighted).
Sources: IEA (2025), Weather for Energy Tracker; Energy End-uses and Efficiency Indicators; Real Time Electricity Tracker (accessed October 2025).

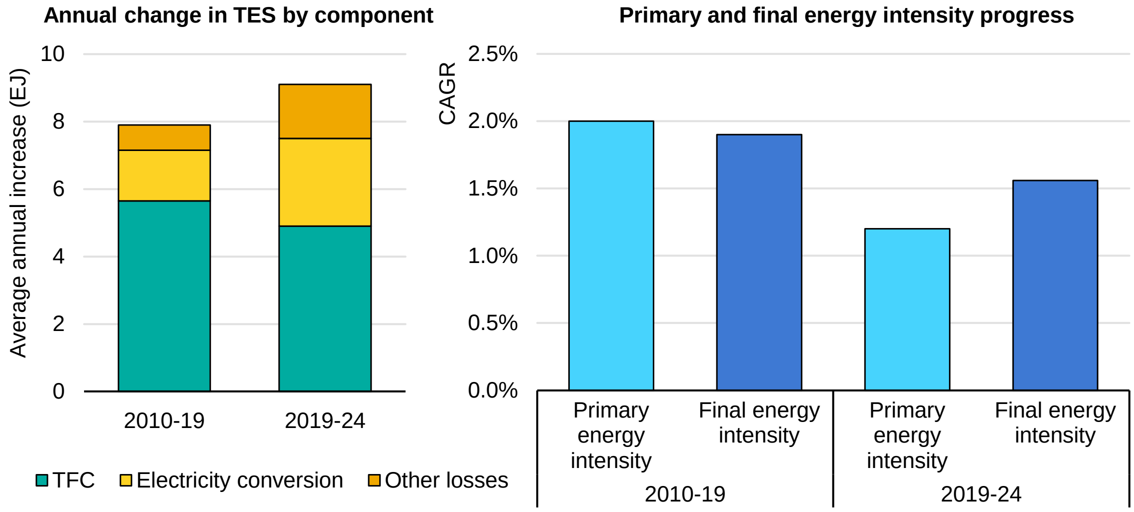
Electricity demand growth has outpaced renewable supply, leading to an increase in less efficient generation

Primary energy intensity, the main global metric for tracking energy efficiency, uses total energy supply (TES) as its key input. This is appropriate since TES reflects the full amount of energy used within a country. However, the total final consumption (TFC), representing the energy consumed by end users, is around 30% lower at the global level. This is due to production and conversion losses in the power sector and heat losses from the direct use of fossil fuels. Further losses occur at the consumer level, before energy services are provided.

In the previous decade, primary and final energy intensity improved at nearly the same rate, about 2% per year. This reflected the fact that both primary and final energy demand grew at a similar pace. Since 2019, however, this relationship has shifted, as fossil fuel generation also increased, alongside renewables, to meet extra electricity demand needs. This contributed to slightly faster average annual growth in TES (1.5%) compared with TFC (1.1%) between 2019 and 2024, shaving around 0.4% off the rate of primary intensity progress this decade.

As the world continues to accelerate the deployment of highly efficient renewable energy capacity and shift away from fossil fuels, this will become a positive driver of efficiency progress. For instance, wind and solar PV are expected to cover over 90% of the increase in electricity demand this year, while coal-fired generation is set to contract, reversing the trend observed in the last years.

Change in total energy supply (left), and global primary and final energy intensity progress (right), 2019-2024e



Notes: Electricity conversion includes transformation losses in power plants and transmission and distribution losses. CAGR = compound annual growth rate.

1.3 Accelerating progress

Key actions to scale up progress vary between countries due to differences in how and where energy is used

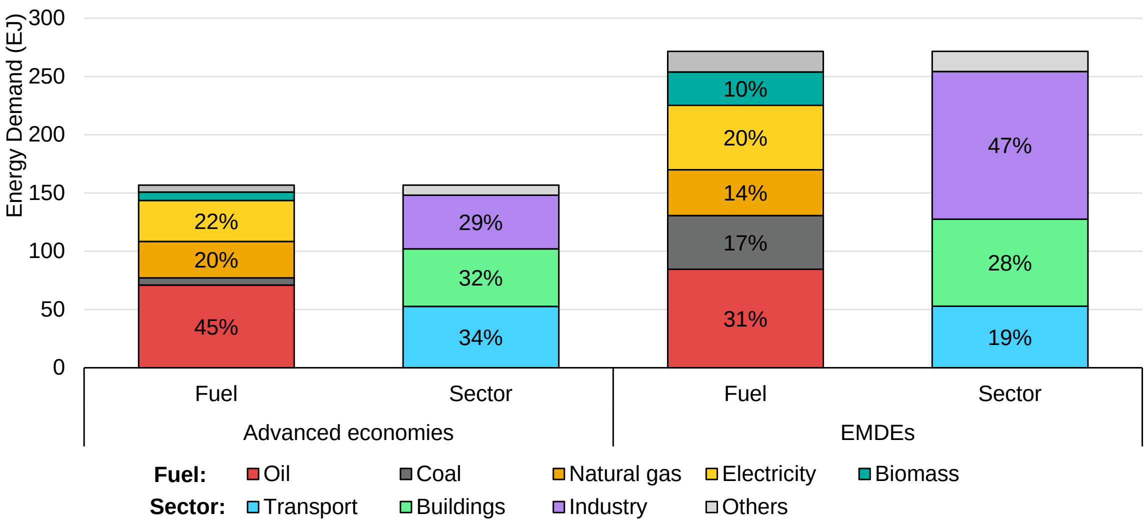
Governments around the world have two key levers to accelerate energy efficiency progress: raising the ambition of existing policies (e.g. increasing already-existing efficiency requirements for appliances or buildings) and closing specific policy gaps (e.g. introducing regulations in a key sector). Which policies to prioritise will vary between countries depending on the structure of energy demand.

In advanced economies, the buildings, industry and transport sectors all account for roughly one-third of final energy demand. Energy demand is not growing as fast in these countries, as access to energy services is already high, so raising progress requires replacing and improving the efficiency of the existing stock.

In emerging markets and developing economies (EMDEs), the industrial sector dominates energy demand, accounting for nearly half of the total, followed by buildings (around 28%), and transport (19%). With a high construction rate and increasing access to energy services, such as air conditioners and private vehicles, accelerating efficiency progress in emerging economies also involves addressing the efficiency of new products being sold.

The analysis in this section helps policy makers to identify where and how energy is used, and what key measures can help accelerate progress, in three key sectors: residential buildings, industry, and road transport.

Final energy demand, by sector and fuel, in advanced and emerging economies, 2023



Notes: EMDEs = emerging markets and developing economies. Other sectors include agriculture and fishing.

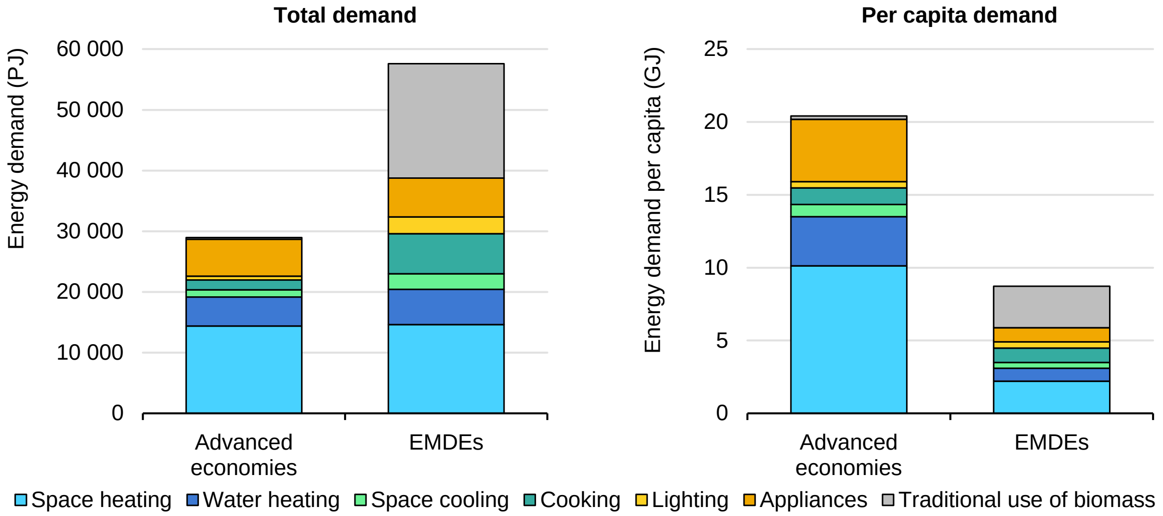
Residential buildings: how and where is energy used?

The residential sector makes up about 70% of global energy demand in buildings, while commercial and public buildings account for the remaining 30%. Around two-thirds of global residential energy demand is in emerging economies, and around one-third in advanced economies.

In advanced economies, most energy in homes is used for space and water heating, together accounting for about 70%. This is followed by the use of electrical appliances, such as refrigerators, televisions and washing machines, with households owning up to 40 different appliances. Addressing inefficient heating technologies and poorly insulated buildings is therefore key for most advanced economies to accelerate efficiency progress. Space cooling is still a minor share of total demand, but it is expected to grow in the coming years.

In emerging and developing economies, per capita space and water heating energy use is less than one-fourth that of advanced economies, due to a large share of the population living in warmer climates and lower access to affordable energy services. Growing populations, rising incomes and hotter summers are increasing the total residential energy demand in EMDEs, particularly for space cooling. Addressing inefficient cooling technologies, ensuring new buildings are efficiently designed and constructed, and promoting clean cooking can help emerging and developing economies to accelerate efficiency progress.

Energy demand in the residential sector, by end use, in advanced and emerging economies, 2023



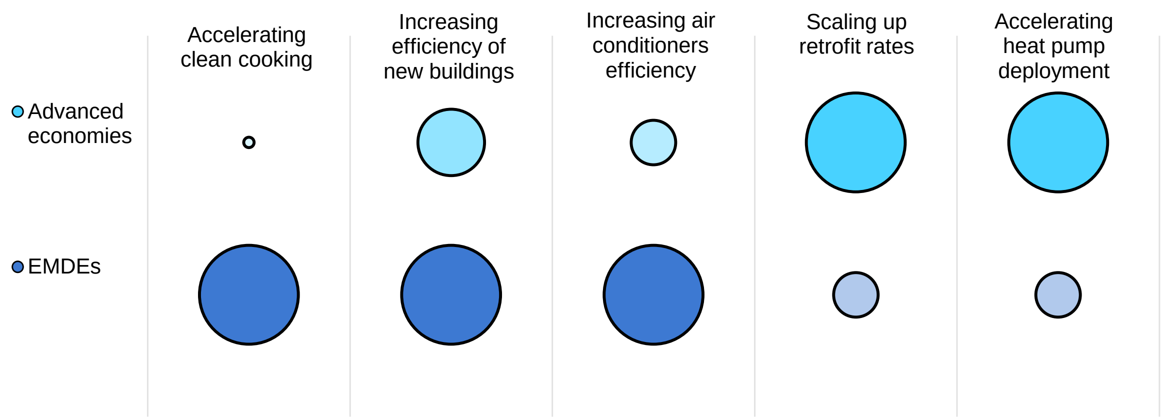
Note: Traditional use of biomass refers to the use of solid biomass with basic technologies for cooking, heating and lighting.

Residential buildings: what are the key measures to accelerate efficiency progress?

In advanced economies, the number of buildings is growing at a slow rate, and many existing buildings are poorly insulated. Accelerating retrofits to reduce heating and cooling energy demand, and electrifying heating systems, are therefore some of the most important drivers of efficiency progress. Policies, such as energy performance certificates, retrofit targets and incentives can help improve the efficiency of existing buildings. To accelerate the deployment of electrified heating systems, such as heat pumps, governments can regulate fossil fuel-based heating technologies, harmonise labels for all heating solutions, provide targeted rebates or tax benefits, and give preferential electricity pricing to reduce the price gap between gas and electricity.

In EMDEs, the number of buildings is growing almost twice as fast as in advanced economies, so efficient new buildings and urban planning are important to accelerate efficiency progress. Building energy codes, which currently apply to around half of new floor area in EMDEs, can ensure that new buildings are built efficiently and help avoid lock-in effects. Improving the efficiency of air conditioners is another key focus area in EMDEs, given the higher and increasing need for cooling compared to advanced economies, and the strong growth in sales of air conditioners. Lastly, reducing the use of traditional biomass through clean cooking measures can prevent 815 000 premature deaths annually in Africa, while also contributing to a significant increase in efficiency progress.

Key measures to accelerate efficiency progress in the residential buildings sector



Notes: Bubble sizes give an indication of the relevance of each measure within the country grouping (classified as high, moderate, low and very low). The classification is based on multiple factors, such as how and where energy is used, current trends and current policy coverage. Actions listed are not exhaustive but are meant to give policy makers an overview of key focus areas that can accelerate progress.

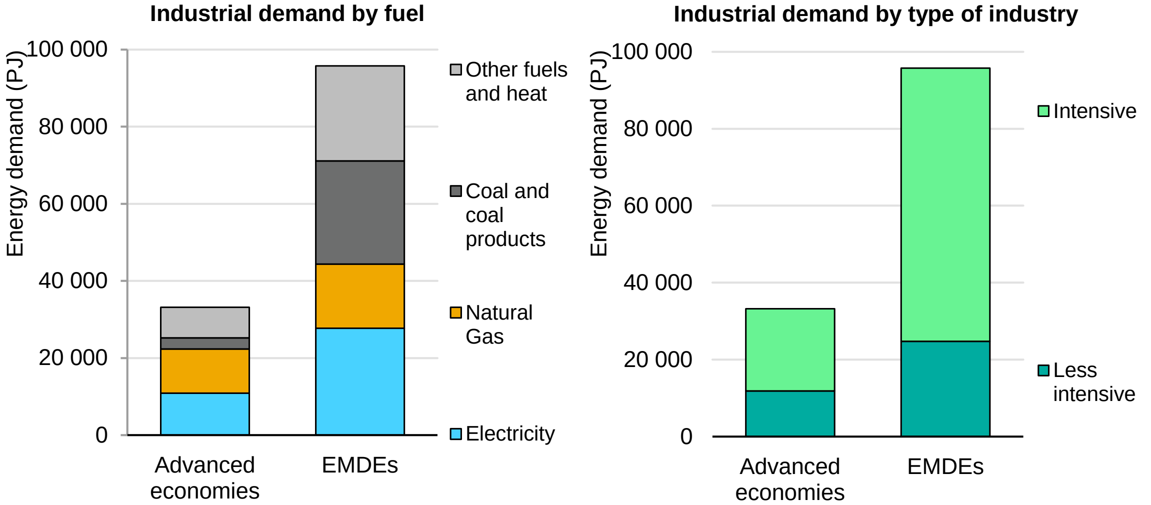
Industrial sector: how and where is energy used?

The industrial sector can be divided into energy-intensive industries (iron and steel, non-metallic minerals, non-ferrous metals, chemicals, and pulp and paper), responsible for three-quarters of total industrial demand, and less intensive industries, which are responsible for the remainder.

In energy-intensive industries, energy is largely used in processes that require high-temperature heat, generally above 500°C. Coal accounts for the largest share of this demand (~30%), while electricity accounts for around 25%. Efficiency improvements, particularly in the short term, can come from material efficiency, technical efficiency and process optimisation. However, as the sector is characterised by long-life assets, policies targeting these industries are often part of wider long-term decarbonisation efforts rather than energy efficiency alone.

In less energy-intensive industries (such as food and drink, and textiles), a larger share of the demand can be addressed in the short term with proven, economically feasible and readily available efficient technologies and methods. Electricity supplies over 40% of the demand in these industries and is primarily used to power motor-driven systems. The remainder is supplied by natural gas and other fuels for heat production. Most of the required heat falls within low-temperature ranges (up to 200°C), which could potentially be efficiently electrified with existing technologies, or medium-temperature ranges (up to 500°C).

Analysis of energy demand in less intensive industries, by subsector and fuel, in advanced and emerging economies



Notes: Feedstocks are not included in the industrial sector. Other fuels include oil, oil products, biofuels and waste.
Source: IEA (2025), World Energy Balances (accessed October 2025).

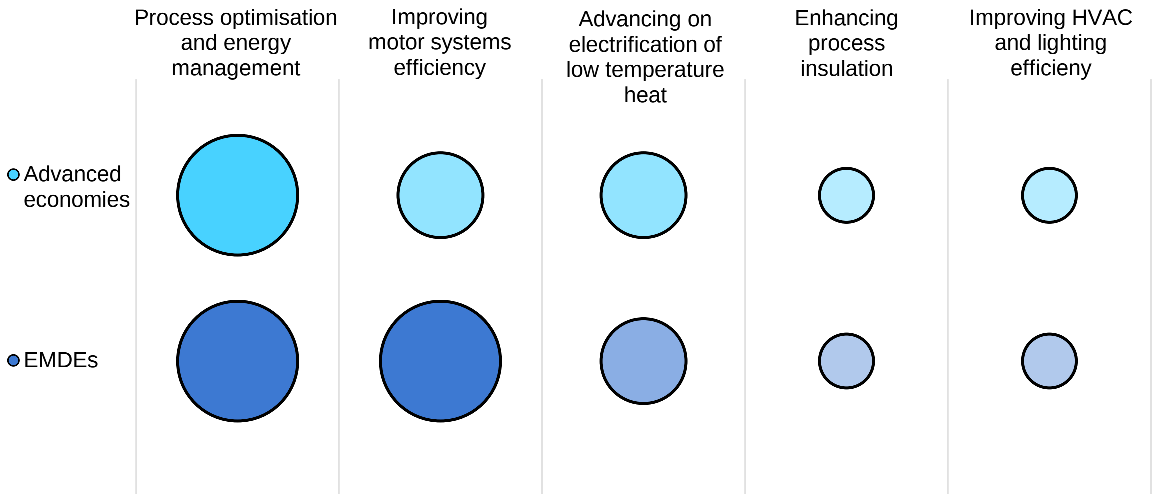
Industrial sector: what are the key measures to accelerate efficiency progress?

Electrification of low-temperature heat can be an important lever to accelerate efficiency progress, particularly in less intensive industries, due to its large share in energy use and the efficiency gains enabled by heat pumps. Governments can accelerate their deployment by offering grants or tax breaks for their installation, introducing standards for industrial heat technologies and expanding access to dynamic electricity pricing to incentivise their use during low-demand hours.

Upgrading industrial motor systems is another key area to promote efficiency. Countries can implement more stringent standards for new motors and equipment, such as fans, pumps and compressors. Additionally, promoting the use of variable speed drives, through regulations requiring minimum system efficiency and targeted incentives, can increase savings in variable-load applications. Material efficiency, such as optimising design, light weighting, increasing scrap use in metals production, and enhanced recycling, reduces material needs and improves efficiency across multiple sectors, particularly in energy-intensive industries.

Other comprehensive policies can accelerate and enable efficiency improvements across end uses, such as the use of energy audits and energy management systems. Similarly, energy efficiency networks can improve peer-to-peer learning to enhance energy efficiency in a cost-effective way. Last, digitalisation-enabled AI, based on data collection and analysis throughout the production process, can help production operations or detect inefficiencies.

Key measures to accelerate efficiency progress in the industrial sector



Notes: Bubble sizes give an indication of the relevance of each measure within the country grouping (classified as high, moderate, low and very low). The classification is based on multiple factors, such as how and where energy is used, current trends and current policy coverage. Actions listed are not exhaustive but are meant to give policy makers an overview of key focus areas that can accelerate progress. Process optimisation and energy management includes waste heat reduction and recovery, material efficiency and AI-driven optimisation, among others.

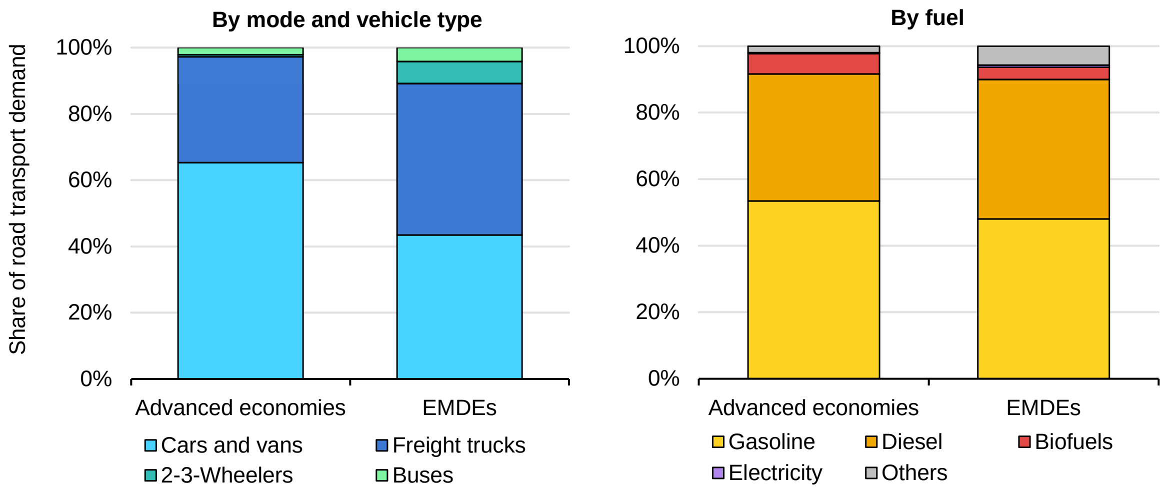
Road transport: how and where is energy used?

In the transport sector, road transport accounts for nearly 90% of total domestic energy demand. The remaining 10% is split between domestic aviation, domestic shipping and rail. Total transport energy demand is similar in advanced and emerging economies but demand per capita is nearly five times higher in advanced economies, in large part due to higher levels of private car ownership.

In advanced economies, passenger cars dominate road transport demand, accounting for around 65% of the total energy use. The remainder is primarily made up of freight trucks. Buses play a minor role in energy demand, but they transport people in a much more efficient way than private cars. As a result, replacing existing inefficient, fossil fuel powered cars and trucks with more efficient and electric ones, together with promoting more efficient modes of transport (such as public transport and cycling), can contribute most to energy efficiency progress in road transport.

This picture is different in emerging economies. First, there is a larger role for two-wheelers (scooters and motorcycles), which account for around 5% of road transport demand and are more numerous than cars in many countries. Second, there is stronger growth in new vehicles, as private passenger vehicle ownership is significantly lower on average, providing an opportunity to implement policies to promote efficient and electric vehicles as sales grow. Finally, the share of heavy-duty trucks is higher than in advanced economies.

Energy demand in road transport, by mode and vehicle type, and by fuel, in advanced and emerging economies, 2023



Source: IEA (2025), World Energy Balances, Energy End-uses and Efficiency Indicators (accessed October 2025).

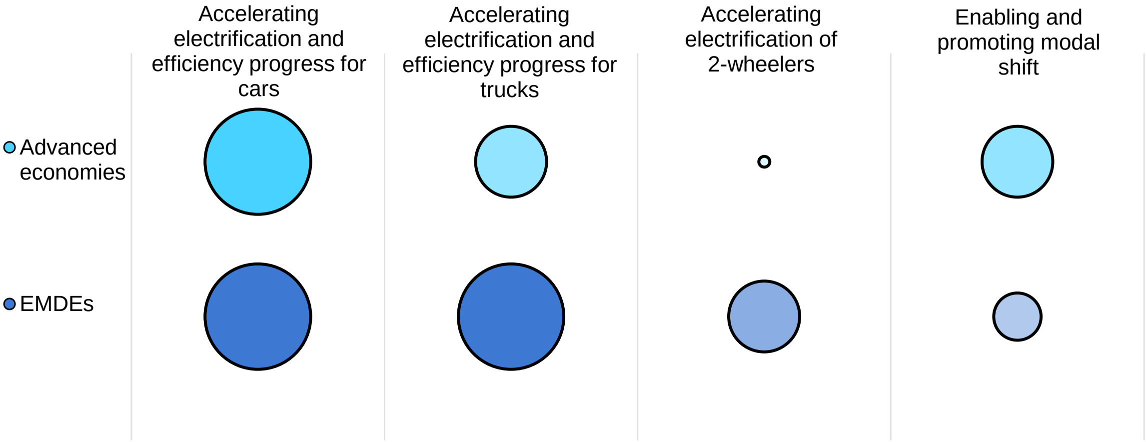
Road transport: what are the key measures to accelerate efficiency progress?

In road transport, governments can primarily accelerate progress in passenger cars through electrification and technical efficiency improvements, together with promoting the lower use of private cars. For example, fuel economy standards accelerate technical efficiency improvements of internal combustion engine vehicles and can contribute to a faster adoption of EVs, as they increase the fuel efficiency of the fleet. Bonus-malus schemes and other taxation policies incentivise the purchase of more efficient cars while penalising less efficient ones, requiring less fiscal space from governments. Governments can promote modal shift by setting up the right infrastructure to make efficient transport attractive. Additionally, introducing low emission zones in cities can increase the use of public transport and accelerate the modernisation of vehicle fleets.

Efficiency improvement through the electrification of two-wheelers is relevant in many emerging economies, such as China, India and Indonesia, where a large part of the population uses them for commuting. Policies such as electrification targets, infrastructure support including charging and battery swapping stations, tax exemptions and financial support can accelerate their deployment.

For heavy-duty trucks, fuel economy standards can play a key role. Countries where standards are already in place can increase their stringency to scale up progress. Others can start by setting standards now to avoid inefficient vehicles entering the market and to accelerate the shift to electric models are fleets are renewed.

Key measures to accelerate efficiency progress in road transport sector



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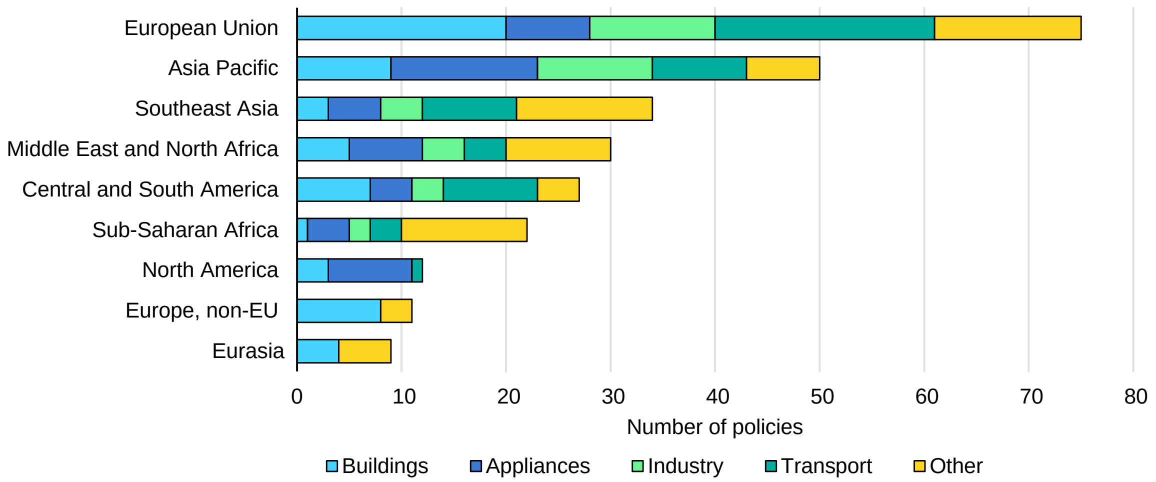
1.4 Policies

Governments have announced more than 250 new or updated energy efficiency-related policies in 2025

Countries representing over 85% of global energy demand have implemented new or updated energy efficiency-related policies in 2025, compared to countries representing around 70% of total energy demand in 2024. Most new or updated policies were announced or implemented in Europe and Asia in 2025. Countries in the European Union put in place over 70 new or updated policies in 2025 (both EU-wide and in individual member states). Countries in the Asia Pacific region announced a combined total of around 50 new or updated policies, indicating strong growth in efficiency policy progress. However, there also have been some policy rollbacks on energy efficiency this year.

The number of policies is one indicator of efficiency progress in a sector, but the real impact depends on the scope, stringency and enforcement of these policies. It can also take time for policies to have an effect on energy efficiency progress, depending on the speed of the implementation and stock turnover rate of the technologies affected by the policy. The number of new or updated policy announcements in 2025 is, however, an indicator of the ambition of many governments around the world to improve energy efficiency.

New or updated energy efficiency-related policies, by region, 2025



Notes: Policies listed here cover energy efficiency and electrification and are implemented or announced in 2025. Updated policies include any changes to existing policies that are expected to improve energy efficiency. New or updated policies that lower ambition have not been included in this. “Other” includes policies targeting multiple end-use sectors. All policies are at the national level or above (such as policies for the entire European Union); state-level policies are excluded. Asia Pacific does not include policies in Southeast Asia in this figure, as these are listed separately. Buildings include policies targeting envelopes and retrofits, while appliances are a separate category.

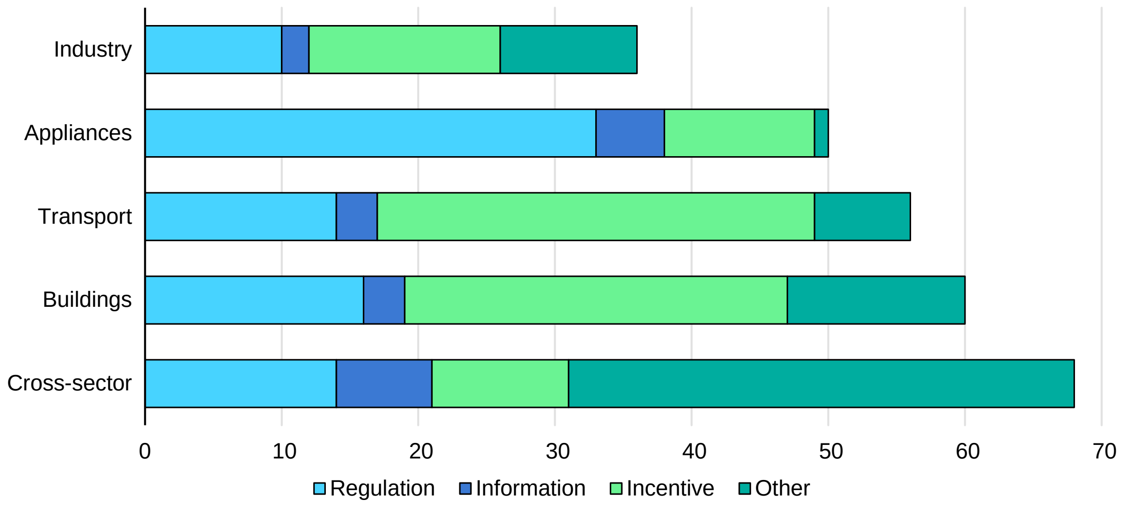
Most new or updated policies in 2025 were in the buildings sector, whereas the fewest were in industry

There are differences in the sectors targeted by the new and updated policies. Many governments have introduced cross-sectoral policies that aim to improve efficiency across the entire economy. Examples include the new energy efficiency strategies in both the European Union and the African Union, which outline plans for the coming decade across all end-use sectors. Countries also put many policies in place to promote efficient buildings and transport, while the industrial sector saw relatively fewer new policies this year.

Almost half of the new or updated efficiency-related policies in buildings this year were incentives, including grants, low-interest loans and targeted support for low-income and vulnerable households. Regulatory instruments, such as building energy codes, have also been reinforced in some countries. Regulation was also the main tool used by governments this year to promote the uptake of more efficient appliances. Several governments strengthened standards and labelling schemes for household appliances such as air conditioners and refrigerators.

In transport, incentives were most used in 2025 to accelerate the shift to more efficient vehicles, alongside growing investment in electric public transport and charging infrastructure. In industry, there were relatively fewer policies compared to other sectors. However, policies promoting efficiency are often part of wider decarbonisation efforts in industry and not always driven by public policies but rather through efforts by the private sector itself.

New or updated energy efficiency-related policies, by sector and policy type, 2025



Notes: “Other” includes policies such as strategies, action plans, roadmaps and targets. “Cross-sector” includes policies that are not specifically target one specific end-use sector but affect multiple sectors. For example, a national energy efficiency target would be included as a cross-sectoral policy in the ”other” category. Policy typology is based on the IEA Energy Efficiency Policy Toolkit 2025 framework.

Regional trends

North America: Supporting consumers facing high energy costs

Canada announced an expansion of the Oil to Heat Pump Affordability Program, with an extra investment of USD 365 million on top of the already committed USD 182 million. Low- and medium-income households can receive grants that cover up to 100% of the cost of a heat pump. At the provincial level, in 2025, Ontario committed USD 7.6 billion over 12 years to enhance efficiency, including a Home Renovation Savings Program that provides rebates of up to 30%. Hydro-Québec also published an efficiency strategy, investing USD 7 billion in the next decade.

In the **United States**, while there have been some efficiency policy rollbacks at the federal level, several individual states have implemented new energy efficiency policies this year. For example, California updated its building energy codes and Massachusetts announced its 2025-2027 Energy Efficiency and Decarbonization Plan.

In 2025, **Mexico** implemented regulatory measures to reintroduce efficiency standards for key appliances, including electric motors, air conditioners, commercial refrigerators, clean water pumps and wood-burning stoves.

Central and South America: Promoting electric mobility and setting new standards for efficiency in buildings

Brazil announced plans for minimum energy efficiency standards for buildings. The proposed regulation applies to all new residential, commercial, service and public buildings (federal, state and municipal). After 2030, all new residential (including social housing), commercial and service buildings should be at least “C” rated. Brazil’s new Mover Programme allocates USD 3.4 billion in tax credits to promote R&D and the production of cleaner vehicles, including trucks and buses. In 2025, **Colombia** published its preliminary long-term Strategic Energy Efficiency Plan, which outlines plans until 2054.

Asia Pacific: Strengthened efficiency regulation for buildings and appliances and increased spending on electric mobility

China implemented several new policies in 2025. For example, in April, the government released an action plan to promote the use of energy-efficient heat pumps across its economy, and in July, China announced the development of “zero-carbon industrial parks”.

In **Japan**, compliance with energy conservation standards, which had been voluntary for residential buildings, became mandatory for new residential buildings in 2025. **Pakistan** also started with enforcement of its Energy Conservation Building Codes, and compliance is now mandatory for all new buildings. **Uzbekistan** launched a National Energy Efficiency Agency, providing grants for home energy audits and heat pumps.

In 2025, **India** increased its funding for electric mobility by 20% to USD 623 million under its PM E-Drive programme. The Bureau of Energy Efficiency also launched the Star Labelling Program for Evaporative Air Coolers this year and implemented a scheme to accelerate industrial energy efficiency.

Korea also promoted EVs in 2025, spending USD 1 billion to support its EV Subsidy Scheme. **Australia** increased funding for the Clean Energy Finance Corporation by USD 1.25 billion, enhancing its support for clean energy, electrification and efficiency projects. The New Vehicle Efficiency Standard, which also came into effect in Australia in 2025, sets increasingly stringent standards from 2025 to 2029.

Southeast Asia: Grants for more efficient equipment and efforts to increase awareness

Malaysia allocated USD 15 million in rebates in 2025 to encourage investment in efficient appliances, and a further USD 2.1 million for its Electric Motorcycle Use Promotion Scheme, with a focus on domestically produced models. **Thailand** also launched a subsidy programme in 2025 that provides financial support of up to 30% to businesses replacing or upgrading equipment certified with the country's top-tier efficiency label. The programme forms part of a national initiative running from 2025 to 2029 to reduce industrial energy consumption. In 2025, **Viet Nam** introduced amendments to its national Law on Energy Efficiency and Conservation to enhance state management in energy efficiency, increase responsibilities for designated key energy users, expand energy labelling and introduce a model for Energy Service Companies.

Sub-Saharan Africa: Ambitious action plans on efficiency

The **African Union** adopted the African Energy Efficiency Strategy and Action Plan. This strategy aims to enhance energy efficiency across sectors such as power, transport, industry, buildings and agriculture, with targets to increase Africa's energy productivity by 50% by 2050 and 70% by 2063. To support implementation of the strategy, the African Union also launched the African Energy Efficiency Alliance and the African Energy Efficiency Programme. The **East African Community** has adopted harmonised regional minimum energy performance standards for refrigerating appliances and air conditioners.

Several countries also adopted national strategies for energy efficiency. **Zimbabwe** approved the National Energy Efficiency Policy, and plans are underway to develop an Energy Efficiency Act and appropriate regulations, as well as a National Energy Efficiency Strategy and Action Plan. **Tanzania** also published its National Energy Efficiency Strategy that aims to scale up efficiency actions in the coming decade. **Kenya** set up regulations for energy management in 2025, as an important step in implementation of its existing energy efficiency strategy, and it launched its Electric Cooking Strategy. Finally, **Cameroon** released a national energy efficiency strategy for domestic and industrial air conditioning and refrigeration.

Middle East and North Africa: Focus on limiting electricity use of appliances, while promoting international co-operation

Morocco updated its energy performance standards and labels for electric motors, air conditioners and refrigerators at the end of 2024, and these came into force this year. A similar decree has been prepared for lighting products. Meanwhile, the **Saudi Arabia** Energy Efficiency Center launched a new campaign aimed at raising awareness about the authenticity of energy efficiency labels for lighting products.

Europe: New plans for energy efficiency to support affordability, competitiveness and energy security

At the IEA Global Conference on Energy Efficiency in June 2025, the **European Commission** announced a new energy efficiency roadmap. It also committed USD 105 billion through the Clean Industrial Deal to boost clean manufacturing within the European Union (including a pilot for industrial heat decarbonisation), launched the Affordable Energy Action Plan and approved an amendment to CO_2 emission standards for new cars and vans. The EU Ecodesign regulation on low-power modes of electrical appliances also came into effect. It is set to save as much as 4 TWh – enough to power more than 22 million refrigerators for a year.

France updated its energy efficiency obligation scheme, which now features a new programme specifically designed to support small and medium-sized enterprises (SMEs). In 2025, it also implemented Energy Performance Certificate regulations prohibiting the rental of properties rated “G”, the lowest energy class. The **United Kingdom** has invested USD 21 billion primarily through the Great British Energy Bill (USD 11.2 billion) and a comprehensive package of energy efficiency measures (USD 8 billion).

Portugal has launched an Energy Spaces Network, a system of 50 local offices offering technical support on energy efficiency, which also helps combat energy poverty. **Spain** has approved USD 578 million for its National Energy Efficiency Fund, including for programmes to boost industrial efficiency and the renovation of public and commercial buildings. **Türkiye**’s 2024-30 National Energy Efficiency Action Plan came into effect in 2025 as well.

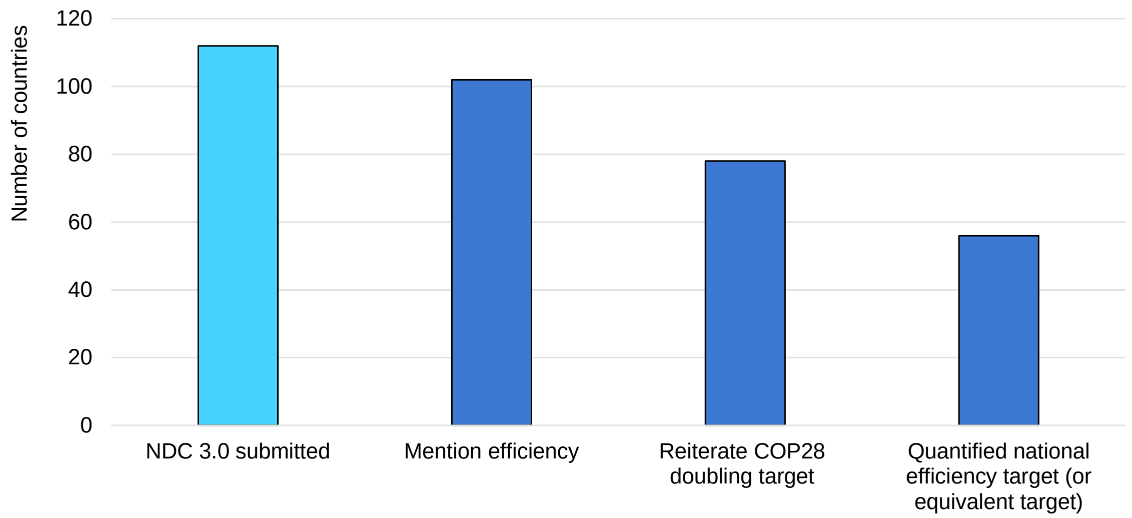
Most new nationally determined contributions mention efficiency but just half of them have quantified targets

Since the global agreement at COP28 to collectively aim to double global energy efficiency progress by 2030, over 110 countries (as of November 2025) have submitted updated nationally determined contributions (NDCs) to the UNFCCC. The NDCs to be submitted in 2025, also known as NDCs 3.0, are to be informed by the outcome of this first global stocktake. The IEA has advised countries to make energy efficiency a central pillar in updated NDCs, as it can improve affordability, competitiveness and energy security, in addition to reducing GHG emissions. Nearly all updated NDCs reference energy efficiency, and around two-thirds specifically reiterate their commitment to the COP28 global doubling target.

However, just over 50 countries submitted concrete, quantified targets for energy efficiency in their new NDC plans. Examples include:

- Morocco: Energy demand reduction targets for 2030 in transport (24%), industry (22%), buildings (14%) and agriculture and public lighting (13%).
- Switzerland: 43% reduction in per capita energy consumption by 2035, compared to 2000 levels, increasing to 53% by 2050.
- European Union: 11.7% reduction in final energy consumption at EU level in 2030 compared to a business-as-usual projection.
- United Arab Emirates: 42-45% reduction in overall energy use by 2050 compared to business as usual, including sector targets in industry, buildings and transport.
- Uzbekistan: double its energy efficiency improvement rate by 2030.

Energy efficiency in nationally determined contributions as of November 2025



Source: UN NDC Registry (accessed November 2025).

Multilateral discussions in 2025 focused on efficiency's role in helping affordability, competitiveness and security

At the IEA's 10th Annual Global Conference on Energy Efficiency, which was co-hosted with the European Commission in Brussels, countries and companies highlighted efficiency as the "first fuel" to reduce energy costs and emissions. The conference brought together almost 700 participants from close to 100 countries, including dozens of ministers and CEOs. At the conference, the IEA released a report on The Role of Energy Efficiency in Enhancing Competitiveness, showing the effects efficiency actions have had on firms, jobs and the economy as a whole.

Also at the conference, governments highlighted the economic, social and sustainability advantages of energy efficiency and, in a joint statement, nearly 50 countries reaffirmed "the role efficiency plays to ensure affordable and secure energy services for our citizens, enhance competitiveness of our businesses, and safeguard the energy security of our nations." The conference was held in partnership with the Energy Efficiency Movement, which co-organised a CEO roundtable which resulted in a CEO letter of commitment, as well as the Brussels CEO Four Point Action Plan on behalf of industry leaders on energy efficiency. In 2026, the IEA Global Conference on Energy Efficiency will be held in Montreal.

In June 2025, under Canada's presidency, G7 countries discussed energy efficiency, particularly through the lens of affordability, competitiveness and energy security. Affordability was also a key focus of an IEA workshop held in January 2025 with G7 country representatives. The IEA prepared a special report for the G7 countries on Designing Efficiency Policies to Enhance Affordability, supported by a survey among G7 governments to understand the obstacles in implementing efficiency policies to improve affordability, such as the landlord-tenant split incentive, high upfront costs and administrative complexity.

South Africa announced energy security and just, affordable and inclusive energy transitions as key priorities during its G20 Presidency, and these themes shaped discussions in the G20 Energy Transition Working Group (ETWG) meetings. In parallel to the ETWG meeting in April, G20 countries participated in an event on Energy Efficiency and Affordability.

In preparation for COP30 in Belém, the IEA and Brazil organised a series of High-Level Energy Transition Dialogues. Building on the role the Dialogues played in shaping the UAE Consensus at COP28 and the energy outcomes at COP29, the 2025 series convened key decision makers with the aim of informing the activities and outcomes of the COP30 conference, including discussions on efficiency. Following up on its COP28 presidency, the United Arab Emirates announced that it will chair the Global Energy Efficiency Alliance, which was launched at COP29, aiming to reinforce the goal of doubling of global efficiency progress by 2030.

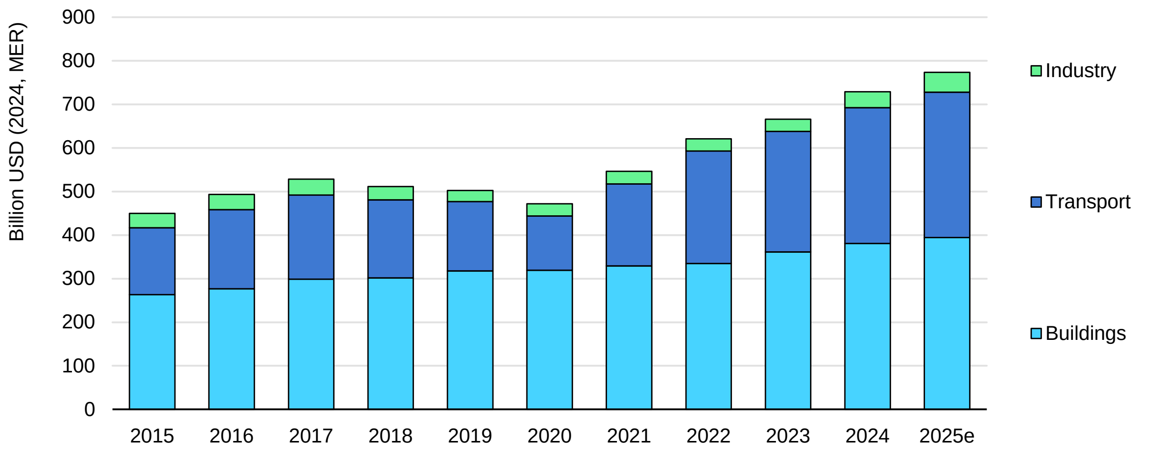
1.5 Investment

Global end-use investment is estimated to reach nearly USD 800 billion in 2025

The IEA defines an efficiency investment as the incremental spending to acquire equipment that consumes less energy than would otherwise have been used to provide the service, had the consumer not bought a more efficient option. Global end-use investment is estimated to reach almost USD 800 billion in 2025, the highest level ever recorded, and a 6% increase from 2024 levels. Over the past 10 years, end-use investments have grown by over 70%. It can take some time, however, for efficiency investments to have an effect on energy demand.

Annual end-use investment in transport is set to reach over USD 330 billion in 2025, primarily driven by growth in electric vehicle (EV) sales. End-use investment in buildings has also increased since 2015, but in recent years stalling construction activity (notably in China) has slowed down growth somewhat. Recent increases in interest rates have contributed to constrained fiscal capacity, with governments facing reduced ability to fund incentives. Geopolitical tensions and impacts on material costs and supply chains are expected to affect efficiency investments in the coming years as well. In 2024, the IEA estimated that the COP28 goal to double global efficiency progress requires a tripling of investment by 2030. The increase in spending in 2025 means that the gap is slightly lower today (2.7 times), but an additional USD 1.3 trillion every year is still needed.

Global investment in energy efficiency, electrification and renewables for end uses, by sector, 2015-2025e



Notes: 2025e = estimated values for 2025; MER = market exchange rate. An efficiency investment is defined as the incremental spending on new efficient equipment or the cost of refurbishments that reduce energy use (excluding labour). The methodology for tracking demand investment was updated in 2025 and now tracks a broader range of technologies. Renewables for end use include behind-the-meter technologies, such as solar, water and geothermal heating.
Source: IEA (2025), World Energy Investment 2025.

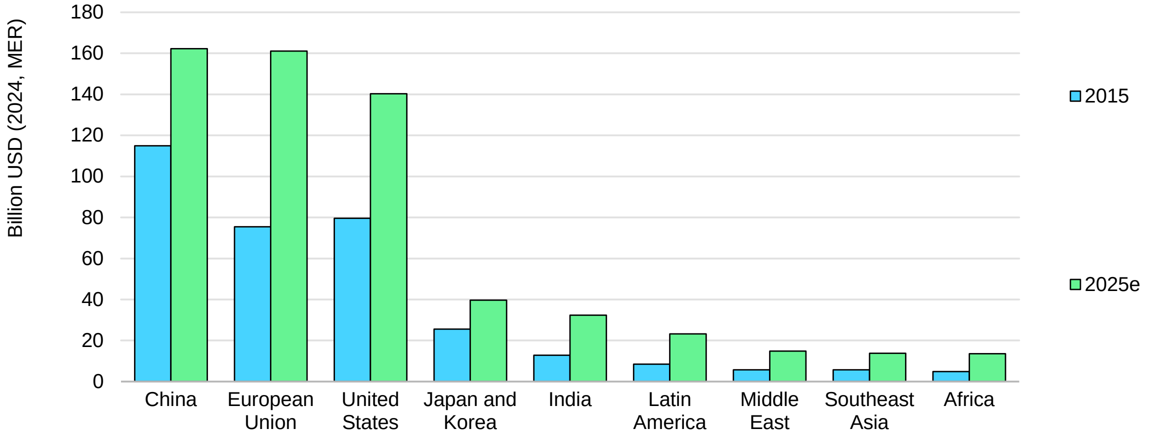
Two-thirds of global end-use spending happens in China, the United States and the European Union

About two-thirds of end-use investment occurred in China, the United States, and the European Union in recent years. End-use investments in China are the highest of any country or region globally and are estimated to increase by around 7% in 2025 compared to 2024, reaching a total of just over USD 160 billion. In the past 10 years, average annual investment growth was around 3.5%. In its 15th Five Year Plan, China aims to further scale up investments in green building construction and building energy retrofits over the period 2026-2030.

End-use investment in the United States is set to increase by around 6% in 2025 compared to 2024, reaching a total of USD 140 billion. This is in line with the medium-term growth trend over the past 10 years. This is in part thanks to strong investments in the buildings sector and some growth anticipated in the transport sector in 2025, contingent on the impact of trade policies affecting the car industry, such as import tariffs.

End-use investment in the European Union is set to increase by over 2.5% in 2025 compared to 2024, reaching a total of around USD 160 billion. In the past 10 years, it has increased on average by nearly 8% per year. The slowdown of growth this year is caused primarily by reduced financial support in some markets (such as Italy, France and Germany), after the record spending levels during the 2022 energy crisis, and EV and heat pump sales not growing as fast as before, partly due to lower subsidies.

Investment in energy efficiency, electrification and renewables for end uses, by region, 2015-2025e



Notes: 2025e = estimated values for 2025; MER = market exchange rate. An efficiency investment is defined as the incremental spending on new efficient equipment or the cost of refurbishments that reduce energy use (excluding labour). The methodology for tracking demand investment was updated in 2025 and now tracks a broader range of technologies. Renewables for end use include behind the-meter technologies, such as solar, water and geothermal heating.

Source: IEA (2025), World Energy Investment 2025.

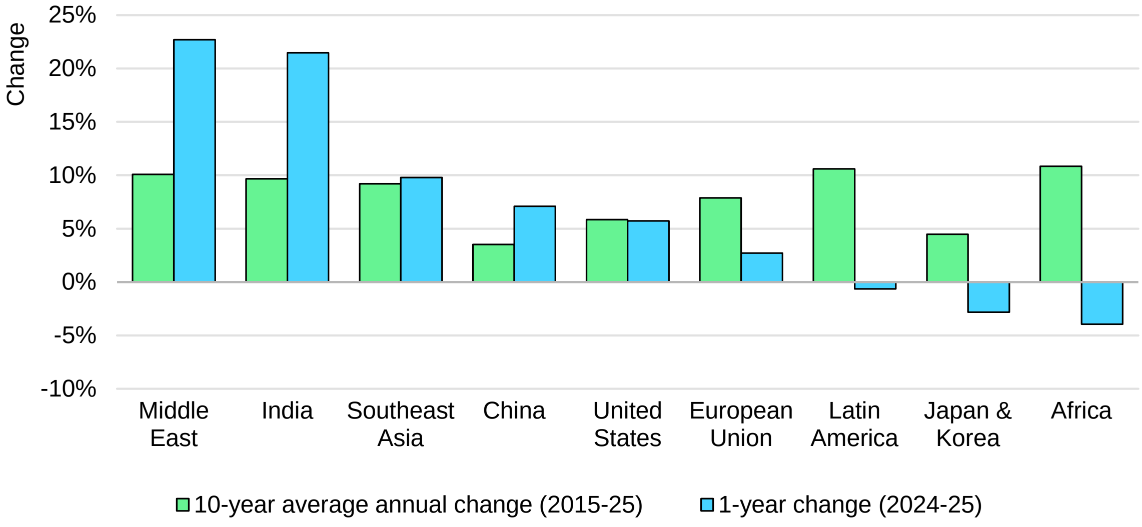
Several emerging economies are set to see growth in end-use investment accelerate in 2025

End-use investments in India and the Middle East are estimated to increase by over 20% in 2025 compared to 2024. In India, end-use investments are set to reach a total of around USD 32 billion, with growth in the buildings and transport sectors. End-use investment in the Middle East is set to reach USD 15 billion in 2025, driven by a growing energy efficiency market and policy ambition, such as the Energy Efficiency Accelerators in the Industrial Sector initiative in the United Arab Emirates.

In Southeast Asia, end-use investment is estimated to increase by around 10% in 2025 compared to 2024, reaching a total of USD 14 billion. This is driven by investments in buildings and electric vehicles, such as in the Philippines, which secured USD 800 million from the World Bank, part of which is for efficiency.

On the other hand, end-use investment in Africa is estimated to decrease in 2025, by around 4% compared to 2024, reaching a total of USD 14 billion. Progress on implementing the 2024 African Energy Efficiency Strategy, which seeks to establish harmonised energy efficiency standards, foster regional co-operation and encourage investment in energy-efficient technologies and practices, could help reverse this trend, if it is coupled with funding commitments.

Annual change in investment in energy efficiency, electrification and renewables for end uses, by region/sector, 2015-2025e



Notes: 2025e = estimated values for 2025; MER = market exchange rate. An efficiency investment is defined as the incremental spending on new efficient equipment or the cost of refurbishments that reduce energy use (excluding labour). The methodology for tracking demand investment was updated in 2025 and now tracks a broader range of technologies. Renewables for end use include behind the-meter technologies, such as solar, water and geothermal heating.
Source: IEA (2025), World Energy Investment 2025.

Key markets promote industrial efficiency investment in 2025 through a mix of public and private finance

Global efficiency investments in industry are estimated to have grown in 2025. For example, investments in China are estimated to have increased from USD 5 billion in 2024 to USD 7 billion in 2025, while the European Union is also estimated to have seen a 30% rise in investments from 2024 to 2025. Investments in industrial energy efficiency are often part of wider decarbonisation efforts and driven by a combination of public and private finance. Several major markets announced new programmes to encourage industry to implement efficiency measures.

Selected financing programmes promoting industrial energy efficiency in 2025

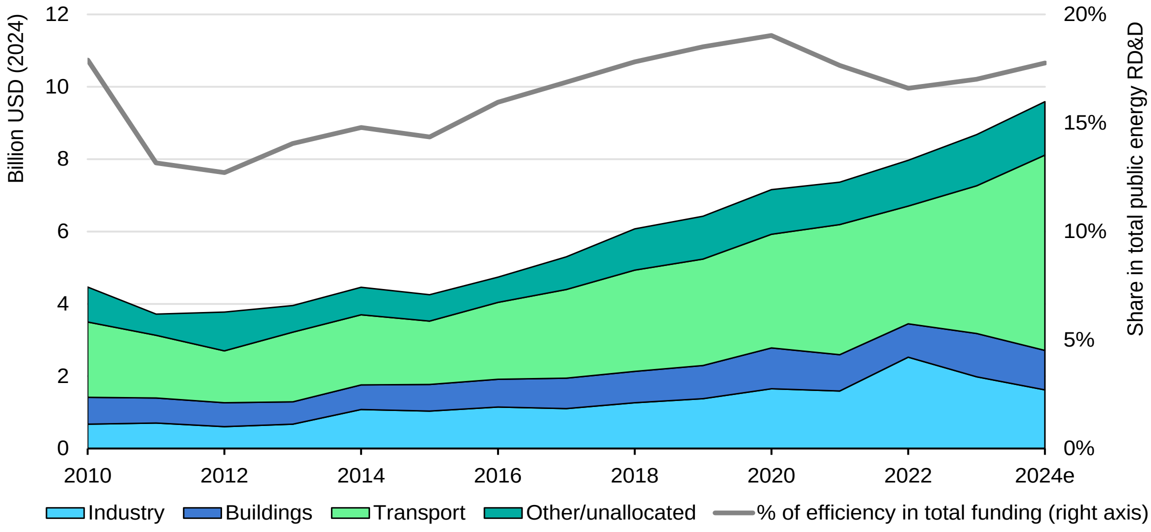
Country/ region	Programme description	Funding (million USD)
China	The Asian Development Bank has approved a loan for a project on Low-Carbon Transition in Industrial Parks to enhance efficient industrial processes in China.	200 (part energy efficiency)
Canada	The Green Industrial Facilities and Manufacturing Program supports efficiency and energy management solutions to improve energy performance and competitiveness.	142 in 2022-27
France	The Industrial Decarbonisation scheme aims to help industries that fall under the EU-ETS scheme to implement efficiency measures and electrify.	3 200 over 15 years
Germany	The Carbon Contracts for Difference scheme provides funding to energy-intensive industries to adopt efficient technologies.	5 400 over 15 years
Europe	The European Commission's Clean Industrial Deal promotes energy efficiency to support EU energy-intensive industrial companies and enhance their competitiveness.	115 000 in 2025-30
	The European Investment Bank provides loans for efficiency upgrades in over 350 000 small and medium-sized enterprises.	17 500 in 2025-27
	The European Bank for Reconstruction and Development increased its efficiency lending, primarily in industry, in its Green Economy Transition finance programme.	1 400 in 2024-25
India	The ADEETIE Scheme provides interest subventions on loans for efficiency projects to micro, small -and medium-sized enterprises, and grants for audits and support.	120 in 2025-28
Netherlands	The National Industry Climate Investment programme funds industrial decarbonisation, efficiency and circularity for companies in manufacturing and waste management.	1 300 in 2025-29
Türkiye	The 2nd National Energy Efficiency Action Plan provides funding for modernisation and adaptation of efficient technologies in industry.	2 180 in 2024-30

Governments spent nearly USD 10 billion to develop and demonstrate innovative energy-efficient technologies

Global public spending on the research, development and deployment (RD&D) of energy technologies was around USD 54 billion in 2024. Around 18% of this (nearly USD 10 billion) was spent on energy efficiency, such as new technological innovations in buildings, industry and transport. Energy efficiency represents the highest spending category for public energy-related RD&D, followed by nuclear energy and renewables. Public RD&D spending on efficiency increased by around 10% compared to 2023 and is more than double the amount of 2015. Over half of the efficiency RD&D spending in 2024 was on efficient mobility solutions, primarily in the United States (USD 2.1 billion) and the European Union (USD 1.2 billion).

The European Commission scaled up RD&D funding with USD 2.6 billion in 2025 from the EU Innovation Fund, and USD 7.9 billion in 2025 from the Horizon Europe Work Programme, including a specific cluster on climate, energy and mobility. Similarly, the Netherlands offered USD 189 million in grants in 2025 for industrial climate and energy innovation, including for projects to improve efficiency in industrial processes. Meanwhile, China updated a list of its green and low-carbon technology demonstration products that received government support in the R&D stage, including technologies such as heat pumps, cooling systems and smart devices. Japan launched a technology strategy to promote RD&D, and in its 2025 7th Strategic Energy Plan, efficient technology development (such as in data centres and industry facilities) also plays a key role.

Global public spending on research, development and demonstration projects in energy efficiency-related fields, 2010-2024e



Note: 2024e contains estimated values for some countries where data was not yet available.
Source: IEA (2025), Energy Technology RD&D Budgets.

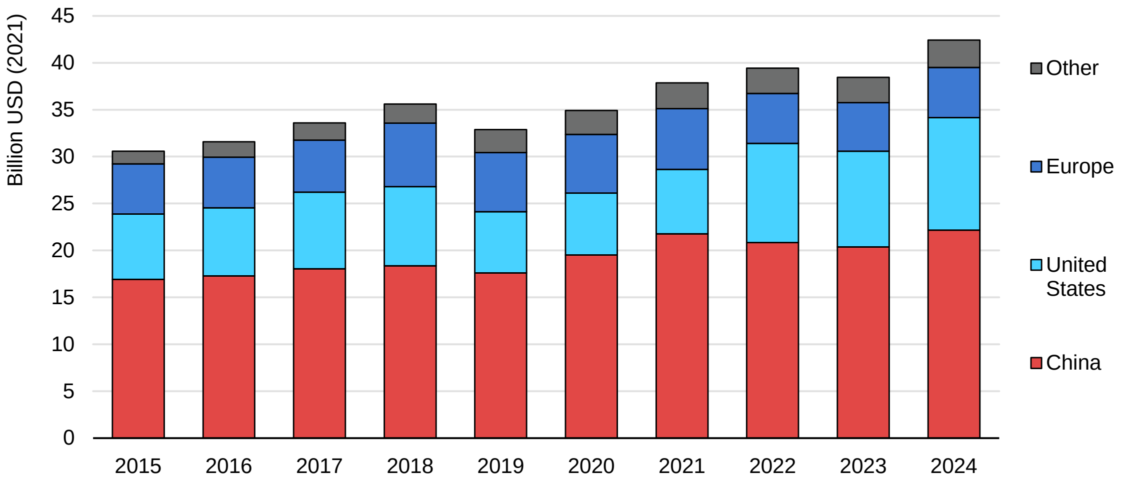
The global market for energy service companies grew by 10% in 2024 to reach a record level of USD 42 billion

After a small dip in 2023, investments by energy service companies (ESCOs), which finance and implement energy efficiency projects with repayment based on the energy savings achieved, have increased by 10% in 2024. Total global investments have reached record levels of around USD 42 billion, a rise of USD 3 billion from the previous record spending in 2022. The majority of ESCO activity, measured in volume of investments, is concentrated in China, the United States and the European Union, which together account for over 90% of the global market. This is in part due to their well-established regulatory frameworks, access to finance and capacity for implementation. ESCO investment is still smaller in emerging and developing markets, which have more limited policy support and fewer financial instruments.

The United States recorded the strongest growth in ESCO investment in 2024, rising by 18% compared to 2023. ESCO spending in the European Union grew moderately by around 3% and is around the same level as during the 2022 energy crisis, at over USD 5 billion. In 2025, the European Commission announced the intention to double the EU ESCO market to around USD 4 – 6.5 billion per year as part of its Action Plan for Affordable Energy.

In 2024, energy savings from new ESCO projects varied widely across other countries, ranging from about 10% in South Africa to as high as 40% in Italy. Most countries, including Germany and the United States, reported average savings in the 20-35% range, resulting in a global average of around 25% compared to baseline consumption.

Investments in energy service company projects, by region, 2015-2024



Source: IEA analysis in 2025, based on IEA-UNEP annual global ESCO market surveys (2024), in collaboration with the Global ESCO Network.

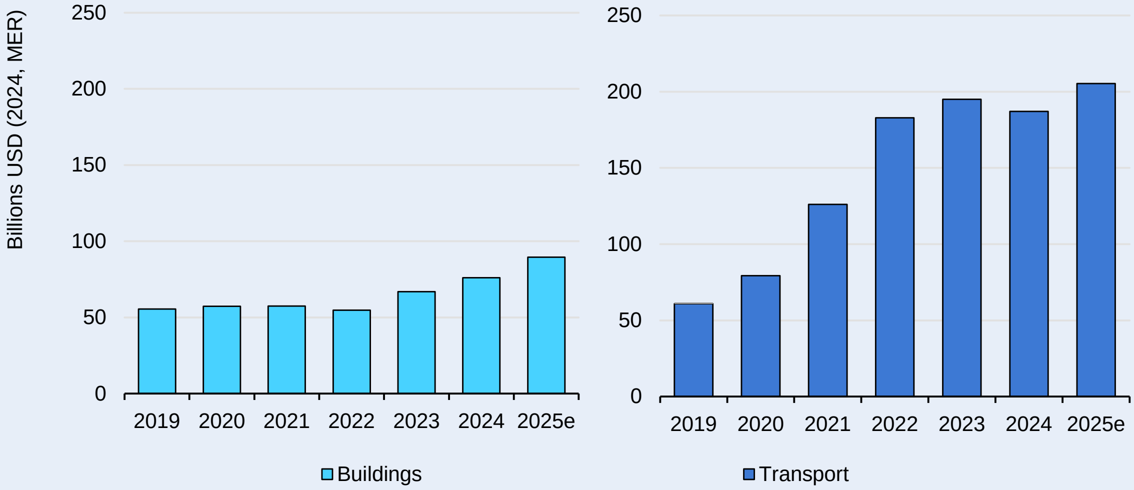
End-use investments in the Age of Electricity: Electric vehicles and heat pumps drive electrification spending

Energy efficiency and electricity demand are closely linked. This year's report therefore explores the role of energy efficiency in the [Age of Electricity](#).

Spending on electrification in the buildings and transport sectors, such as investments in heat pumps and electric vehicles, has grown steadily in the past 5 years. For example, electric car sales reached 17 million worldwide in 2024, rising by more than 25% over 2023. The highest sales are in China, with electric car sales exceeding 11 million. Electric cars in China, especially smaller models, are increasingly cost-competitive with internal combustion engine vehicles, and imports of Chinese electric cars are increasing access in many emerging markets. India is also ramping up policy support for EVs, with its new USD 1.2 billion PM Electric Drive scheme from 2024 to 2026. Global EV sales were slightly tempered by less rapid growth in Europe, in part due to removal of subsidies in Germany.

In the past 5 years, an important part of the growth in investments in the electrification of buildings has come from investments in heat pumps. While the European heat pump market stabilised in 2024, total sales of over 2.2 million that year were still double that of 2017. In the United States, the second-largest heat pump market globally, sales remained stable in the first half of 2025. The market share of heat pumps in the United States continued to rise, with heat pump sales being one-third higher than sales of fossil fuel systems in the first half of 2025. Similarly, heat pump sales topped gas boiler sales in Germany for the first time in 2025 as well.

Global investment in electrification in the buildings and transport sectors, 2019-2025e



Notes: 2025e = estimated values for 2025; MER = market exchange rate. Electrification investments in the buildings sector in this graph do not include investments in renewable energy.
Source: IEA (2025), World Energy Investment 2025.

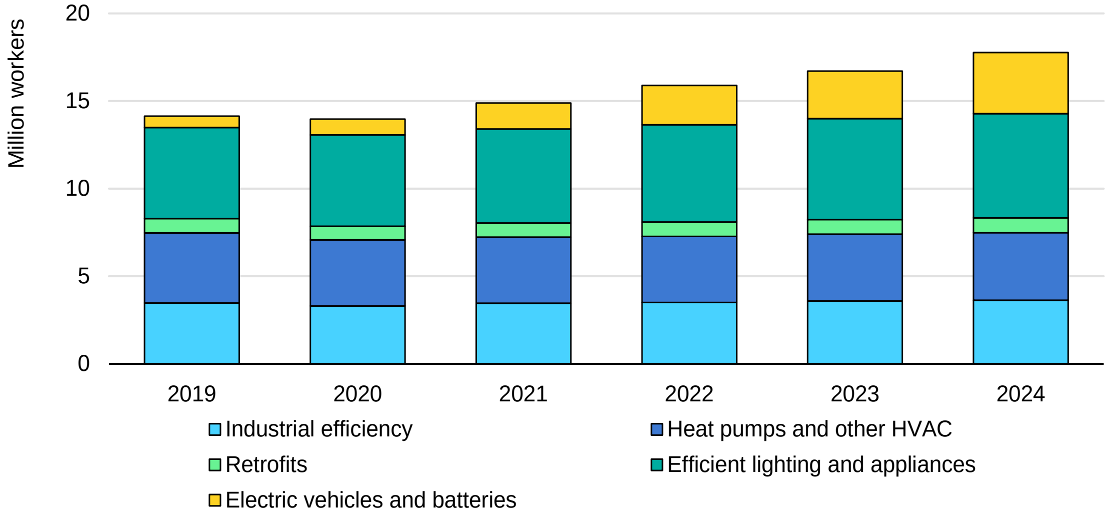
1.6 Employment

Nearly 18 million people work in efficiency-related jobs globally, most of which are in the buildings sector

Nearly 18 million people globally are working in energy efficiency-related jobs, including those in EV and EV battery manufacturing. Total energy efficiency-related employment increased over 6% between 2023 and 2024, following the upward trend observed since 2019. In 2024, 60% of energy efficiency jobs were in the buildings and appliances sectors. Manufacturing and installation of efficient lighting employed nearly 4 million people, while other appliances accounted for around 2 million jobs.

Other efficiency jobs in buildings are related to heat pumps and other efficient and renewables-based heating, ventilation and air conditioning (HVAC) systems, which account for 3.8 million jobs. Industrial efficiency accounted for one in every five energy efficiency jobs in 2024, including manufacturing workers like technicians and engineers, energy managers and system controllers. In 2024, the global EV and EV battery manufacturing sector increased by about 800 000 jobs. These sectors have seen the fastest growth in energy efficiency workers over the past five years. EV manufacturing jobs reached over 3 million in 2024, while EV battery jobs grew to 425 000 (respectively 6.6 and 2.3 times higher than in 2019).

Energy efficiency-related employment by sector, 2019-2024



Note: HVAC = heating, ventilation, and air conditioning. Other HVAC includes other efficient HVAC, such as using geothermal heating, bioenergy heating and solar heating.
Source: IEA (2025), World Energy Employment 2025 (forthcoming).

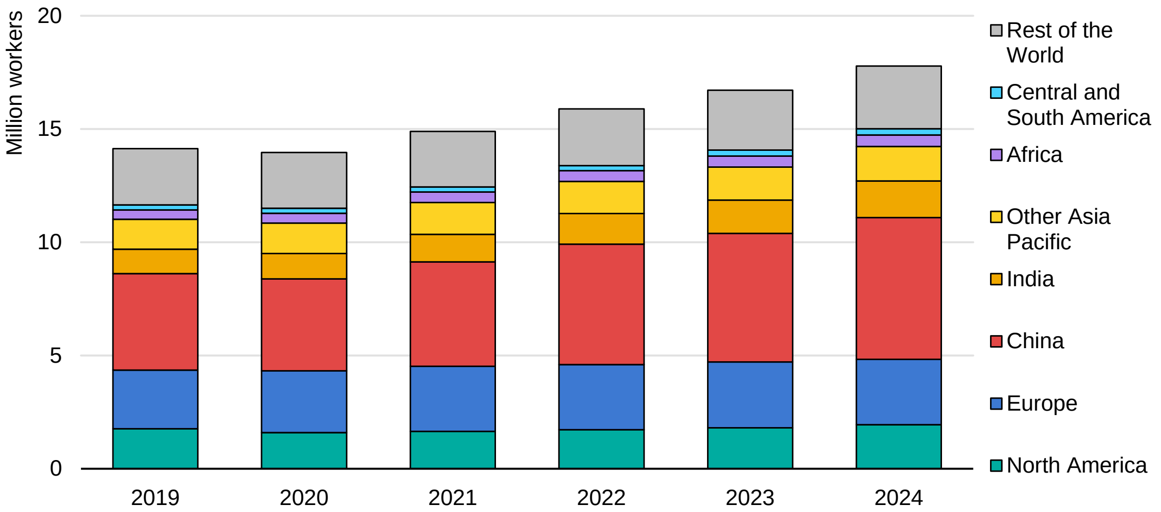
Global growth in efficiency-related employment in recent years was led by China and India

Around 35% of the global energy efficiency-related workforce is in China. In 2024, the number of efficiency-related workers in China grew by more than 10%, despite a slight slowdown in the growth of efficiency jobs in industry. India accounts for around 9% of the global efficiency workforce and has seen efficiency job growth rates accelerate in recent years, from 3.8% in 2019 to 10% in 2024.

The European Union (EU) ranks second behind China in the total number of efficiency-related jobs, accounting for about 16% of the global total. In 2024, however, the number of efficiency-related jobs in the EU declined by 0.5%, driven by a decrease in the number of energy efficiency jobs in industry. North America, which accounts for around 12% of the global efficiency-related workforce, saw a 6% rise in efficiency jobs in 2024. As a result of growth in recent years, it now represents the third-largest global efficiency workforce. Countries in the Asia Pacific region (other than China) experienced a growth of around 5% in efficiency jobs in 2024. Africa and Central and South America experienced a more moderate growth in efficiency jobs in 2024 of around 3.7% and 1.5% respectively.

Advanced economies have seen EV manufacturing jobs grow, although the growth in 2024 (24%) was lower than the rapid growth seen in China (37%) which holds over half of the global EV workforce. The EV workforce in emerging economies (excluding China) reached 78 000 in 2024, nearly double the level in 2020 but still accounting for less than 3% of the global EV workforce.

Energy efficiency-related employment by region, 2019-2024



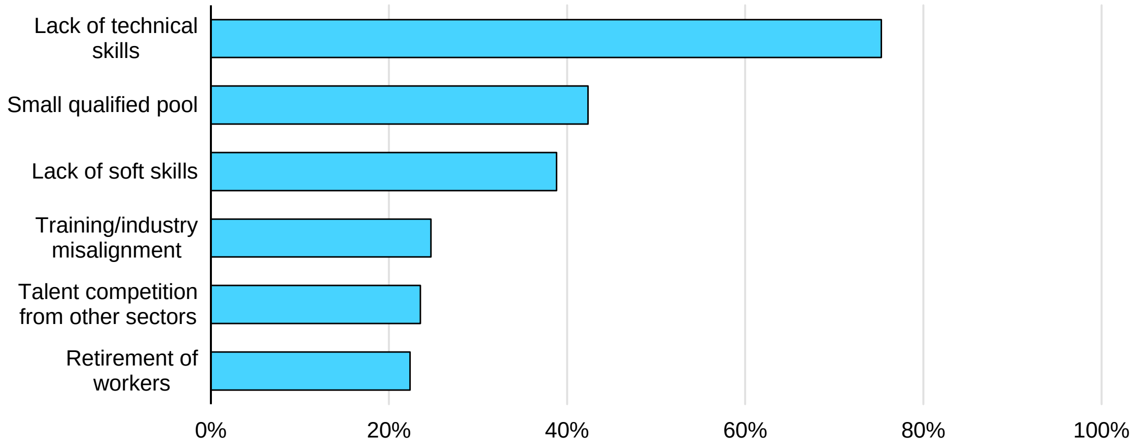
Source: IEA (2025), World Energy Employment 2025 (forthcoming).

The efficiency sector continues to face labour and skills shortages in 2025, which could worsen if not addressed

Skilled labour shortages can be seen across the wider economy, as well as in the energy efficiency sector, and can pose operational challenges. In advanced economies, difficulties in finding available skilled labour are driven by the contrast between a rising demand for workers and an ageing population. The United Kingdom, for example, has an ageing heating and cooling workforce, with two-thirds of workers being over 45 years old, and employers struggling to attract younger workers. The European Union faces shortages of skilled construction workers that are required to renovate its building stock. In EMDEs, shortages of energy efficiency experts were reported by over 90% of energy industry professionals in Africa and the Middle East.

A 2025 IEA survey on industry employment collected insights from over 400 energy companies from 56 countries to analyse labour shortages. Among energy efficiency employers, 72% report a shortage of workers. Around 60% of these employers expect shortages to have a moderate-to-significant impact in 5 to 10 years, and around 50% are already struggling to replace retiring workers. This could raise issues in meeting efficiency targets. For instance, the European Union's targets to renovate its building stock are challenged by a labour shortage in the construction industry. Funding for upskilling current workers, such as the European Union's investment of USD 65 billion in skills programmes, or training programmes aimed at under-represented groups, such as the Efficient and Green-Energy Buildings Project in the Caribbean, could help address skilled labour shortages in the energy efficiency sector.

Main reasons reported by energy employers for labour and skill shortages in the energy efficiency sector



Source: IEA Industry Employment Survey 2025.

Addressing financial and non-financial training barriers could help people to enter the efficiency workforce

Overcoming skilled labour shortages in efficiency sectors will require increased efforts to attract and train workers. Understanding barriers preventing people from accessing training is an important first step in addressing the issue. In a separate 2025 IEA survey, around 75 educators from 44 institutions that provide efficiency trainings identified barriers preventing students from accessing these trainings.

The most reported financial barriers in 2025 were the cost of tuition fees and lost income during training. Policy measures can help overcome these barriers, such as through wage compensation schemes to allow workers to upskill while not losing income. In Denmark, a wage compensation scheme has been in place since 2001 for workers to attend vocational and technical education, including in insulation, HVAC and energy auditing. In Ireland, the Domestic Heat Pump Installation Incentivisation Scheme launched last year offers plumbers up to USD 540 to take time off work to upskill as registered heat pump installers.

Providing free or subsidised training can help encourage more people to work in the efficiency sector. In 2025, the United Kingdom launched the Warm Homes Skills Programme, aiming to train up to 9 000 people to work as installers and retrofitters with over USD 10 million for subsidised trainings. Similarly, regional initiatives can tackle local skilled labour shortages. For instance, a New York State initiative provides funds of up to USD 1 million for trainings on efficient HVAC systems, insulation, air sealing and EV charging.

Offering tax credits is another policy measure to support training. In 2025, Italy announced the Training Tax Credit 5.0, which aims to promote training, including on energy efficiency. International funding can support efficiency training in EMDEs. For example, the Tanzania Energy Efficiency Action Plan, supported by the European Union, Ireland and the United Nations Development Programme, has delivered training to 100 professionals in 2024 and aims to train another 150 in the future, an additional support will see young women sponsored in particular.

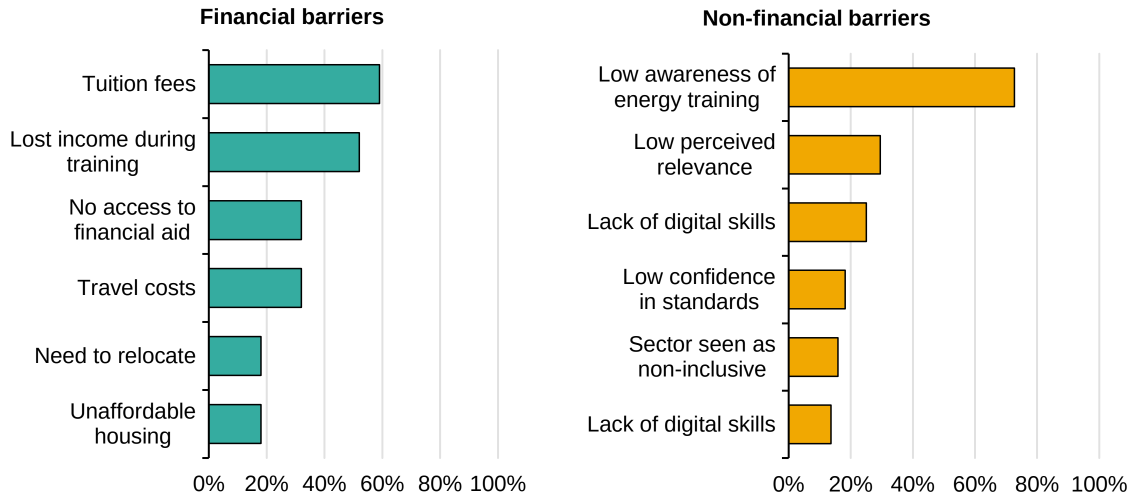
Non-financial barriers, such as a lack of awareness, were also identified in the 2025 IEA survey, with more than 90% of educators and trainers stating that industry bodies and policy makers should do more to disseminate information on training opportunities. Awareness campaigns can help raise interest among workers, such as the EU BuildUp Skills initiative and Australia’s Careers for Net Zero, which promotes energy efficiency roles via career fairs and online tools. Targeted campaigns have also proven to be useful, such as the 2025 Your Best Energy Campaign in Peru that targets industrial SMEs and offers support, including certified efficiency training courses with local workers. In Brazil, public and private stakeholders are working together to showcase job opportunities in the efficiency sector and to raise awareness of job opportunities for young people.

Collaboration between industry and education providers could help overcome the perceived low confidence in standards and the relevance of energy efficiency training, two potential barriers to training uptake. Developing industry partnerships could help ensure that energy efficiency education and training are fit for purpose and lead to swift employment.

In France, collaboration between education providers and industry at the Smart Energy Systems Campus provides training on energy efficiency and energy management to ensure training aligned with local industry needs, with new energy transition training for technicians launched. In Estonia, the current Green Skills Programme is supported by higher education and vocational education providers working with industry and workers representatives to identify skills needs and provide information and certification, including for energy efficiency. The programme, which started in 2023, aims to train almost 3 000 people by 2026. Public and private finance in Luxembourg enables the new Skills Centre for Energy Efficiency and Energy Transitions to provide free or subsidised energy efficiency training with support from industry. The courses are tailored to the current needs of SMEs, architectural and engineering firms, municipalities and state administrations to ensure that they are fit for purpose.

In 2025 in South Africa, international funding has enabled the first students to complete the UNDP's Just Energy Transition Skills Programme in Energy Efficiency. The programme connected education providers with the efficiency industry to deliver accredited, job-relevant training. Two-thirds of the graduates were women, who were specifically targeted as an under-represented group.

Financial and non-financial barriers preventing students from accessing energy skills training, share of respondents



Source: IEA Educators Employment Survey 2025.

Chapter 2: End-use sectors

Global final energy demand (the total energy consumed by end users) grew over 5% (around 25 EJ) between 2019 and 2024. Around two-thirds of the growth in global final energy demand since 2019 has come from industry, with the buildings sector accounting for most of the remainder of global energy demand growth between 2019 and 2024. The transport sector had the lowest contribution to energy demand growth over this period.

In industry, there has been the lowest number of new policies in 2025 of any end use sector, and policies have lagged technological progress in recent years. For example, over the last 20 years, electricity demand from industrial motors rose about 60%. However, in 2025, just one-third of countries globally have efficiency standards for motors in place, and stringency levels vary widely. Similarly, although new IEA shows that energy management can cut costs by at least 10% in the early years of implementation, it is not widely promoted or mandated in most countries.

In the buildings sector, there has been efficiency progress in both new and existing buildings. As of 2025, nearly 60% of new buildings globally are covered by building energy codes, and spending on efficiency in buildings is over 20% higher than in 2019 in major markets. However, ambition levels of building energy codes still vary widely between countries, and some governments have reduced their budgets on retrofit programmes in 2025. Meanwhile, energy efficiency progress in appliances is primarily achieved through regulation. The number of efficiency standards for appliances continued to grow in 2025, with 90% of energy use by air conditioners and refrigerators now covered by standards.

Transport efficiency progress in 2025 has been boosted by strong growth in electric vehicles, particularly in emerging economies. Electric car sales have continued to expand in 2025, reaching close to one-quarter of sales globally, and electric two-wheelers are now price-competitive with internal combustion engine models in major markets. In IEA Member countries, efficiency gains in vehicles since 2000 have offset growth in passenger car travel, but not in freight transport.

Across end use sectors, electricity demand is rising, partly driven by electrification. As a result, many countries experience a rising strain on grids and power systems. Energy efficiency is one of the cheapest and fastest ways to offset some of this growth in electricity demand. It can also help consumers shift their electricity demand to alleviate some of the pressure on the grids. As of 2025, countries representing more than half of global energy use have policies in place to promote demand flexibility mechanisms.

Overview of end-use sectors

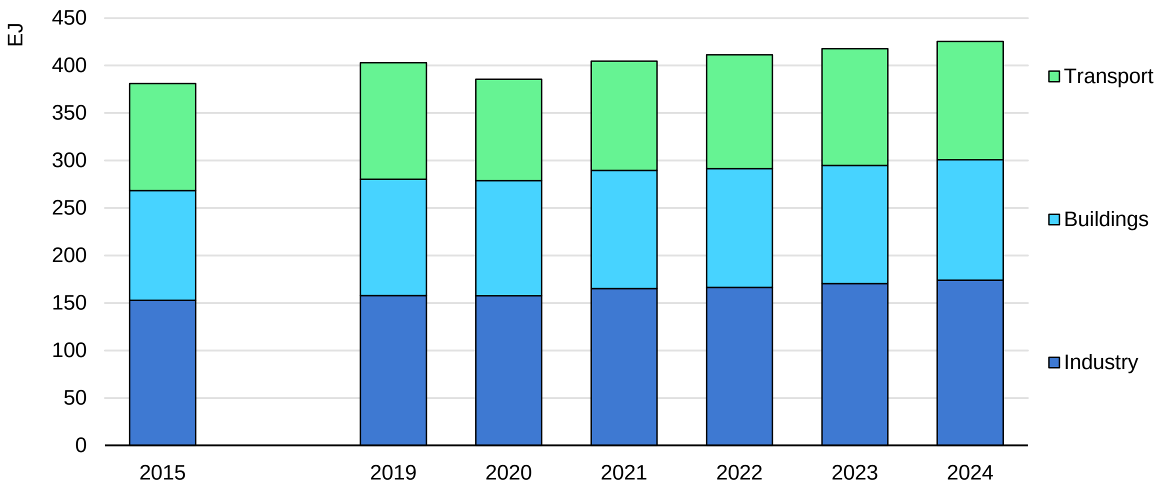
Total final consumption in 2024 was over 450 EJ and has grown by around 25 EJ since 2019. Industry accounts for the largest share of demand, at nearly 40%, while the buildings and transport sectors are both responsible for around 30%. Industry saw the strongest growth in this period, contributing two-thirds of the total increase, followed by buildings at just below 20% and transport at less than 10%.

China continues to have the largest **industrial** energy demand in the world. It accounted for around two-thirds of the increase in global demand since 2019, growing its industrial demand 3% per year, an acceleration from a growth rate of just over 1% per year from 2010 to 2019. Meanwhile, India was responsible for one-fifth of the growth in global industrial demand since 2019. It is also seeing one of fastest growth rates, sustaining an average increase in industrial demand of 5% per year this decade. Its industrial demand grew twice as fast as in transport and four times as fast as in buildings from 2019 to 2024.

China, the United States and the European Union account for around half of global energy demand in **buildings**. In China, energy use in buildings has grown by nearly 50% since 2010, driven by a growing population and rising incomes. In the United States, energy use in buildings today is similar to 2010 levels, while in the European Union, building energy demand declined by 20% in the past 15 years.

The **transport** sector experienced the slowest growth in demand between 2019 and 2024. The United States is the country with the highest transport energy demand globally, but most growth in recent years has come from emerging economies, where transport energy demand rose over 20% since 2015.

Global total final consumption, by sector, 2010-2024



Note: total final consumption is only shown for buildings, industry and transport. The remainder accounts for around 25 EJ.
Source: IEA (2025), World Energy Outlook.

2.1 Industry

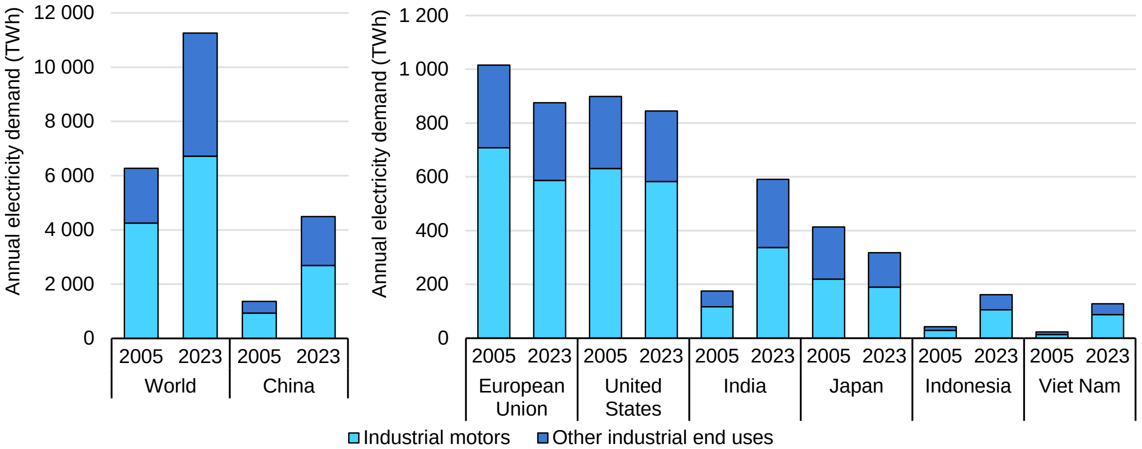
In 20 years, electricity demand from industrial motors rose about 60%, driven by growth in emerging markets

Industrial electric motor systems account for about 60% of global industrial electricity demand and around 25% of global electricity use. Global electricity demand by industrial motors has grown by around 60% between 2005 and 2023, primarily driven by China (+190%) and India (+180%). Other emerging economies, such as Indonesia and Viet Nam, have also seen rapid growth over the past twenty years, but they account for a relatively smaller share of the global total. In Japan, the United States and the European Union, industrial electricity demand (including demand from motor-driven systems) has decreased slightly since 2005.

The share of demand from motors in total industrial electricity demand varies across industrial sub-sectors, as in energy-intensive sectors more energy is used for process heat and other uses. In countries with a large share of less intensive industries, motor-driven systems often thus account for a higher share of total industrial electricity use. In Latin America and the European Union, for example, where less intensive industries represent up to 50% of total industrial energy use, motor-driven systems account for over two-thirds of the industrial electricity use.

Conversely, in countries with a lot of energy-intensive industry, motors generally make up a smaller share of industrial energy demand. Australia and Iceland, for example, have a significant share of energy-intensive industries, and the share of electric motors in industrial electricity use is estimated to be less than 50%.

Industrial electricity demand and share of electricity use by motors in selected countries, 2005-2023



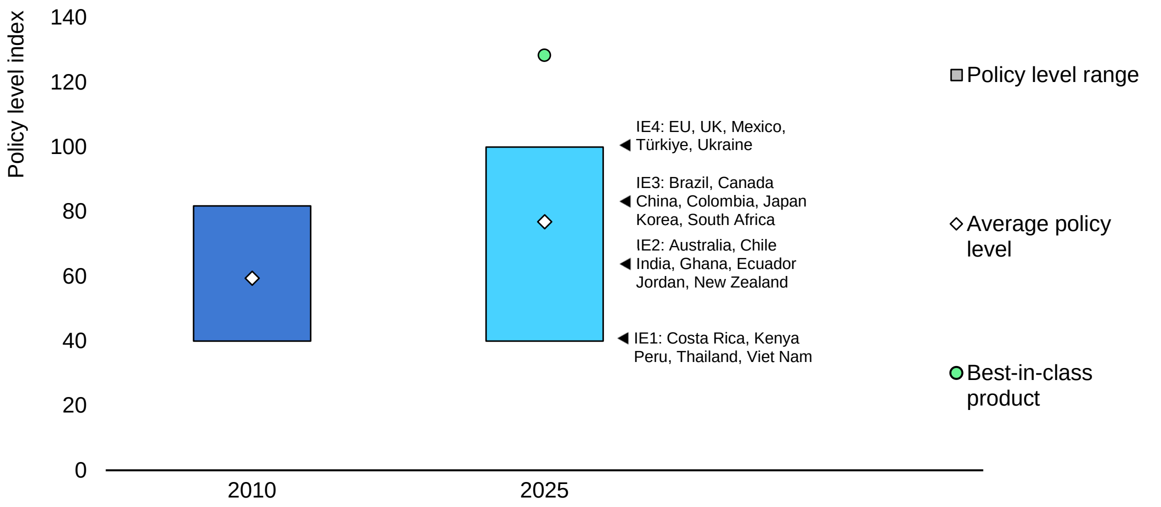
Source: IEA (2011), Walking the Torque, IEA (2025), World Energy Balances (accessed October 2025).

One-third of all countries have performance standards for electric motors in 2025 and stringency levels vary

Standards for the minimum efficiency level of industrial equipment can help to eliminate the most inefficient ones from the market. This is especially relevant for motors, as they have long lifetimes, so models installed today will be in place for decades. As of 2025, 71 countries have standards for motors in place, with requirements ranging from IE1 (known as standard efficiency) to IE4 (super premium efficiency), which are up to 14% more efficient than IE1 models, depending on the size. A single 20kW motor upgraded from IE1 to IE4 used daily for sixteen hours would save around 2 850 kWh per year – the same annual electricity use as an average UK household. IE5 models are also commercially available, but no country has mandated these yet as a minimum standard.

Five countries introduced new or updated energy performance standards in 2025. South Africa's new standards for electric motors came into effect, requiring most new three-phase electric motors to have an efficiency level of at least IE3. Firms can continue to run operational IE1 and IE2 motors, replacing these upon failure. Existing IE1 and IE2 motor stock can be sold until May 2026. Other countries strengthened existing standards. Mexico, for instance, updated its MEPS to IE3 levels for electric motors in 2025. Meanwhile, the European Commission, in light of technological progress in motors and variable speed drives, has launched a public consultation on its MEPS. Similarly, Australia also launched a consultation on increasing its energy performance standards in 2025.

Minimum energy performance standards, industrial electric motors, IEA Efficiency Policy Level Index, global country range, 2010 and 2025



Notes: Efficiency policy levels refer to the highest stringency when the policy differentiates between equipment classes (e.g. capacity). An index of 100 aligns with an IE4 stringency level. Country sample represents 81% of global total final energy consumption.

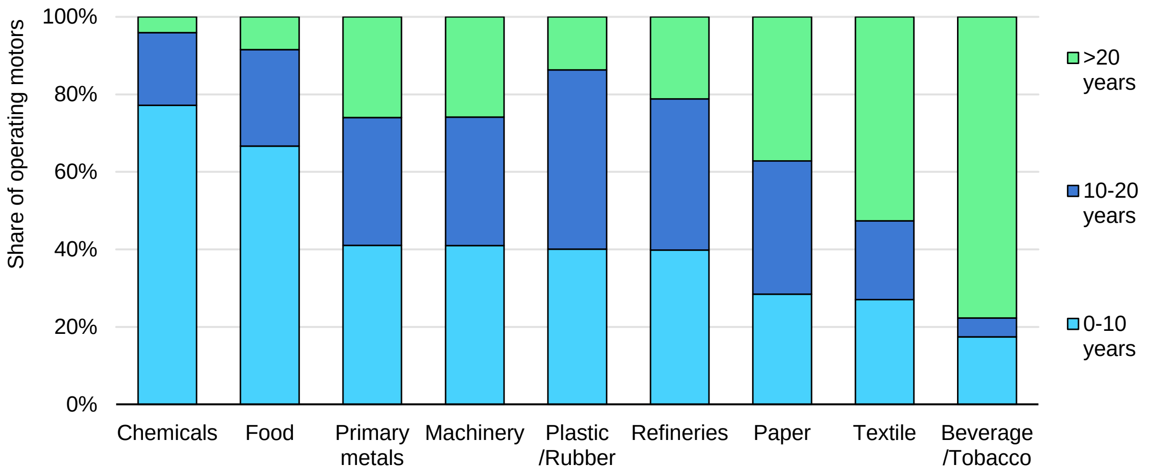
Half of all industrial motors in place today are over ten years old and are often less efficient than new models

Over 50% of all industrial motors are estimated to be over 10 years old, with almost a quarter being over 20 years old, but there are large differences between industrial sectors. In the paper, textile, beverage and tobacco industries in the United States, for example, up to three-quarters of industrial motors are more than ten years old, while in the chemical sector, just under a quarter are that old.

Older motors, purchased during times of less stringent regulations, tend to fall into low efficiency ratings. For example, an IE1 class motor, a minimum standard still in use in many markets, is up to 12% less efficient than an equivalent IE4 class motor, today's standard for Mexico, Switzerland, Türkiye, Ukraine, the United Kingdom and the European Union. Replacing an existing motor with a high-efficiency motor can reduce losses, and thus energy use and costs, with an average payback time of under two years for many industrial applications. Replacing the worst performing 10% of motors worldwide with new efficient motors (to IE3 and IE4 levels) would reduce annual electricity use by 30 TWh, equivalent to the annual electricity use of Denmark.

Additional savings can be achieved through the use of advanced controls and variable speed drives (VSDs). For applications with variable loads, such as HVAC applications, VSDs can improve the overall system energy performance by up to 40%. It is estimated that the full potential of savings achievable through the use of VSDs in the European industry exceeds 121 TWh/year, equivalent to about 15% of the total EU industrial electricity demand. In 2025, the European Commission has launched a public consultation process on future potential regulation for VSDs.

Age of industrial electric motors as share of total stock, by sector, United States, 2023



Source: US Motor System Market Assessment (2025), Lawrence Berkeley National Laboratory.

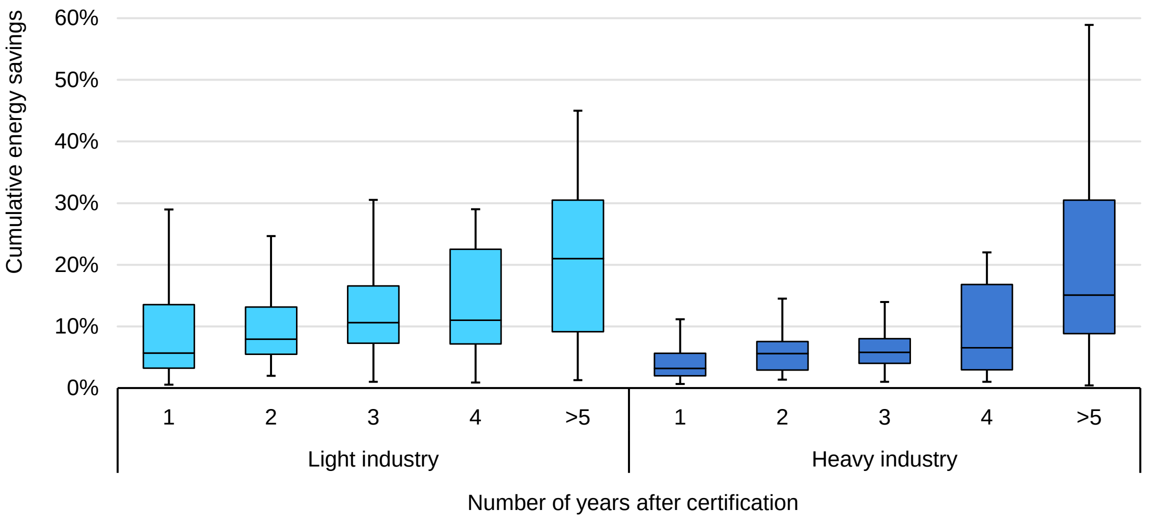
Energy management can enable energy cost savings of more than 10% in the first years of implementation

Energy management, the proactive and systematic monitoring, control and optimisation of an organisation's energy flows, could save industrial facilities billions every year. New IEA analysis of more than 300 energy management case studies in 40 countries has shown an average of 11% energy savings within the first years of implementation of energy management, well exceeding the average improvements in energy savings across the industrial sector as a whole.

A growing number of companies are demonstrating savings of 30% and even higher, with many of them low- or no-cost measures. Comparisons between implementation of energy efficiency measures identified by audits at sites with and without energy management and monitoring systems indicate that sites with energy management systems have higher levels of implementation of energy efficiency measures.

Even companies that have previously invested in energy efficiency find that, once they put energy management in place, significant and continuous energy efficiency opportunities are uncovered. Analysis shows that companies with energy management systems achieve continuous improvements even after 12 years of having the system in place, regardless of the sector.

Energy savings of 240 industrial facilities implementing ISO 50001, global, 2016-2024



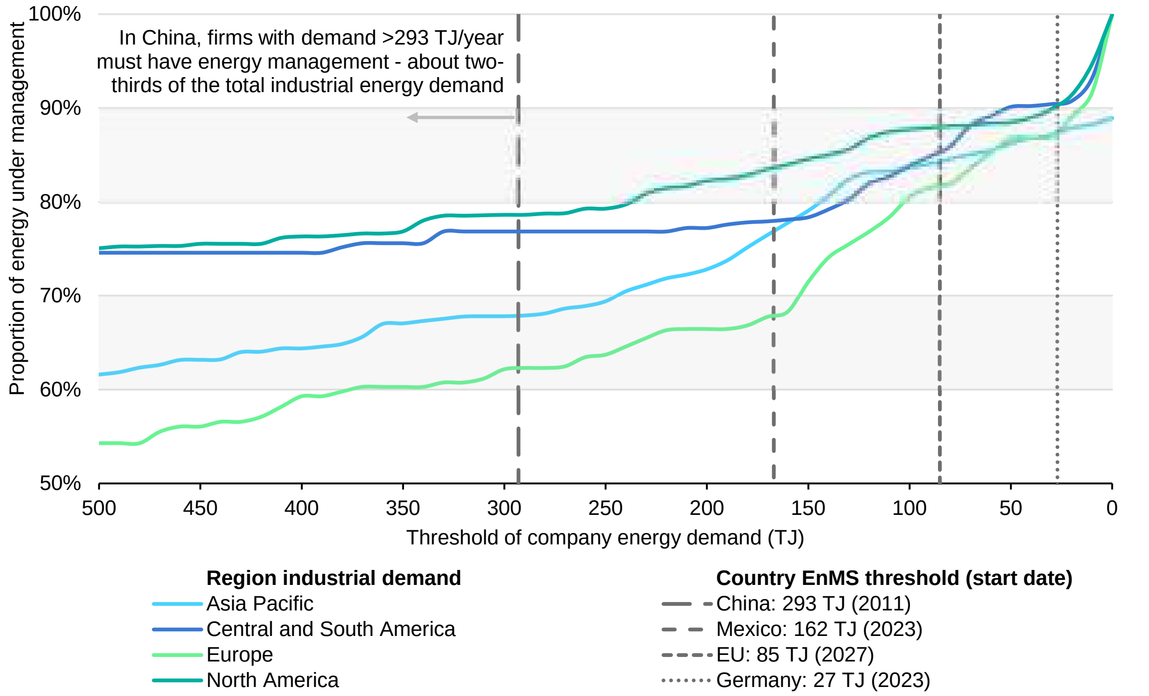
Note: Lines denote the 5th to 95th percentiles, while boxes show the 25th percentiles (bottom line), median (middle line), and 75th percentiles (top line).
Source: IEA analysis based on Clean Energy Ministerial (2024) Energy Management Leadership Awards.

Since 2023, countries covering half of global industrial demand have tightened energy management regulations

In recent years, several countries have put regulations in place to mandate energy management for companies above a certain energy demand threshold. By the end of 2026, China will lower its threshold from 293 TJ to 147 TJ, increasing the scope from facilities covering around 60% of industrial demand to more than 80%. In the European Union, a threshold of 85 TJ will come into force in 2027, covering firms that account for around 80% of EU industrial energy demand.

In 2025, Mexico established a threshold for the first time of 162 TJ, which is similar to the threshold set in 2023 by Indonesia of 167 TJ. The most stringent threshold has been set by Germany at 27 TJ in 2023. This tightening of the threshold required an estimated number of 3 500 companies to implement an energy management system for the first time, covering around 90% of total industrial energy use in the country. Increasing the coverage of energy management regulations can lead to greater efficiency gains, but it can also lead to complexity of delivery for governments due to the increased administrative burden.

Selected thresholds for energy management requirements, potential industrial energy demand coverage, selected regions, 2023



Notes: This figure provides a snapshot of the current regional energy demand and coverage. It does not show coverage at the time of policy implementation. Asia Pacific does not end at 100% on the right side due to differences in business-size reporting methodologies.

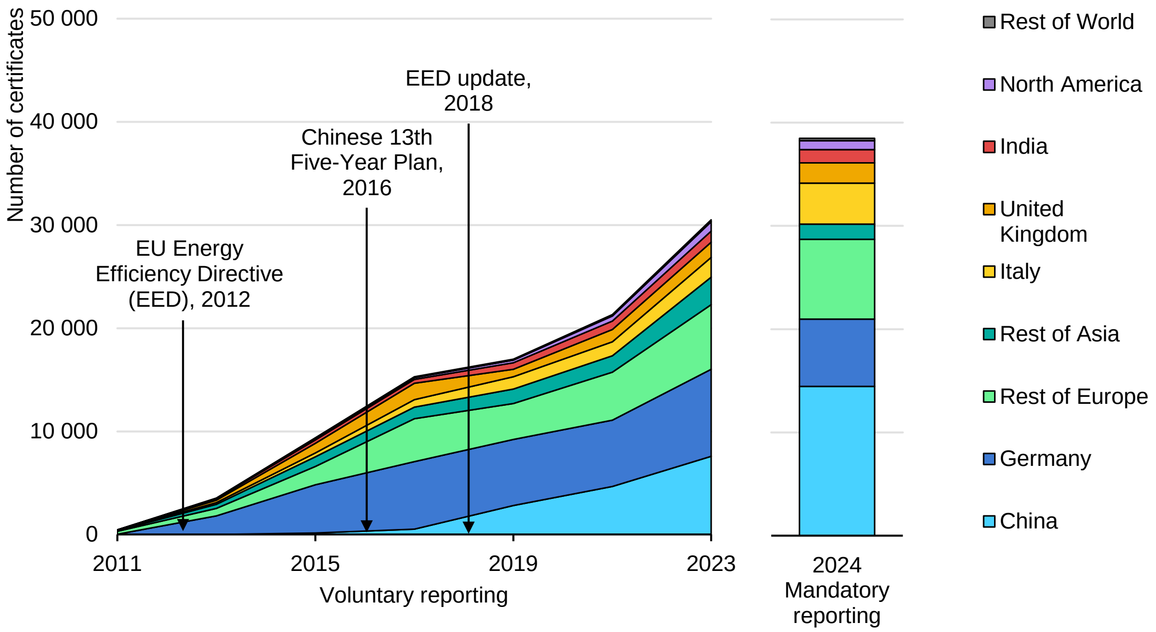
Sources: IEA analysis based on IEA (2025), World Energy Balances and OECD (2025), Structural Business Statistics.

Energy management certifications have quadrupled since 2015, but still cover just a fraction of firms

Energy management standards and certification processes can ensure that energy management approaches are well-implemented. The main international standard for energy management is ISO 50001. The number of ISO 50001 certifications has grown from around 10 000 in 2015 to over 38 000 in 2024. Around 85% of these were issued in China (~40%) and Europe (~45%), primarily in Germany, Italy and the United Kingdom. In recent years, India and the United States have seen the number of ISO 50001 certifications start to pick up as well.

Looking at the growth in ISO 50001 certificates worldwide, policies such as the EU Energy Efficiency Directive (EED) or the 13th Chinese 5-year plan in 2016 have had a clear role in encouraging uptake. Numerous countries have also developed voluntary schemes to provide guidance for firms looking to implement energy management, but without the requirement to certify. The US 50001 Ready programme, for example, has been adopted in both Canada and Saudi Arabia. At a global level, increasing company coverage from the estimated baseline of 20% of global industrial energy demand in 2035 to 66% could unlock around 20 EJ of additional savings. This could be achieved using existing and proven technologies and methods. The potential additional savings are equivalent to around 15% of global industrial energy demand in 2023.

Number of ISO 50001 certificates issued and selected policies, by region, 2011-2024



Note: Until 2023, the number of ISO certificates were reported on a voluntary basis by national accreditation bodies. From 2024 onwards, this has been made mandatory. This provides more complete data but means the certification numbers collected prior to 2024 cannot be directly compared to those collected prior.
Source: IEA analysis based on an ISO Survey of ISO certificates.

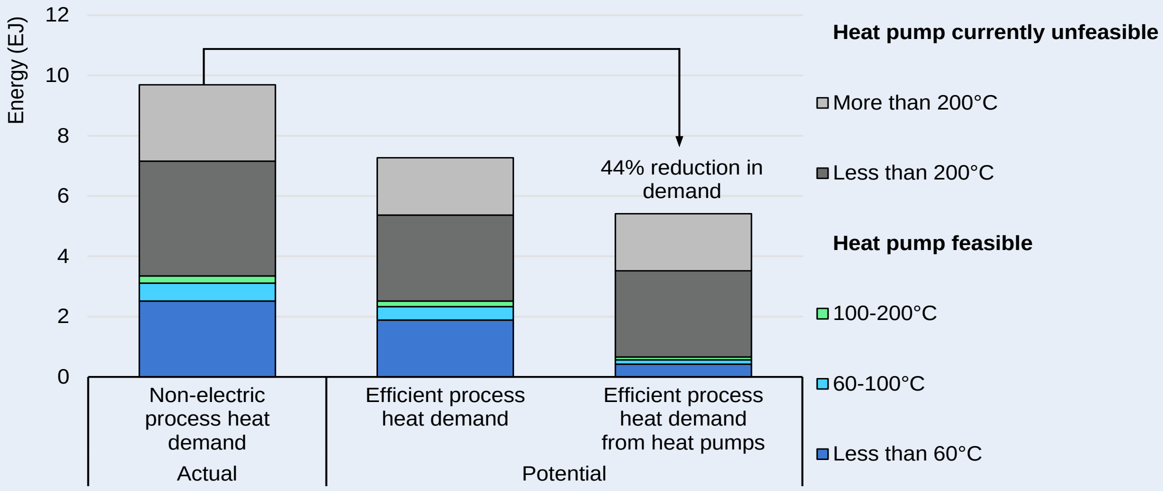
Industry in the Age of Electricity: Maximising the benefits of heat electrification

Energy efficiency and electricity demand are closely linked. This year's report therefore explores the role of energy efficiency in the Age of Electricity.

In less energy-intensive industrial sectors, just under one-quarter of all energy demand is used for process heat (nearly 10 EJ). Around one-third of this process heat demand is technically suitable for electrification using low-temperature heat pumps (< 200°C). This could result in this process heat energy demand (around 3.3 EJ) reducing by up to 75%. To achieve the maximum efficiency benefits, however, it is crucial to address overall plant efficiency prior to electrifying process heat. Enhancing system efficiency could total lower process heat demand in these sectors to around 7.3 EJ. Heat electrification would then further reduce total process heat demand to below 5.5 EJ (~45% below current levels).

Some countries are seeking to realise these savings for new facilities, placing efficiency first and unlocking substantial cost savings. For instance, New Zealand has supported industrial heat pumps since 2013, and has estimated that around a quarter of the heat pump potential in industry has been captured. Its Energy Transition Accelerator programme offers up to 40% co-funding for decarbonisation measures and helps firms understand how heat pumps can be used together with other efficiency measures. Another example is the EXEED Certified Grant Scheme in Ireland, which emphasises efficient design first, followed by electrification. In one case study, a distillery, this approach cut energy demand by two-thirds compared to a conventional distillery.

Global non-electric process heat demand in less intensive manufacturing, and estimated efficiency-related savings potential, 2023



Sources: IEA analysis based on data from the IEA (2024), World Energy Balances; IEA (2022), Future of Heat Pumps; and IEA (2024), Future of Heat Pumps in China.

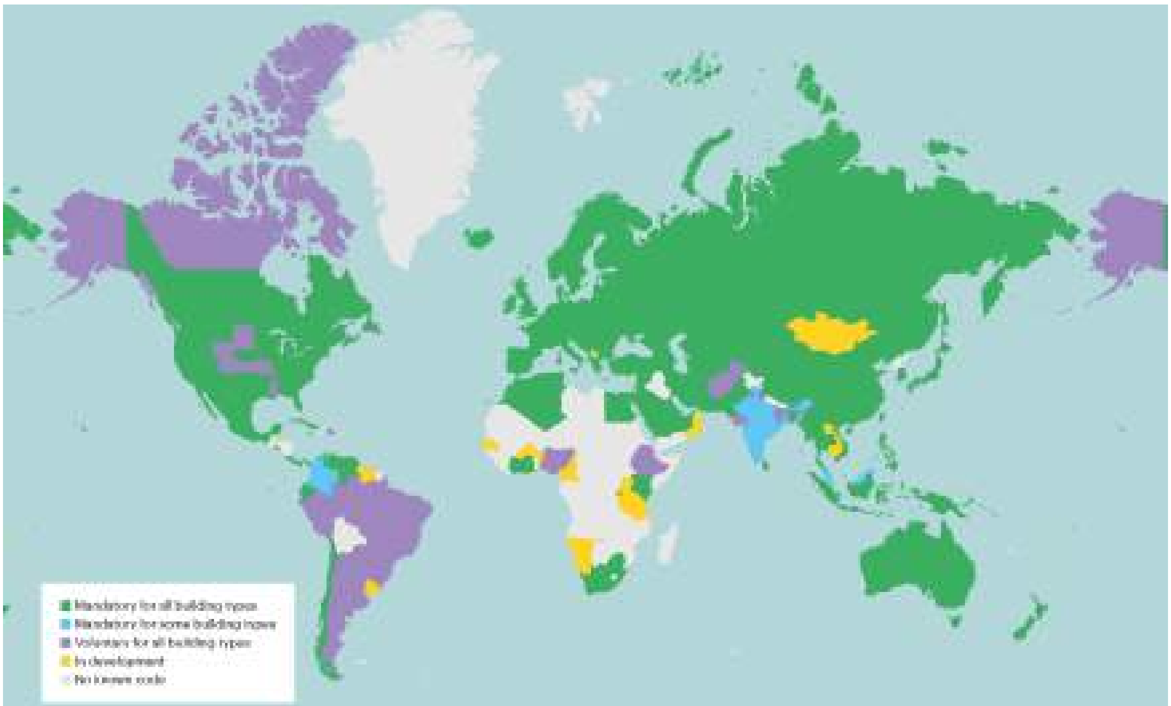
2.2 Buildings

As of 2025, around 60% of new buildings globally are covered by building energy codes

As of mid-2025, there are 95 mandatory building energy codes or standards for residential buildings and 97 for non-residential buildings. Yet around half of all countries worldwide do not have in place mandatory requirements for energy efficiency in buildings. As a result, 2.6 billion square metres of floor space was built in 2023 that was not mandated to meet energy performance requirements.

Eight governments implemented new or updated building energy codes in 2025. For example, Japan's updated Building Standards Act mandates compliance with higher insulation and energy standards for all new homes and small buildings. Meanwhile, India's Energy Conservation and Sustainable Building Code 2024 is updated with stronger efficiency requirements for commercial buildings. And in Singapore, the 2025 Mandatory Energy Improvement Regime targets existing large buildings. When cooling-energy use intensity is in the worst-performing quartile of its peers, the owner must do an audit and implement improvements.

Mandatory and voluntary building energy codes, 2025



IEA. CC BY 4.0.

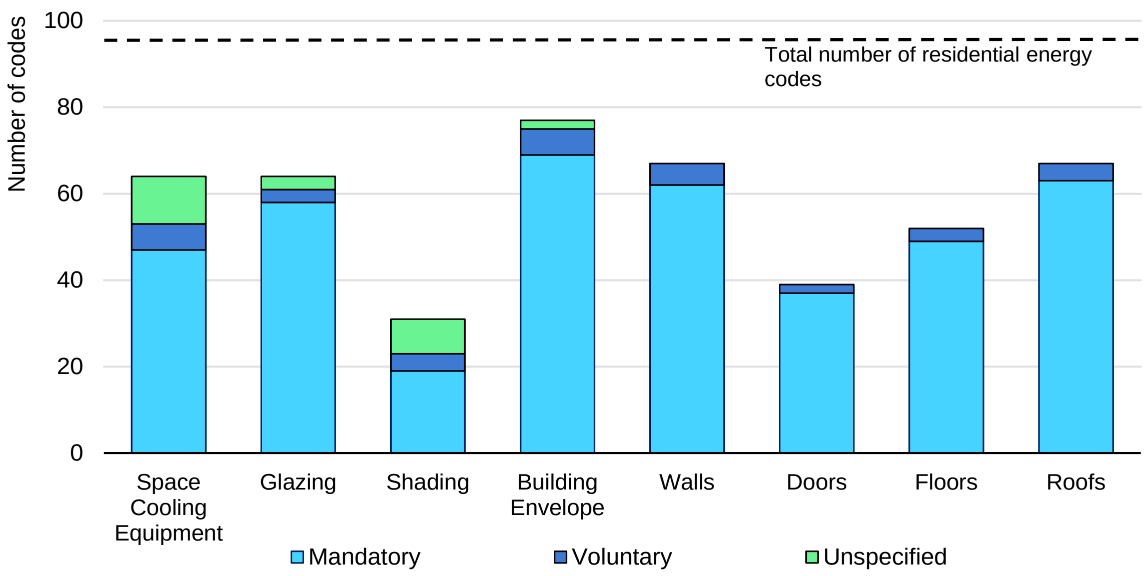
Notes: The map tracks known national building energy codes and those where a national mandate for adoption exists. In cases where the national mandate exists, the map shows its status and not its adoptions at the sub-national level (e.g Brazil, Mexico, India). In cases where building energy codes are not mandatory at the national level, the map shows implementation at the sub-national level jurisdictions (e.g. the United States, Canada, Belgium).

In 2025, at least 60 building energy codes had mandatory requirements for space cooling in residential buildings

Passive cooling requirements in building energy codes mandate a design approach focused on minimising heat gains to improve thermal comfort with low or no energy use, reducing the need for additional active cooling, such as from air conditioners. This can include requirements such as solar shading, ventilation design, and using high-performance glazing. In 2025, over 60 building energy codes globally had some sort of mandatory requirements for space cooling in residential buildings, compared to a total number of 95 mandatory codes.

In many countries facing rapidly rising cooling demand, passive cooling requirements in building energy codes are lacking or remain insufficiently robust, with weak or absent provisions to address heat avoidance. Several countries are taking steps to address this. For instance, Pakistan's Energy Conservation Building Code sets mandatory U-values for roofs, walls and glazing and Ghana's Sustainable Cooling for All Roadmap calls for passive-design provisions in its building code. Seventeen countries also published national cooling action plans that contain passive cooling elements. For example, Indonesia's National Cooling Action Plan recommends the adoption of cooling requirements into its building codes, while Jordan's 2025 National Cooling Strategy advocates for incentives to promote passive design. Passive cooling measures are often low-cost and reduce heat-related health risks. This is particularly relevant for lower-income populations without access to active cooling. Brazil's 2025 Beat the Heat in Cities programme, for example, promotes cool roofs, shading and nature-based solutions, targeting communities in the hottest areas to reduce heat-stress mortality.

Cooling requirements in residential building energy codes, 2025

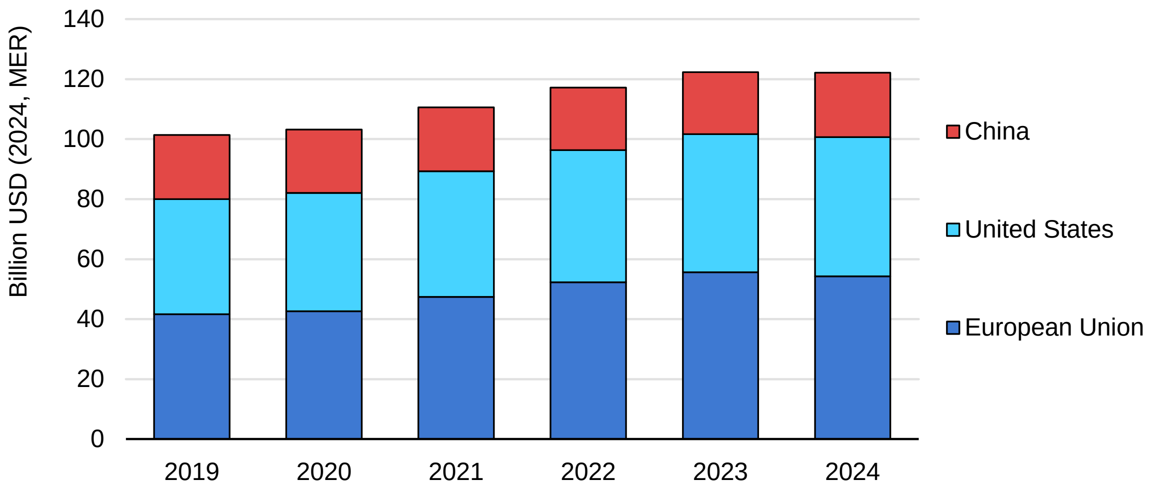


Investment in building energy retrofits and envelopes in major markets is over 20% higher than in 2019

Since 2019, combined spending on building retrofits and envelopes in China, the United States and the European Union has increased over 20% to around USD 120 billion in 2024. Material costs for envelopes and retrofits have also increased in recent years, however, pushing up upfront investment costs. To improve the efficiency of the building stock, several governments have increased public spending on retrofit grants the past five years. From 2021 to 2024, for instance, spending in France rose from USD 1.5 billion to USD 3.5 billion, and from USD 5 billion to USD 7 billion in Germany. In the Netherlands, Ireland and Norway, public spending on grants tripled in each between 2021 and 2024, to a combined USD 1.1 billion. Similar trends are seen outside of Europe as well. In Canada, annual retrofit public funding quadrupled from 2021 to USD 662 million in 2024, and in Japan, spending grew from USD 55 million in 2023 to USD 355 million in 2024.

In 2025, however, some countries decreased spending, while others shifted the focus of their schemes. In Italy, the Super Ecobonus tax credit was reduced to 65% in 2025, and new applications have dried up since 2024. France's retrofit scheme reopened in September 2025, after a temporary suspension, with stricter criteria and lower spending ceilings. In Canada, the USD 584 million Canada Greener Homes Affordability Program was launched to specifically target low-to-median-income households in 2025-2030. In Germany, retrofit grant commitments tripled in the first half of 2025, with strong growth in heat pump applications.

Estimated spending on building retrofits and envelopes in selected regions, 2019-2024



Note: An energy efficiency investment is defined as the incremental spending on new energy-efficient equipment or the cost of refurbishments that reduce energy use (excluding labour). The intention is to capture additional spending compared to the reference technology and which leads to reduced energy consumption
Source: IEA (2025), World Energy Investment.

Public grant programmes for residential energy retrofits, selected countries, 2021-2024

Country	Retrofit programme description	Number of houses / grants	Cumulative funding (USD)
Canada*	The Canada Greener Homes Grant and Oil to Heat Pump Affordability program fund measures such as insulation and heat pumps. From 2025, the Canada Greener Homes Affordability Program targets retrofit funding at low-to-median-income households.	405 000 grants	1.4 billion
Denmark	The Building Pool, Heat Pump Pool, and Energy Renovation Pool provide grants for building energy retrofits.	60 000 grants committed	210 million
France	The MaPrimeRénov scheme funds individual measures and deep renovations. In 2025, USD 3.9 billion is available, targeted at low-income groups in poorly insulated homes.	2.3 million houses	13.7 billion
Germany	The Federal Funding for Efficient Buildings programme funds individual measures and full renovations. Over 100 000 applications have been submitted in the first half of 2025.	3.8 million houses	37.3 billion
Ireland	The Better Energy Homes Scheme funds individual measures, and the National Home Energy Upgrade Scheme and the Warmer Homes Scheme fund (deep) renovations.	80 000 houses	760 million
Japan	The Energy Conservation Subsidy and the Eco-Home grant have promoted building upgrades, efficient water heaters and window replacement. In 2025, the Home Energy Saving Campaign was launched.	1.9 million grants	415 million
Netherlands	The Investment Subsidy for Sustainable Energy and Energy Efficiency funds individual measures, such as insulation and heat pumps. In 2025, the amount of funding for each insulation measure has increased.	860 000 houses	1.8 billion
Norway	The Enova Housing Grant and Program for improving energy conditions in housing associations fund upgrades such as insulation and metering. From 2025, support can be granted before the renovation starts.	57 000 houses	180 million

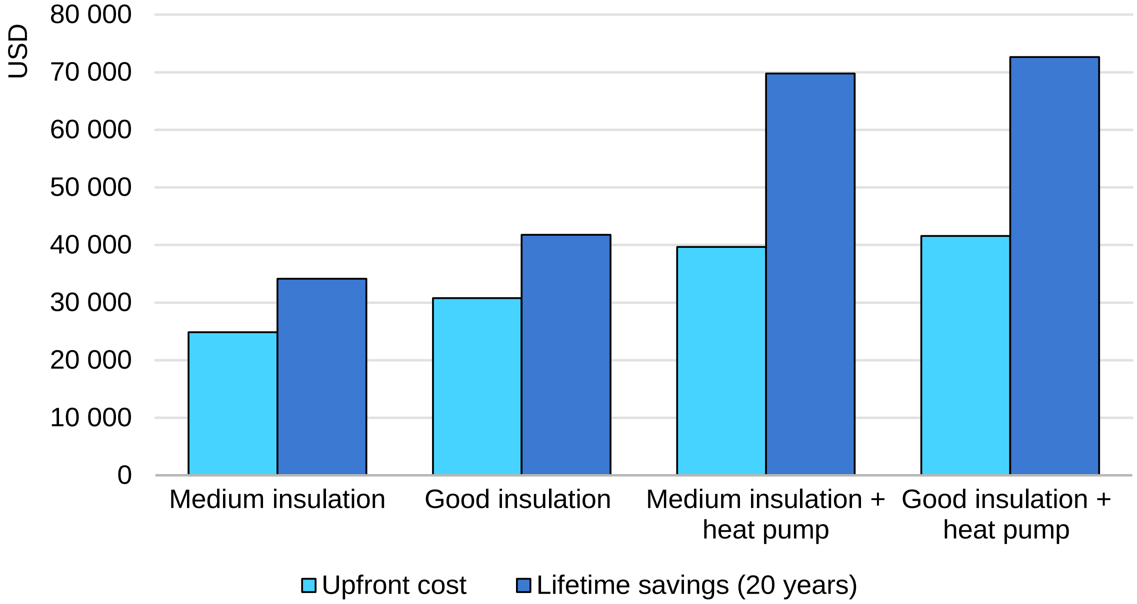
* For Canada, data is based on fiscal years, not calendar years.
Note: Currency conversions are based on the average exchange rate to USD in 2024.

The long-term cost savings of retrofits can outweigh the upfront costs, especially given recent high energy prices

Energy-efficiency investments in energy retrofits of buildings are a long-term benefit to building owners and occupants. In 2025, gas and electricity prices remain elevated in many major economies compared to five years ago. The rise in energy prices since the global energy crisis has meant that the potential benefits of retrofits through lower energy expenditure have increased. A typical dwelling in the Netherlands, for example, might save 300-500 USD/m^2 in energy costs over a 20-year period (or USD 35 000 to USD 70 000 for a 140m^2 house) at today's price levels, compared to the upfront costs of around USD 40 000 for good levels of insulation and high-performance heat pumps.

Many governments have deployed financial incentives to support households with the high upfront costs of retrofits. The private sector, however, is also developing innovative models to finance efficiency as a revenue-generating asset. Energy service companies, for instance, use energy performance contracts to deliver retrofits with guaranteed energy savings, which are then used to repay the initial investment. Berlin's Energy Saving Partnership has leveraged ESCOs to upgrade nearly 1 400 public buildings, with private investment of USD 54 million. Commercial banks have also announced plans to support retrofits in 2025 through energy renovation loans.

Estimated cost and lifetime savings for retrofit measures in a typical single-family home (140m^2) in the Netherlands



Notes: Cost of energy saved based on current country tariffs (NLD: 0.18 USD/kWh for gas and 0.24 USD/kWh for electricity). Net cost savings over 20 years are calculated as the difference between energy prices and levelised cost per unit of saved energy calculated based on the upfront investments, 20-year timespan and 5% discount rate.

Private investment needs to grow, as public spending is insufficient to renovate all inefficient buildings

Households and the private sector finance over 90% of energy-efficiency related investments in buildings, whereas public spending accounts for just a small proportion. While public funds are important, the costs of renovating all inefficient buildings extend far beyond what public programmes alone can address. In 2024 and 2025, there have been some signs of a decline in public budgets for retrofit programmes, after a decade of expansion, highlighting the need for private capital if investment levels are to continue rising. Governments have announced or updated various market-based instruments to attract private capital for retrofitting in 2025, such as energy supplier obligations and auctions.

The European Commission, for instance, proposed new plans to develop a tradable EU-wide energy efficiency market as part of its 2025 Affordable Energy Action Plan. As part of this, the Commission also announced the intention to double the EU ESCO market to around USD 4 – 6.5 billion per year. In response to the revised EU Energy Efficiency Directive, several EU countries have updated or implemented energy efficiency obligation schemes in recent years. For example, Spain introduced an energy supplier obligation scheme at the end of 2023. In 2024, this generated around 1 900 GWh in energy savings, equivalent to the annual electricity use of over half a million households. Between January and September 2025, this has been surpassed already, with nearly 3 000 GWh in generated savings. Hungary also updated its energy efficiency obligation scheme in 2025, including higher targets between 2025 and 2030, to align with the updated EU legislation.

Some other countries launched consultations on their supplier obligation to prepare for the next phase. Brazil, for instance, has a long-running Energy Efficiency Program that generated investments of over USD 160 million in 2024 alone, and in 2025, they launched a public consultation on how to improve the programme for its next phase. Similarly, Ireland also launched a consultation in 2025 on the next phase of its supplier obligation, which is planned for the period 2026-2030. An analysis of its last phase showed the benefits of the programme are nearly twice as high as the costs, and are financed by both public and private investors.

Public and private investment are complementary. Public incentives can de-risk projects and build demand for investments, while private capital can address market gaps and can offer a greater variety of financial products for retrofits, such as green mortgages or property-linked financing. The scale-up of private capital will depend on how quickly viable business models can prove their ability to reduce reliance on long-term public subsidies.

Buildings in the Age of Electricity: Digital optimisation can boost efficiency gains in commercial buildings

Energy efficiency and electricity demand are closely linked. This year's report therefore explores the role of energy efficiency in the Age of Electricity.

Commercial buildings are typically more complex and energy-intensive than residential buildings. With larger floor areas, multiple functional zones and highly variable internal loads, these buildings are difficult to manage efficiently through hardware upgrades alone. Optimising performance therefore goes beyond physical measures. Digital optimisation (using advanced sensors and controls, communication, fault detection and automation) enables smarter co-ordination of equipment and continuous adjustment for efficiency improvements.

Digital optimisation, even when applied on its own to existing facilities, can typically deliver energy savings between 5% and 40%, and can boost the impacts of physical upgrades, although the savings vary depending on technologies applied and specific energy-use characteristics of each building. Several governments have implemented policies in recent years to enable advanced building optimisation and automation, and to promote the use of smarter sensors and control systems.

Selected policies promoting digital optimisation in commercial buildings

Country/region	Policy
European Union	The 2024 Energy Performance of Buildings Directive mandates non-residential buildings to have building automation and control systems installed that can detect opportunities for efficiency improvements.
Singapore	The 2024 Mandatory Energy Improvement Regime expands on the Building Energy Code to promote smart building solutions, such as automated sensors and enhanced monitoring capabilities.
France	From 2025, the Building and Housing Code mandates automation and control systems in existing commercial buildings. Prior to 2025, these systems were mandatory only for new commercial buildings.
India	In 2025, the Union Territory of Chandigarh set up a public energy management team to improve HCAV automation and enhance advanced energy management practices in government buildings.
Germany	The 2024 revised Building Energy Act requires commercial buildings to install an automation system of at least class B, which corresponds to an advanced building automation and control system (on a scale from A, the highest performance, to D, non-automated).
Australia	Australia expanded its Commercial Buildings Disclosure programme requiring mandatory disclosure of commercial building energy performance to take advantage of digital and technology capabilities.

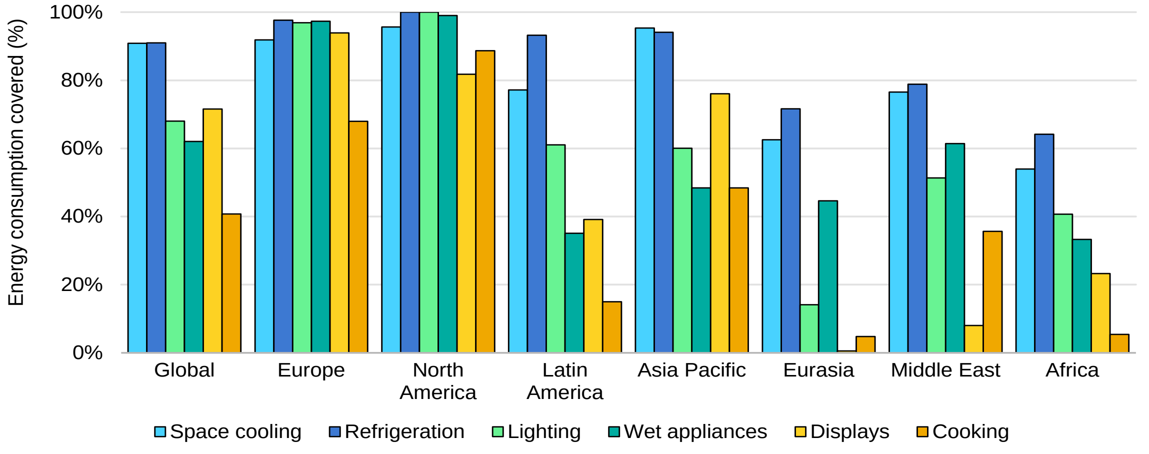
2.3 Appliances

90% of energy used by air conditioners and refrigerators is regulated in 2025, but other appliances lag behind

Minimum energy performance standards are one of the most frequently used policies to improve the efficiency of household appliances, such as air conditioners and refrigerators. They mandate an efficiency level below which products are not allowed to be sold. As a result of the new energy performance standards enacted in 2025, 90% of the global energy use of air conditioners and refrigerators is now covered by some sort of regulation, and the same is true for over 60% of the energy used in lighting, wet appliances (such as washing machines) and displays. Cooking appliances are the least regulated, with around 40% of energy use covered.

In Europe and North America, most appliances are covered by minimum energy performance standards already, but the ambition levels of these standards are regularly updated. In Latin America and Asia, air conditioners and refrigerators are also well-regulated, but there are fewer MEPS for other appliances. In Africa in 2025, as countries seek to increase access to clean cooking, cookstoves have the highest remaining potential for energy performance standards, which can bring not only high-efficiency gains, but also other important benefits, such as improved air quality and health.

Energy use coverage of minimum energy performance standards for appliances by region, 2025



Notes: Space cooling includes air conditioning and fans. Refrigeration includes refrigerators and freezers. Wet appliances include clothes washers, clothes dryers, washer-dryers and dishwashers. Cooking includes basic hobs, conduction, induction and gas stoves. All end uses refer to the residential sector.

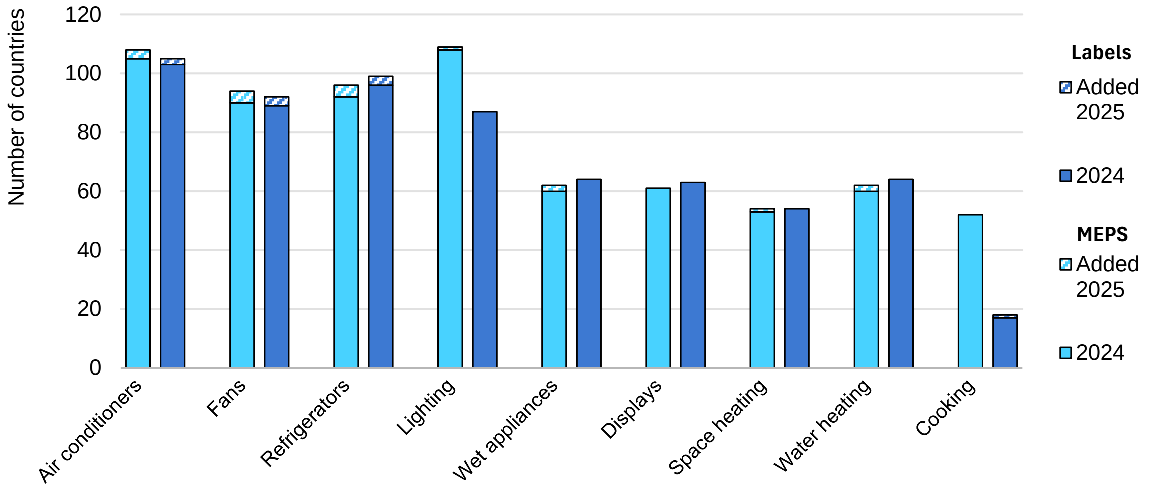
Most new energy performance standards in 2025 target air conditioners, fans, refrigerators and lighting

Fifteen countries have newly implemented or updated MEPS for appliances in 2025. Various emerging economies, such as Bahrain and Kazakhstan, have introduced new or updated lighting standards, pushing up the global coverage from around 60% of lighting energy use in 2024 to over 65% in 2025. Meanwhile, Malaysia introduced more stringent standards for air conditioners for 2026 and 2030, while also updating the labelling scales for air conditioners.

Many countries are combining MEPS with mandatory labels. As a result, in 2025, most new energy-efficiency labels were introduced for air conditioners, fans and refrigerators. Labels are also being extended to new product categories. In 2025, for example, the European Union implemented energy-efficiency labels for all new smartphones and tablets on the market.

Next to implementing labels, it is also important to ensure consumers are aware of the energy efficiency ratings and their meaning, and to ensure that mandatory labels are well-implemented. Governments therefore often combine the introduction of new labels with an information campaign. In 2025, for example, the Saudi Arabia Energy Efficiency Center launched a new awareness campaign about the importance of verifying the authenticity of energy efficiency labels for lighting products. At the same time, it also announced better enforcement for the label on dishwashers, asking consumers to report on the correct use of labels.

Number of countries with minimum energy performance standards and mandatory performance labels for appliances, 2025



Notes: Refrigeration includes refrigerators and freezers. Wet appliances include clothes washers, clothes dryers, washer-dryers and dishwashers. Cooking includes basic hobs, conduction, induction and gas stoves.
Source: IEA analysis based on IEA efficiency regulation policy tracking.

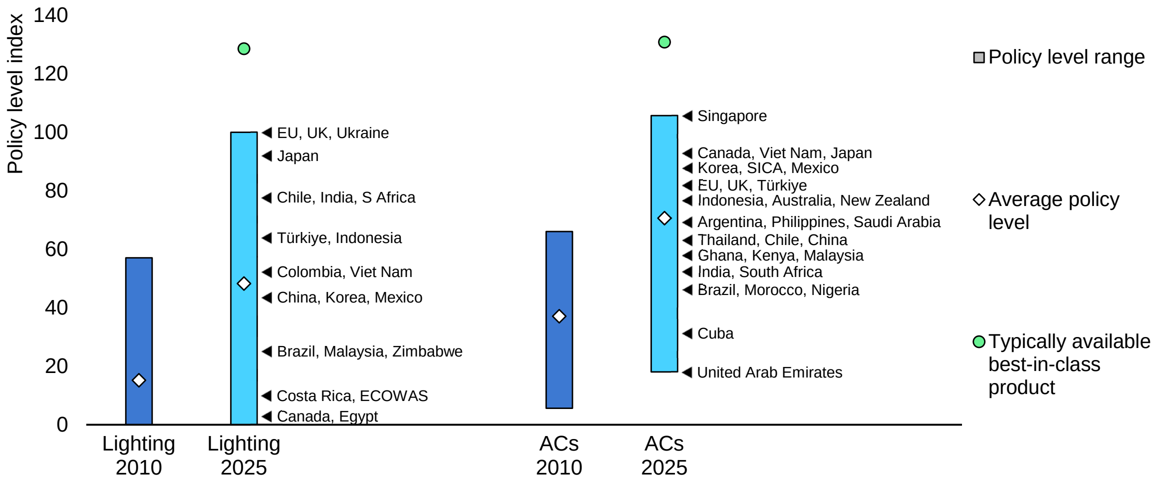
In 2025, just half as many standards were updated as in 2024 while ambition levels vary widely across the world

The total of fifteen new or updated standards in 2025 was just around half the number of updates seen in 2024, when 29 countries implemented revisions. While momentum for change in air conditioners and refrigerators has kept up at around ten updates standards in both years, lighting and wet appliances such as washing machines or dishwashers have seen much fewer countries updating their regulations.

The IEA Energy Efficiency Policy Level Index shows the progress in stringency of MEPS across countries and progress over time. Since April this year, Singapore has the most stringent MEPS for air conditioners in the world. The new MEPS for single-splits were raised to the 4-tick efficiency class (out of 5), or a coefficient of performance value of 4.86, equivalent to 6.1 measured in a cooling seasonal performance factor. For multi-split models the requirement is even higher, reaching a cooling seasonal performance factor of 6.86.

Meanwhile, Mexico has also updated its standards for air conditioners in 2025, particularly targeting models that are widely used in the commercial, service and industrial sectors, in medium- and large-capacity spaces such as offices, hospitals, hotels, restaurants, shopping centres, educational facilities, industrial hangars and warehouses.

Minimum energy performance standards, lighting and air conditioners, IEA Efficiency Policy Level Index, global country range, 2010 and 2025



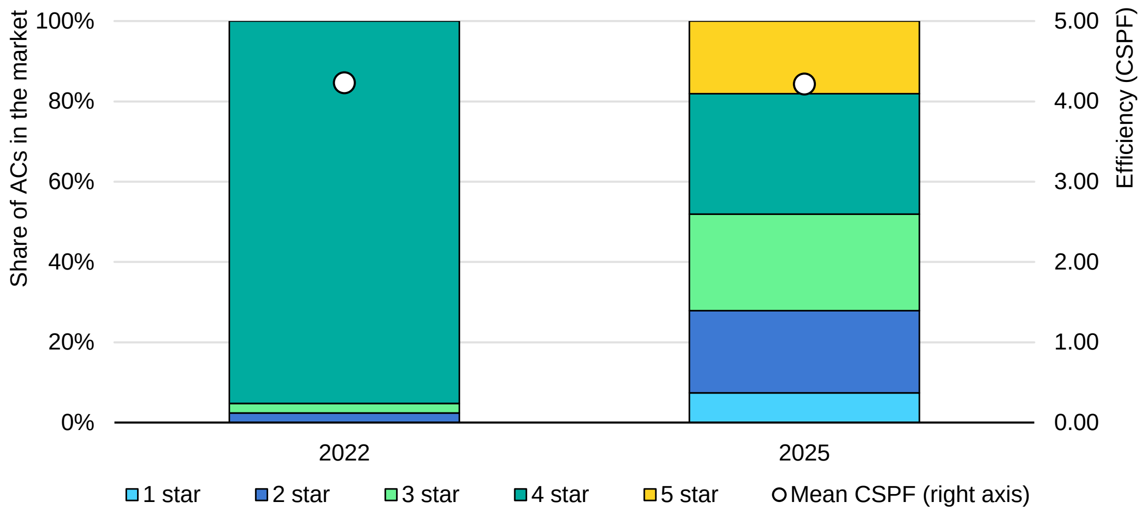
Notes: ACs = Air conditioners; ECOWAS = Economic Community of West African States; S. Africa = South Africa; Saudi A. = Saudi Arabia; EU = European Union; UK = United Kingdom. Japan does not regulate air conditioners for each device, but requires the average performance across all devices per manufacturer to conform to a specific level. Brazil has passed legislation to increase air conditioner MEPS stringency, effective 2026 and not part of this chart. Not all countries with regulations are displayed in the figure. Efficiency policy levels refer to the highest stringency when the policy differentiates between equipment classes (e.g. capacity). Baseline for lighting is 120 lm/W. For ACs, it is a Seasonal Energy Efficiency Ratio (SEER) of 6 Wh/Wh. Country samples represent 73% of global total final energy consumption for lighting, and 89% of global total final energy consumption for ACs.

New IEA data shows that careful labelling design and implementation matters to create a change in the market

Labels can improve awareness about the energy performance of appliances. They make it easier for consumers to recognise efficient equipment and can affect purchasing decisions. However, new data shows that labels alone might not be sufficient to shift the market if they are not carefully designed and implemented, in combination with other policy measures. This can prevent a concentration of products in the highest label categories. For example, in Indonesia, in 2021, most AC models were labelled in the top category (4 stars). This led to a regulation change, which added a class (5 stars) and updated the testing conditions, allowing efficient models to be differentiated from the rest. This reclassification was effective and has spread models more evenly across classes. It has, however, not yet led to an improvement in average market efficiency. To accelerate progress, Indonesia introduced new MEPS in 2024, banning products in the lowest class.

Similarly, the European Union had a labelling system in place ranging from A – G. When updating these in 2010, rather than reclassifying products, three new classes were added on top, then going from A+++ to D. However, consumer behaviour did not change much, as an A level product was still perceived as good. In 2017, the European Union introduced legislation to rescale all appliance labels again to range from A to G. This trend has also emerged in Brazil, which updated its AC labelling scheme in 2022. New IEA data shows that most models are concentrated in the top class under the new scheme, but new thresholds for efficiency classes will take effect in 2026.

Classification of air conditioners in Indonesia and average efficiency, 2022-2025



Notes: CSPF = cooling seasonal performance factor. For 2022 models, energy efficiency ratio values were converted to cooling seasonal performance factors based on Irsyad et al. (2021), Cooling Seasonal Performance Factor (CSPF) Application in Indonesia for Residential Air Conditioning (AC) Unit, IOP Conference Series Earth and Environmental Science 927(1):012008.

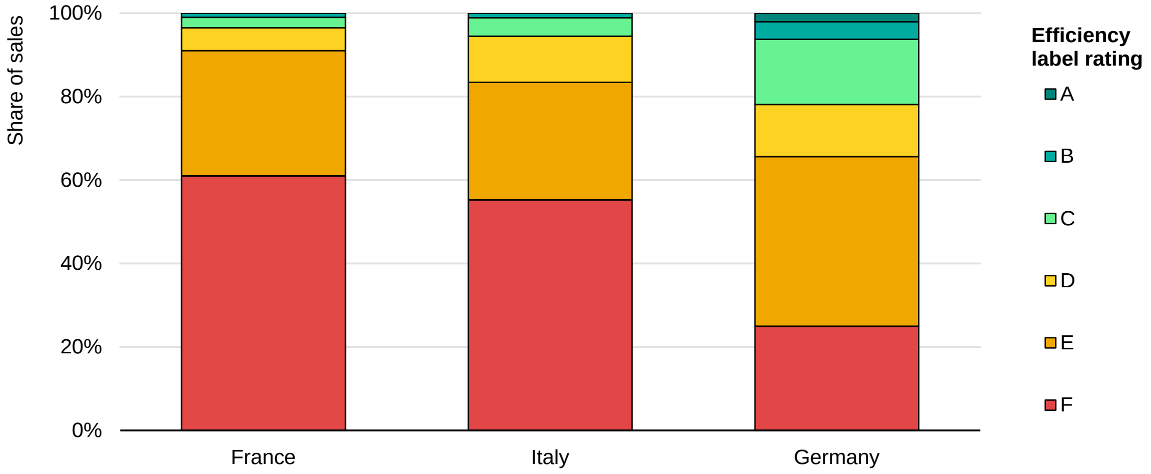
Markets under the same regulations do not always see the same uptake of efficient technologies

Recent market data from European countries show that, despite sharing the same regulations and being part of a common market, the performance of appliances sold varies widely across countries. In 2023, 60% of new refrigerators sold in France were rated F (very low efficiency), compared to 55% in Italy and only 24% in Germany. At the same time, just 4% of sales in France were in the top three classes, while they made up 21% of sales in Germany.

One of the factors related to this is that the average premium for high-efficiency products is lower in Germany, at about USD 150 on average, or a 30% price increase, while it is almost USD 290, or a 65% premium in France, where low-efficiency models are more affordable. Another factor is electricity prices, which are different in these countries. France has the lowest prices, with residential rates of around 0.25 USD/kWh, while in Italy they reach 0.41 USD/kWh, and Germany has the highest prices, at 0.44 USD/kWh. With high electricity prices, the savings from high-efficiency models are higher. Brand recognition and preference for local manufacturers might also play a role in purchases of efficient appliances.

On top of energy performance standards and labels, some countries have also offered financial incentives to encourage consumers to purchase more efficient appliances. For example, Italy offers vouchers of up to USD 110 for purchasing refrigerators of efficiency classes higher than D. In Belgium, the Flanders region offers vouchers worth USD 270 for high-efficiency appliances. Meanwhile in Spain, local governments offer discounts that depend on the appliance type and its energy efficiency label rating.

Share of refrigerator sales by efficiency level in selected countries, 2023



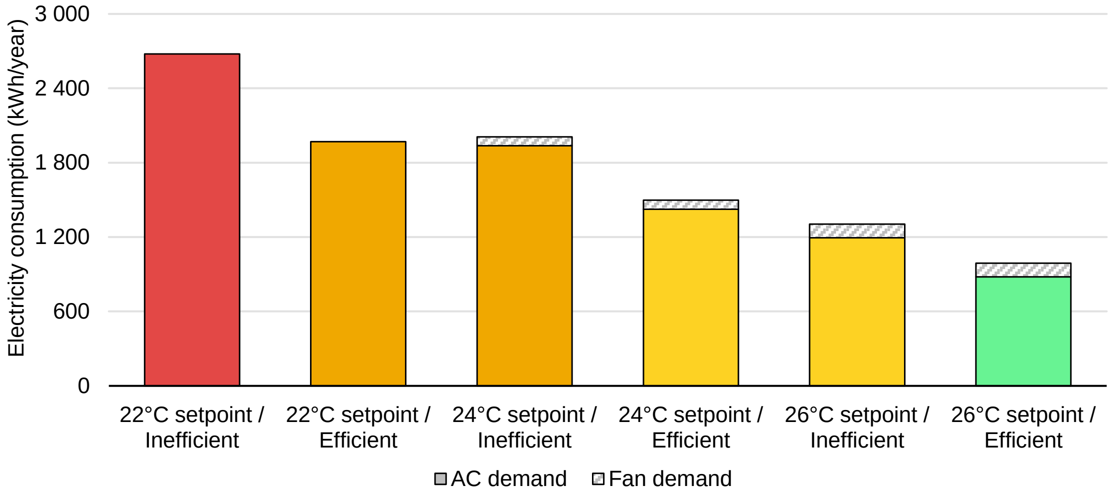
Note: The European Union Energy label is scaled from A to G.
Source: IEA analysis based on data from Ademe (2025), Energy efficiency of white goods in Europe: market monitoring.

Combining technical efficiency with higher cooling set-points can shrink electricity demand of air conditioners

Along with passive measures such as shading or ventilation, increasing the air conditioner setpoint (the desired temperature) by 2°C can reduce energy demand and costs by over 20%. In many cases, a 1°C increase can lead to similar savings, such as increasing one efficiency class on the label. Air conditioners can also be combined with fans, achieving similar levels of comfort at a lower setpoint and leading to 30% savings, while the fans themselves consume a lot less energy. Additionally, high-efficiency air conditioners can save up to 50% of energy compared to low-efficiency units under the same external conditions. Combining high-efficiency air conditioners with an adjusted cooling setpoint, paired with fans, can result in a 65% demand reduction without compromising thermal comfort.

Many countries have recommendations or regulations on cooling temperature set-points, generally implemented in public buildings. France mandates a minimum cooling setpoint of 26°C for all non-residential buildings, with exceptions for specific buildings such as hospitals. In the Philippines, the air conditioning thermostat in public buildings must be set to 24°C. In Japan, the Cool Biz campaign promotes a temperature setting of 28°C and the use of light clothes to reduce cooling needs, particularly in offices, with a strong focus on individual thermal comfort. In India, with a different approach, new air conditioners have a default setpoint of 24°C, which users may modify based on their needs. In Argentina, the city of Buenos Aires also has recommendations for AC set-points, depending on the season, ranging from 20°C in winter to 24°C in summer.

Annual electricity consumption for cooling a small apartment in Jakarta



Notes: Estimations are based on annual cooling needs for a 28 m^2 room, with standard insulation on walls and 3 m^2 of glazing. Models used for Inefficient and Efficient categories are ACs of 2 stars and 5 stars labels, with estimated cooling seasonal performance factor values of 3.6 and 5.2 respectively, using fixed indoor temperatures and variable outdoor temperatures.

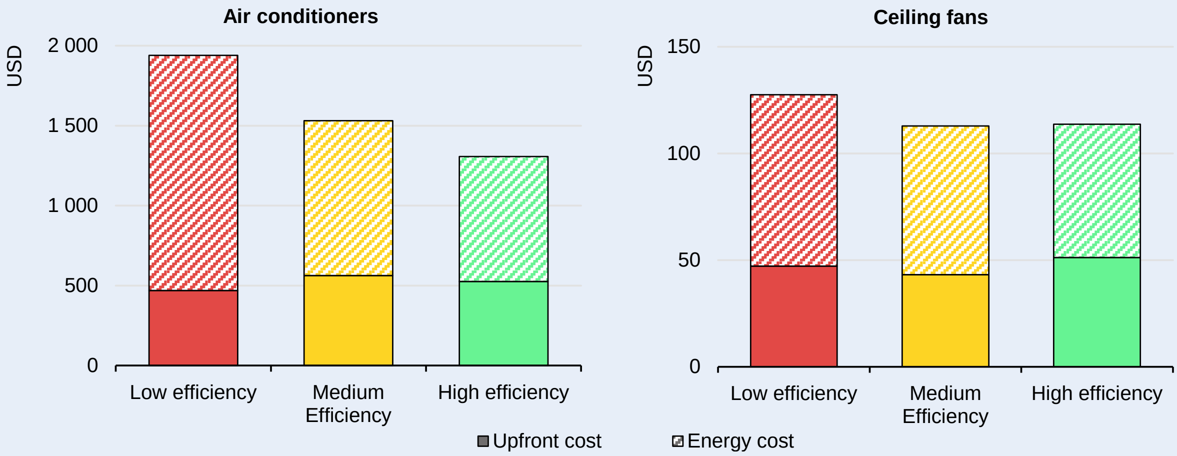
Appliances in the Age of Electricity: Smart technologies have enhanced the cost savings of efficient appliances

Energy efficiency and electricity demand are closely linked. This year's report therefore explores the role of energy efficiency in the Age of Electricity.

Because efficient technologies use less energy than inefficient models, and can often be purchased for a similar price, the cost benefits over their entire lifetime far outweigh those of inefficient models. Consumers purchasing efficient ACs are estimated to have saved up to 30% in energy costs this year, while paying similar upfront costs. In 2025, some countries have implemented new policies to promote efficient cooling appliances. For example, China has doubled the budget of its rebate program to trade in inefficient air conditioners for more efficient ones to nearly USD 42 billion in 2025.

Last year, the IEA reported that efficient air conditioners do not necessarily have to cost more than their less efficient counterparts. Based on market data, we showed that efficient models in Southeast Asia, Latin America and Africa can be purchased for roughly the same price as ones that are only half as efficient. New data for Brazil reinforce this finding and show that the business case for efficient ACs, for instance, is even more attractive than before. These cost savings have been enhanced by the progress in smart technologies, and several governments have rolled out policies to encourage the uptake of smart appliances. For example, the United Kingdom announced a standard for new appliances to be smart-ready. When an appliance's smart function is activated, it will respond to price signals and can then use energy when it is cheapest, such as overnight. And in China, new standards for refrigerators award a better energy label rating to appliances with demand-response functionalities.

Lifetime costs and efficiency ratings of appliances, Brazil, 2025



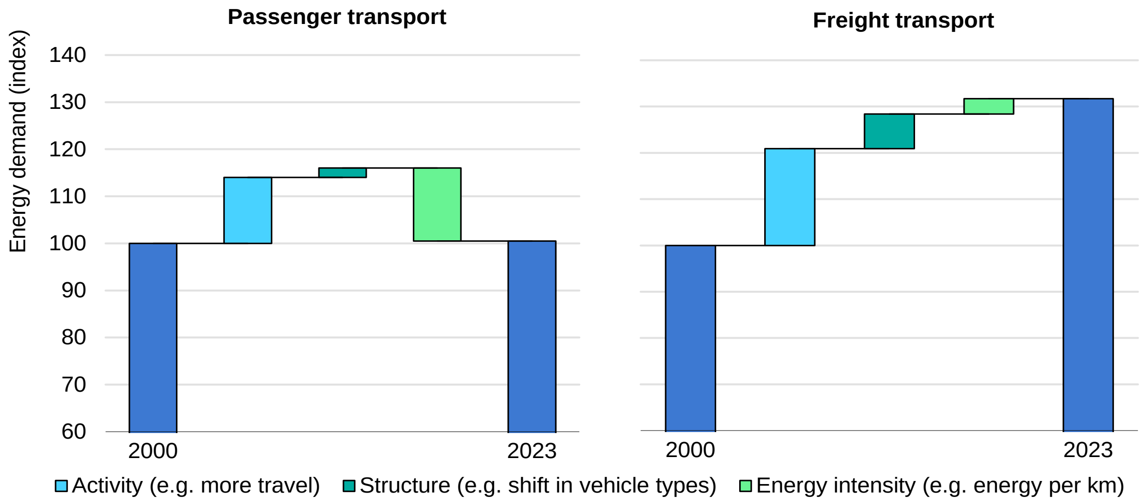
2.4 Transport

In IEA countries, efficiency progress since 2000 has offset travel growth in cars, but not in freight transport

Passenger transport energy demand in IEA countries is around the same level as twenty years ago. Growth in travel lifted demand by about 15% between 2000 and 2023, but efficiency improvements over the same period more than offset this growth, driven by stricter fuel economy standards and the wider adoption of electric vehicles. At the same time, there has been a shift towards larger sports utility vehicles, without which car fuel efficiency progress would have been 30% higher. Freight transport energy demand in IEA countries in 2023 was around 30% higher than in 2000, and the global average energy intensity of trucks has increased over the same period. With global freight demand expected to roughly double by 2050, improving freight efficiency is therefore important.

Some governments have implemented policies to improve truck efficiency in the past year. For example, heavy-duty vehicle fuel economy standards have improved freight efficiency in Canada, Japan and Europe. In 2025, China updated their truck standards, targeting an efficiency improvement of 15% compared to the existing standards. India also produced a draft update to their standards in 2025, targeting a 30% reduction in truck fuel consumption relative to the baseline for the period 2027-2032. Brazil, Chile, Colombia, Indonesia and Mexico are all at various stages of developing fuel economy standards for heavy-duty vehicles.

Transport energy demand decomposition, IEA countries, 2000-2023



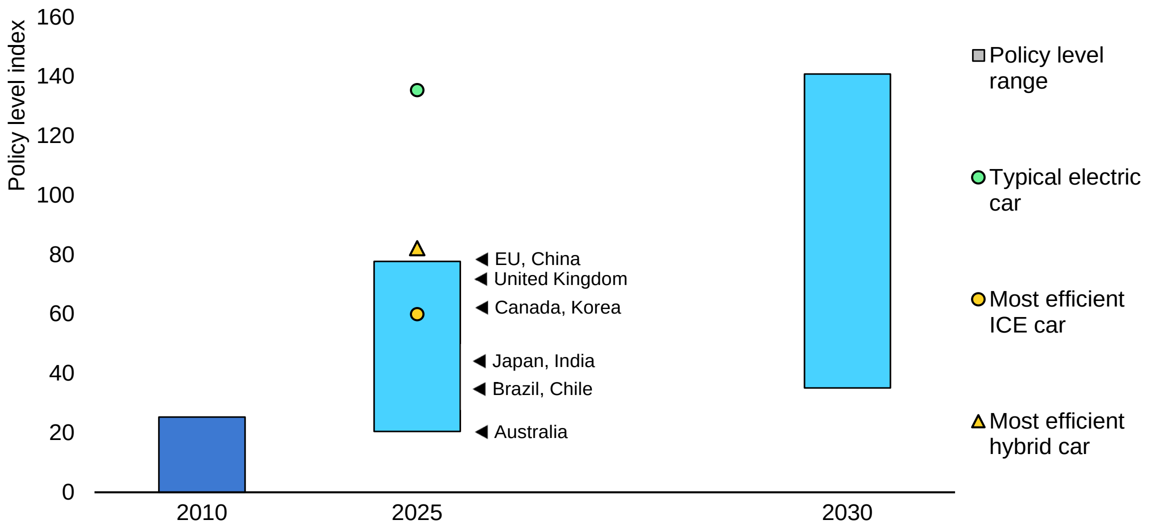
Notes: For countries without 2023 data, the 2023 values were estimated based on historic growth rates.
Source: IEA (2025) Energy End-uses and Efficiency Indicators database.

Fuel economy standards cover 80% of all new cars sold, but policy momentum has shifted in key regions in 2025

Several countries introduced new or updated fuel economy standards for light vehicles in 2025. Australia's light-duty New Vehicle Efficiency Standard came into effect, for example, and China announced a 10% more stringent limit to fuel intensity for light commercial vehicles, alongside reduced per-vehicle and corporate average limits for passenger cars. Adjustments to existing regulatory frameworks were also introduced in 2025. For instance, the European Union adopted a temporary measure to allow carmakers some extra flexibility to comply with the CO_2 emissions reductions, while the United States removed civil penalties for non-compliance with federal standards, and directed the re-evaluation of corporate average fuel economy standards. In India, the government is considering relaxing weight-based targets, which automakers argue disproportionally penalise small cars.

2025 also saw changes to tax policies that will impact the efficiency of cars. In France, weight-based taxation will be extended beyond conventional and hybrid vehicles to all battery electric vehicles starting mid-2026, disincentivising the sale of larger, less efficient vehicles. Italy is also proposing a differentiated vehicle tax structure, offering reduced rates for BEVs (10%) and plug-in hybrid electric vehicles (20%), while the rates for ICE models are higher (50%).

Fuel economy standards, passenger cars, IEA Efficiency Policy Level Index, global country range, 2010, 2025 and 2030



Notes: ICE = internal combustion engine. All fuel consumption is normalised to the worldwide harmonised light vehicles test procedure cycle in litres of gasoline equivalent (lge) and tank-to-wheel efficiencies according to ICCT methodology. Fuel economy standards for 2025 are in force, and 2030 values are those defined in current policies. Typical electric car: Tesla Model 3 RWD. The index is scaled from 0 = average efficiency of compact car in 1990 (7.5 lge/100km) to 100 = efficiency level of 3 lge/100km. It covers only usage phase efficiency and does not allow lifecycle assessment. Country sample represents 53% of global total final energy consumption.

Several cities accelerate efforts to promote more efficient last-mile solutions for online deliveries

The combination of e-commerce growth, rapid urbanisation, and changing consumer preferences is driving demand for delivery and return services. In Europe, for example, online purchases grew by 18% year-on-year in the second quarter of 2025. These changes have put pressure on traditional direct-to-consumer delivery which operates well in predictable, low-volume markets, but is not well designed for the emerging more frequent, varied and dispersed demand. The efficiency of existing domestic truck fleets is therefore greatly undermined by underutilised cargo space with 20-35% of truck kilometres driven empty in the United States and the European Union. If this issue is not addressed, some cities could see delivery vehicle numbers and associated emissions increase by 60%.

In response, hub-and-spoke or hybrid transport models are emerging, where goods are delivered by heavy-duty vehicles to a central location and then distributed by fleets of smaller vehicles, better integrating the increasing share of last mile deliveries. Higher population densities and demand mean that these models can now offer economies of scale and improved efficiency. In 2025, cities such as New York, Helsinki and Munich, among others, have piloted urban consolidation centres and micro hubs, paired with electric vans, cargo-bike fleets and pick-up and drop-off parcel lockers, greatly increasing efficiency, and reducing congestion and emissions in the process.

An additional advantage of hub-and-spoke models is that it can lead to faster electrification of the freight transport sector by reducing the need for heavy-duty trucks, while increasing the use of lighter commercial vehicles, which are easier to electrify. In the Netherlands, for example, battery electric models accounted for 9% of heavy-duty vehicle sales in 2025, while for light commercial vehicles, this share was 86%. From 2021 to 2024, the share of electric models in the total light commercial vehicle fleet has increased from 0.8% to 4.4% in the Netherlands. This has been driven by a subsidy for zero-emission commercial vehicles between 2021 and 2024, and other financial incentives in 2025.

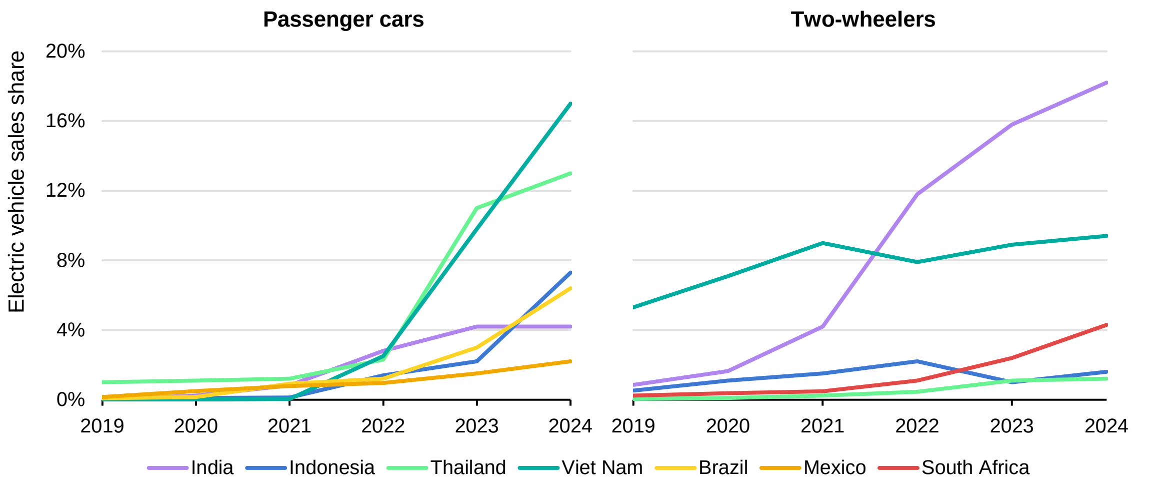
This trend can be further enabled with a mix of policies. From expanding low-emissions zones, introducing congestion charges and providing support for EV charging, to more targeted policies such as granting access to public spaces for parcel lockers, faster permitting of hubs and enabling smart kerbside management. The application of AI for demand prediction, inventory management and route optimisation can further accelerate the deployment of hub-and-spoke distribution models. This new model also offers more predictable routing for larger trucks and access to destination charging, which enables faster electrification and right-sizing, enabling even greater efficiency gains.

Transport efficiency progress in emerging economies was boosted in 2025 by growth in electric vehicles

Electric car sales continued to expand in the first half of 2025, reaching around a quarter of all new light-duty vehicles sold globally. China continues to drive this, but emerging markets in Asia and Latin America are becoming the new centres of growth, driven by lower battery costs combined with targeted policies (customs relief, local production) and incentives, with electric car sales rising by around 60% in 2024 and continuing to rise into 2025.

In Southeast Asia, Viet Nam (35%), Thailand (22%) and Indonesia (11.5%) posted strong electric car sales shares in the first half of 2025. These are set to grow further in the region due to recent investments in domestic EV assembly in Malaysia and Viet Nam. In India, EV sales shares have passed 4% in 2025, up from 2.6% in 2024. This is expected to increase as Indian car market leader, Maruti Suzuki, began production of its EV range and BYD India crossed the milestone of 10 000 cars sold. In Brazil, the largest car market in Latin America, EV sales shares passed 6%, thanks to falling EV prices, expanded model options, tax exemptions and the expectations of rising EV import taxes. Colombia (7.4%) and Mexico (2.2%) also show rising EV sales shares. Chinese automakers, due in part to competition and their overcapacity and dominance in battery manufacturing, are largely responsible for the rise in EV sales in emerging economies, making up 75% of the 2024 increase. Chinese brands have rapidly expanded in countries such as South Africa and Uruguay, supported by relatively low import tariffs and limited requirements for local production. From 2023 to 2024 the share of Chinese automakers in total EV imports rose from 1% to 81% in Egypt, 11% to 68% in Indonesia, 17% to 67% in Mexico, and 59% to 85% in Brazil.

Sales of electric vehicles, selected countries, 2019-2024



Source: IEA (2025), Global EV Data Explorer.

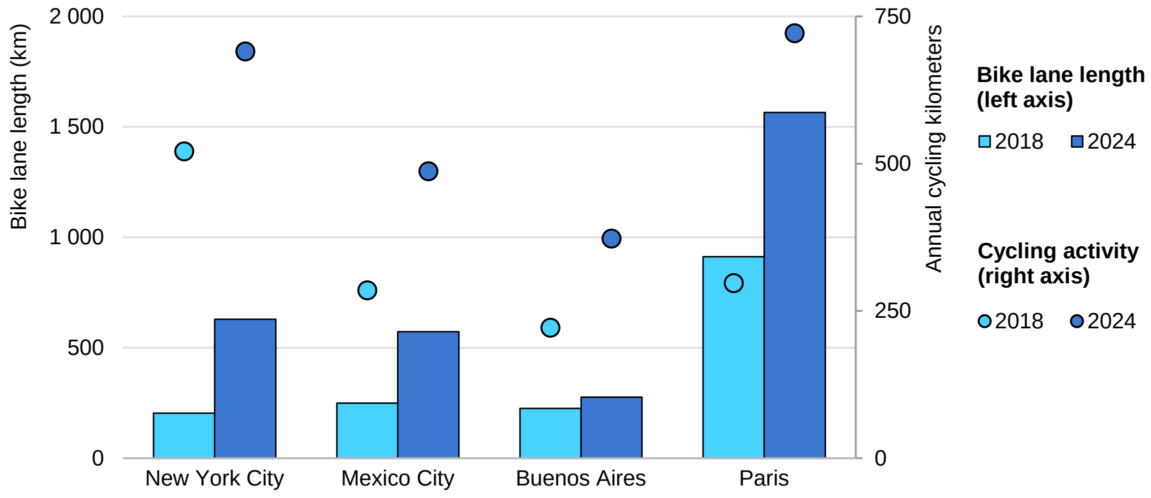
Cities are continuing to promote modal shift through improved infrastructure in 2025

Modal shift can be an important driver to improve efficiency in the transport sector. Cities around the world are promoting modal shift through improved infrastructure and encouraging the use of public transport. In 2025, Bangkok introduced a flat fare for its electric rail system, and Geneva temporarily made public transport free. This has been done before in Montpellier, where it was made permanently free, which led to an over 30% increase in public transport usage in 2023. This follows the earlier examples of Tallinn in 2013 and Luxembourg in 2020.

Expanding cycling infrastructure also represents an opportunity in many cities, given that a significant share of urban trips is short. In the United States, more than 50% of all trips are under 5 km, and trips under 16 km account for almost 40% of carbon emissions from vehicles globally. The construction of protected bicycle lanes can drive substantial increases in cycling activity. The Cycling Cities initiative, consisting of 34 cities globally, reported that the addition of 2 000 km of new cycling infrastructure in 2025 led to an estimated reduction of 877 million km of car travel.

In New York, doubling the length of dedicated bicycle lanes appears to have contributed to a doubling of distance travelled by bicycle. In cities in Latin America, East Africa and Southeast Asia, authorities have also accelerated the rollout of cycling infrastructure.

Bike lane length and annual cycling kilometres, selected cities, 2018-2024



Source: IEA analysis based on NYC Open Data, City Bike Operating Reports and cycling data for Mexico City, Buenos Aires and Paris.

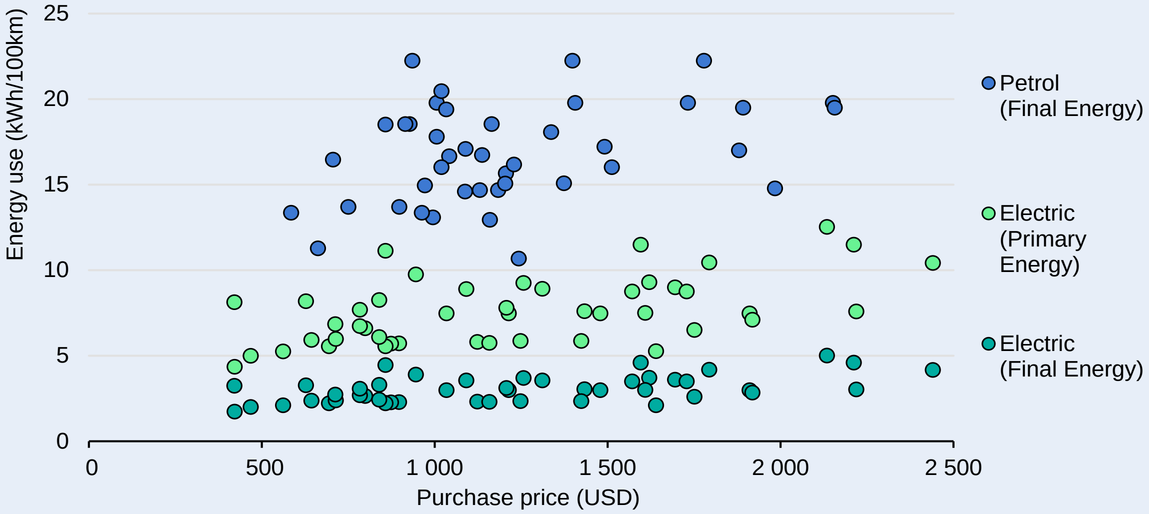
Transport in the Age of Electricity: Electric two-wheelers are now often cost-competitive with fossil fuel models

Energy efficiency and electricity demand are closely linked. This year's report therefore explores the role of energy efficiency in the Age of Electricity.

Electric two-wheelers are key for the shift to efficient transport, particularly in emerging economies. They are an affordable entry point into electric mobility, with roughly twice as many electric two- and three-wheelers as cars sold to date. A key advantage over cars is that they often do not require specialised charging infrastructure. Countries are trying to speed up their rollout. Rwanda’s capital, Kigali, for example, has banned the registration of petrol two-wheelers for public transport in 2025. In Viet Nam, Ho Chi Minh City and Hanoi are also planning to ban or limit the use of petrol two-wheelers, and incentivise the switch to electric ones. In India, Delhi is planning to ban the sales of petrol models from 2027, while currently offering rebates of USD 85 for new electric models.

Last year, we reported that the total cost of ownership of electric two-wheelers had become competitive with petrol models. New IEA analysis shows that electric models can now often be purchased at prices similar to or lower than those of petrol models in markets such as China, Indonesia and Viet Nam, some of the largest markets in the world. Electric models use around one-fifth of the final energy of petrol equivalents. An important price determinant for electric two-wheelers is the battery size. As battery costs fall, battery sizes are set to increase while prices remain competitive, increasing their utility and attractiveness.

Energy use and purchase price of common petrol and electric 2-wheeler models in China, India, Viet Nam and Indonesia



Notes: For electric models, energy use was estimated based on declared range and battery capacity. Primary energy includes electricity generation, transmission and distribution losses.

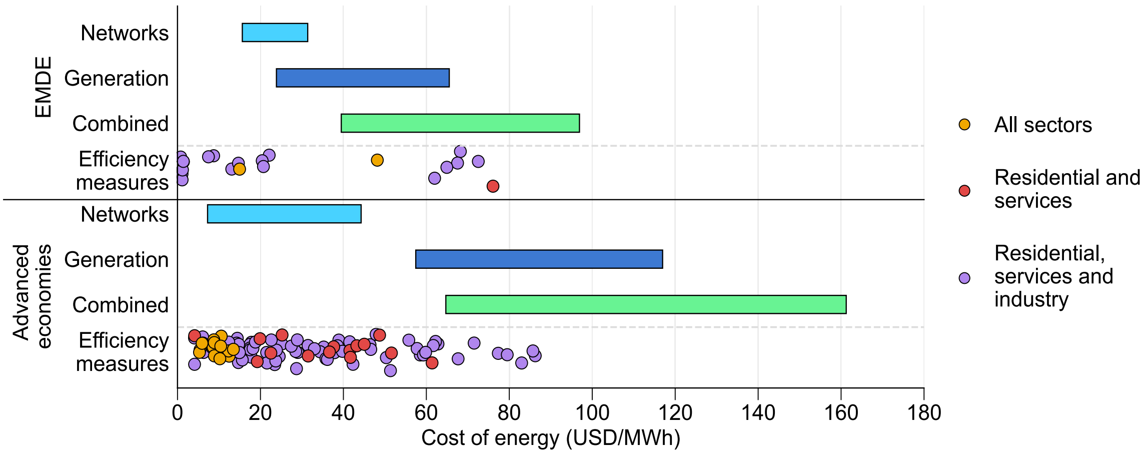
2.5 Power systems

At today's prices, efficiency is one of the cheapest and fastest ways to match electricity supply and demand

Global electricity demand is rising rapidly. According to IEA analysis, global electricity demand could be 25% higher in 2030 than in 2023, or up to 50% higher in some countries, such as India. Data centre demand, driven by the AI boom, will likely grow even faster, doubling between now and 2030 to around 945 TWh (equivalent to the 2024 electricity demand of Japan). This growth requires expanded investment in electricity infrastructure, such as grids, which was already around USD 1.5 trillion in 2025.

Energy efficiency can, in many cases, avoid the need for the same energy at a lower cost than new infrastructure. For example, Efficiency Vermont's obligation scheme, in its 25th year, will cost USD 56/MWh for electricity saved from 2024 to 2026, when average retail electricity prices in the USA are USD 131/MWh. The Brazilian Energy Efficiency Programme, also well into its second decade, delivered savings in 2024 at USD 49/MWh. To capture this, the California Public Utilities Commission moved in 2024 to using a Total System Benefit metric to include the systems benefits in efficiency goal-setting. Meanwhile, demand-side resources now participate in capacity markets in France, Italy and Japan, competing with new generation infrastructure.

Range of capital costs for future network and generation infrastructure (2030) versus historic efficiency programme costs (2010-2025)

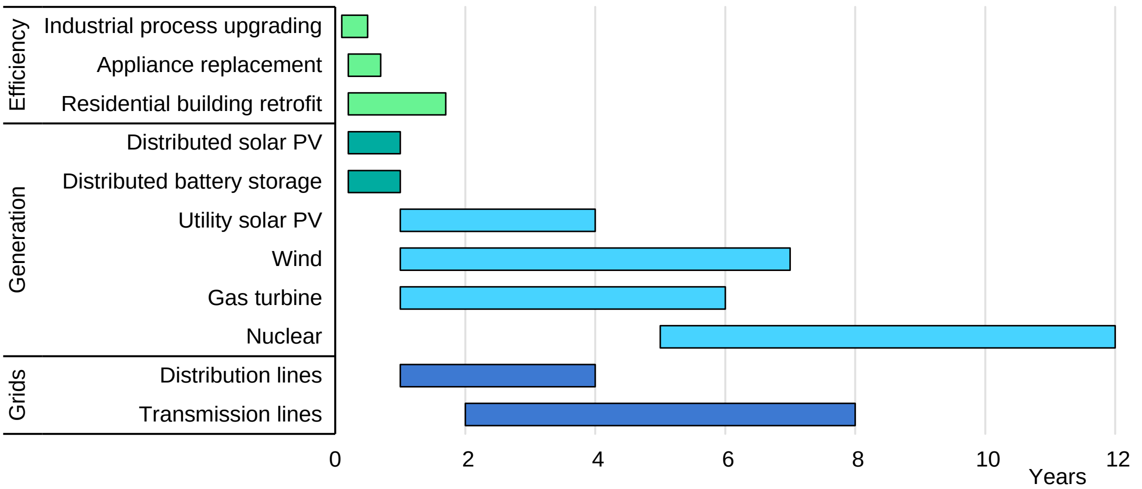


Notes: Combined refers to the sum of networks and generation. The figure shows the average of all generation types. Capital cost estimates for 2030 are based on IEA (2025) Multiple Benefits of Energy Efficiency, and will be sensitive to changes in the cost of capital. Efficiency costs are based on IEA analysis of different efficiency programmes. For programmes that do not include lifetime savings, a lifetime of 13 years and discount rate of 4% are used.

Efficiency measures can also be deployed relatively quickly. Whereas electricity supply infrastructure can take years to complete, efficiency measures can often be implemented in a matter of months. For example, in just three years (during its most recent phase), the French white certificate scheme targeted 826 TWh of cumulative electricity savings which, conservatively assuming a 25-year lifetime, avoids generation equivalent to 3 GW of firm capacity. On average, it would have taken much longer to build new generation installations with the same capacity. The programme allows flexibility in how energy is savings (technology-neutral), which is often one of the most cost-effective ways. Market-based policies can achieve long-term levels of savings equivalent to large electricity generation projects.

One example of a country that has deployed a combination of demand -and supply-side measures to address grid congestion is the Netherlands, which has been facing pressures on its electricity grids in recent years. Annual network tariffs doubled to around USD 600 per household from 2022 to 2025, and for small and medium-sized enterprises (SMEs) they increased by at least 40% as well. Grid connection times for new large consumers in the province of Noord-Holland (of which Amsterdam is a part) are at least ten years, holding back economic development. To address these issues, the National Action Programme for Grid Congestion has three main recommendations: “build faster”, “better use” and “smarter insight”. Off-peak grid tariffs up to 65% lower have enabled the network operator to allocate 9 GW of new demand. Through smart grid management, energy distributor Alliander was able to facilitate 9% more network capacity (and in some cases up to 30%), freeing up 213 MW of existing capacity.

Typical development time for selected efficiency measures and electrical infrastructure



Source: IEA (2025), Multiple benefits of Energy Efficiency.

In 2025, countries representing more than half of global energy use are promoting demand flexibility mechanisms

The use of different sources for electricity generation throughout the day means that, next to *how efficient* the equipment is, it also matters *when* electricity is used. To cope with challenges of growing electricity demand, decarbonisation, energy security and affordability, demand flexibility is increasingly being used to provide services to the grid, revenue to suppliers and other benefits to stakeholders.

There are a range of ways to encourage residential, commercial and industrial energy consumers to adjust the timing of their demand, usually by no more than a few hours. Depending on the available metering infrastructure or end-use technology, this shifting can be automated through network connected technologies or done manually. It is usually used to reduce demand in peak periods, when electricity prices are highest, which is most commonly during mid-morning and/or early evening. Signalling can also incentivise greater demand during high periods of cheaper and cleaner renewable output. This can help to balance supply and demand, defer network upgrade costs, integrate renewables and avoid expensive peak generation.

A growing number of countries around the world are recognising this growing value. In the last year, countries have advanced on a range of mechanisms to encourage flexibility in all sectors of demand:

- Colombia's transitional demand-response programme registered 0.6 GWh of shifted demand per day in October 2024.
- Germany now requires that all suppliers above 100,000 consumers must offer dynamic electricity tariffs to consumers with smart meters.
- India started a phased introduction of time-of-day tariffs for all large commercial and industrial consumers, with lower prices during high solar output hours.
- Malaysia introduced time-of-use electricity tariffs to cope with growing peak demand, while Mauritius announced plans to introduce them.
- In the Netherlands, the city is Utrecht is enabling EV owners to use dynamic tariffs at public charging points to reduce grid congestion and enhance flexibility.
- New Zealand is developing a flexibility framework, with regulatory changes to require connectivity and interoperability in MEPS and labelling.
- In South Africa, ESKOM will contract 1 GW of demand flexibility for the 2025 winter through a range of programmes.
- The United Kingdom's Demand Flexibility Service was expanded to year-round at the end of 2024, allowing consumers to help balance the system at peak stress periods through email or text alerts.
- The United States Federal Communications Commission ruled that utilities can send automated calls or texts about demand-response programmes.

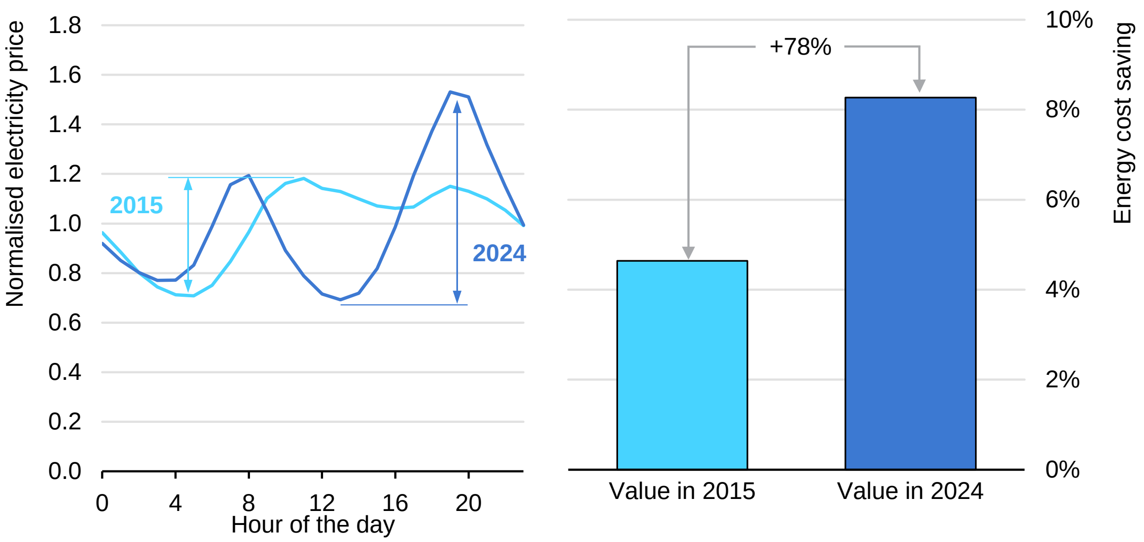
The value of flexibility has increased, with potential bill savings rising about 80% since 2015 in certain countries

The value of flexibility to system operators, utilities, consumers and policy makers, has increased in recent years. The main driver of this is variability in hourly electricity prices across the day, as shown by IEA analysis of electricity spot prices in 13 countries. Although consumers do not directly experience variations in spot prices, they indicate where dynamic tariffs could enable consumer bill savings through flexibility actions.

Since 2015 in these countries, volatility in electricity spot prices across the day has increased by more than 150%. This is driven by both gas price volatility, with EU prices 40% higher than before the 2022 energy crisis, and a greater share of generation from intermittent renewables, which grew by 10% in 2024, double the growth of the previous year. This has increased the potential bill savings for consumers by around 80%.

Looking beyond 2025, the potential of demand flexibility will likely increase. Renewables are already expected to meet 90% of electricity demand growth between now and 2027, and this could further increase the value of flexibility for all stakeholders involved.

Change in the value of demand shifting to consumers based on hourly electricity prices for 13 European countries, 2015-2024



Notes: The 13 countries are Austria, Belgium, Czechia, Finland, France, Hungary, the Netherlands, Norway, Poland, Romania, Slovakia, Spain and Sweden. Spot prices here are used as a proxy for dynamic tariffs, which track the time-varying nature of spot prices, which could be offered by suppliers to consumers.

Sources: IEA analysis using IEA (2025), Real-time electricity tracker and Octopus Energy for Business (2025) Shape Shifters demand shifting product.

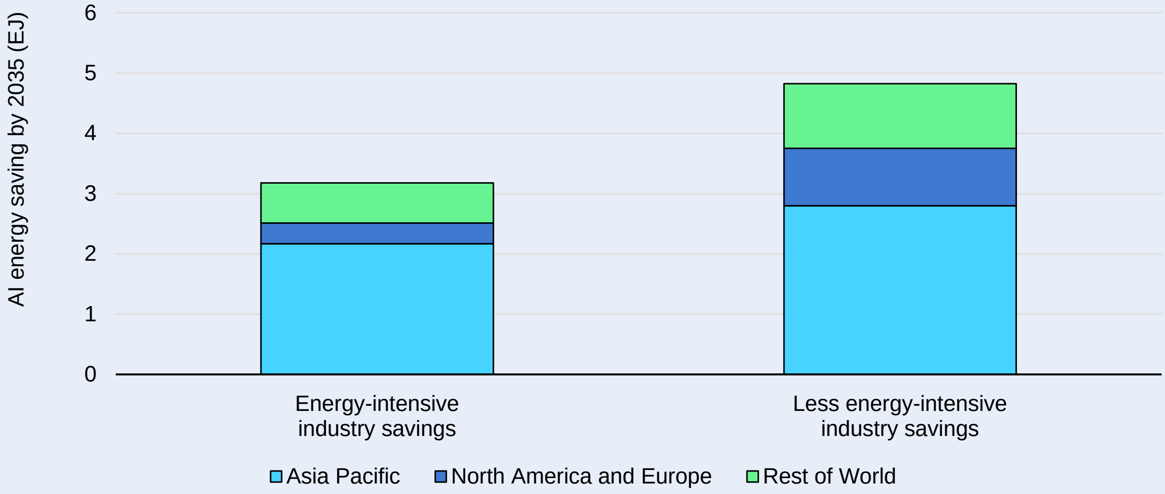
AI in the Age of Electricity: Energy for AI is set to double by 2030, but could be offset by AI-enabled energy savings

Energy efficiency and electricity demand are closely linked. This year's report therefore explores the role of energy efficiency in the Age of Electricity.

Energy is essential to AI, with the recent boom corresponding to a 12% year-on-year increase in data centre electricity demand since 2017. Although there is uncertainty on how this demand will develop, continued growth seems likely. Many countries have introduced mandatory and voluntary approaches to improving data centre efficiency. Despite this increased demand, AI also has the power to transform efficiency and flexibility of demand.

In industry, AI could reduce production costs through design improvements, operational optimisation and automation. The greatest saving potential comes from process optimisation. AI algorithms can detect inefficiencies or improve physical models of processes without requiring significant additional effort or investment. Digital infrastructure, access to a skilled workforce and a culture of trust can, however, be a barrier for some companies to unlock AI energy optimisation, particularly for SMEs. In energy-intensive industries, this could unlock around 2-6% savings, depending on the sector. The savings for less energy-intensive sectors are even higher due to greater scope for process optimisation. IEA analysis suggests that the widespread adoption of AI could unlock 8 EJ of energy savings by 2035, or approximately the industrial demand of the European Union today, well in excess of projected data centre demand.

Potential energy savings from widespread adoption of AI by world region and industry sector, 2035



Source: IEA analysis based on World Energy Outlook (2024) and Energy and AI (2025).

Chapter 3: Efficiency and global energy policy priorities

Energy efficiency plays an important role in global energy policy priorities, such as enhancing energy security, affordability and sustainability.

Without efficiency actions over the past 15 years, energy-related emissions would have been around 20% higher today. This can be observed at the sector level too. For example, emissions intensities from space heating in IEA countries are today on average one-fifth lower than ten years ago, partly driven by a rise in heat pump sales. Similarly, transport emissions in cities have decreased because of efficiency-related policies, and in 2025, cities in at least ten countries introduced new or updated low emission zones or congestion pricing.

Efficiency gains since 2000 have avoided the need for 20% more fossil fuel imports in IEA countries. New data shows, for example, that efficiency-related actions accounted for around two-thirds of the gas-demand savings in Europe during the energy crisis. In 2025, the role of energy efficiency in enhancing energy security was also a key element in national security plans and global discussions.

Countries representing nearly 40% of global energy use announced new or updated efficiency-related policies in 2025 to specifically address energy affordability issues. This is in part a response to the fact that in some countries, household energy expenditure is still up to 20% higher today than in 2019. Efficiency actions have reduced household energy bills in the past, leading to a reduction in bills in advanced economies up to 20% because of gains since 2000.

In a 2025 IEA survey on industrial competitiveness, a majority of firms has named energy efficiency as the first line of defence against price volatility. Efficiency can improve competitiveness, with industries today producing 20% more value with a given amount of energy as 20 years ago. However, companies still prioritise smaller efficiency actions over deeper system upgrades, despite these being able to generate higher energy savings, highlighting persistent barriers to investment and the need for policy action.

This role of energy efficiency in wider energy policy priorities was also recognised at the 10th Annual IEA Global Conference on Energy Efficiency in Brussels. Participating governments reaffirmed their commitment to stronger energy efficiency action and particularly highlighted its role as a key tool to address energy affordability, quality of life and industrial competitiveness.

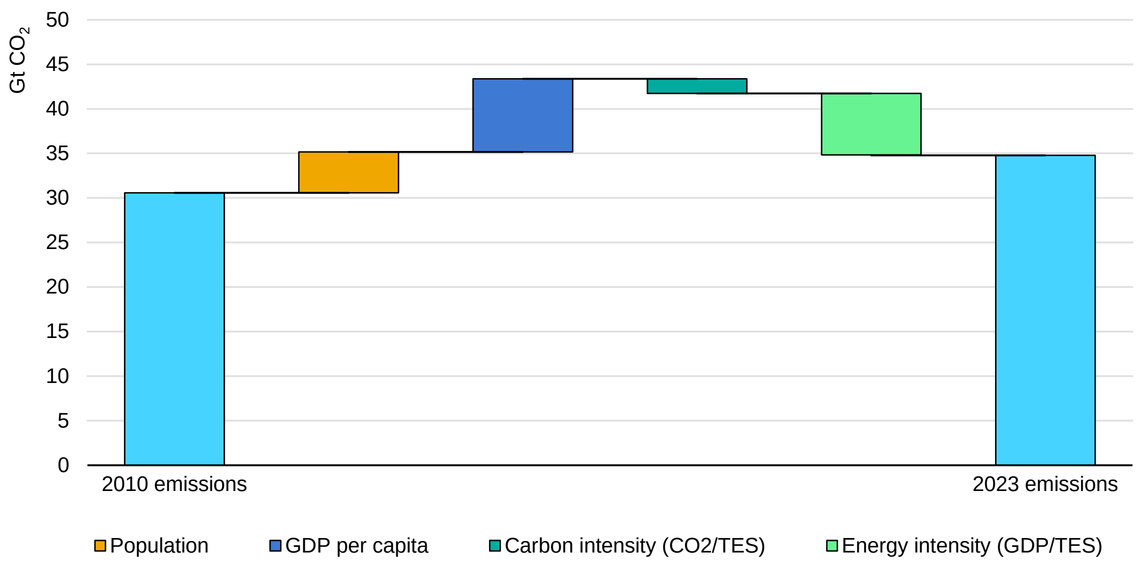
3.1 Emissions reductions

Energy efficiency actions in the past 15 years avoided emissions equivalent to over 20% of today's global total

Global energy-related CO_2 emissions increased by over 15% since 2010, driven by an increase in population and strong economic growth. Emissions in emerging markets and developing economies (EMDEs) went up around 37% during this period, driven by strong economic growth, with the average GDP per capita increasing by 46%. In advanced economies, emissions declined by around 17% between 2010 and 2024, while GDP per capita rose 20%. Emissions per capita are still twice as high in advanced economies as in EMDEs.

Energy efficiency measures have helped reduce global greenhouse gas emissions over the past decades. For example, as a result of energy efficiency improvements since 2010, global energy-related CO_2 emissions are nearly 7 Gt per year lower than they otherwise would be today, equal to around 20% of the global total. Accelerating energy efficiency improvements could deliver around one-third of all energy-related CO_2-emission reductions between now and 2030, the largest share of any sector or technology, in a pathway aligned with the COP28 target of doubling energy efficiency improvements.

Change in global CO_2 emissions from combustion activities, 2010-2023



Note: GDP = gross domestic product; TES = total energy supply. Decomposition analysis expresses the change in CO_2 emissions in four major indicators (carbon intensity, energy intensity, GDP per capita and population) using the logarithmic mean divisia index (LMDI) method.

Source: IEA (2024), Global Energy and Carbon Tracker.

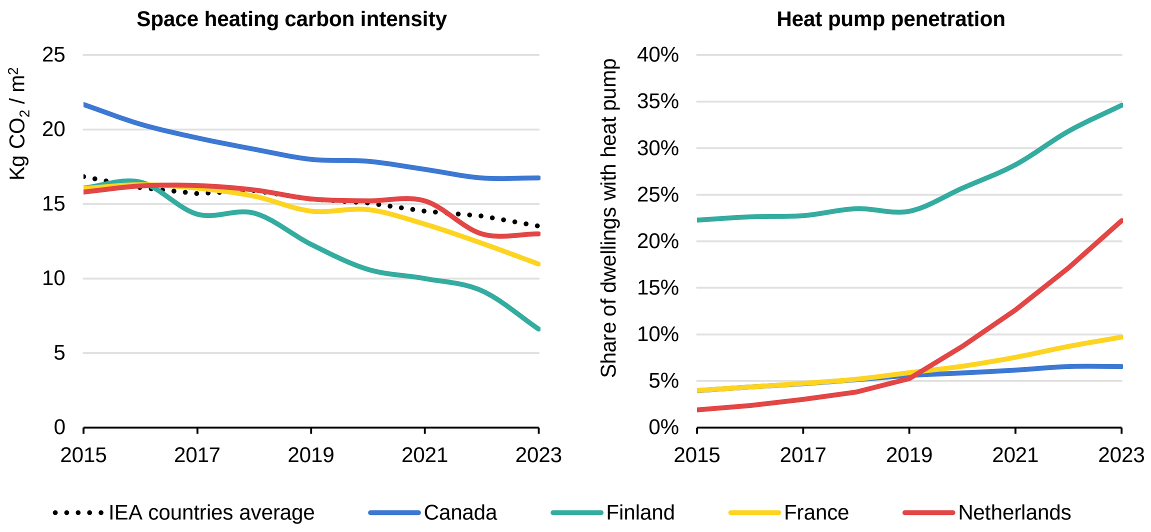
Emissions intensities from space heating are on average over 20% lower in IEA countries today than ten years ago

The carbon intensity of space heating in residential buildings, as measured by the amount of CO_2 emissions per square metre, is over 20% lower on average in IEA countries today compared to ten years ago. From 2015 to 2019, space heating became a little over 2% per year less carbon-intensive, and since 2019 this rate has increased to over 3% per year. Heat pumps and district heating are a key driver of space heating decarbonisation in residential buildings, and have seen a rising uptake. Between 2019 and 2024, global heat pump sales grew around 30%.

Several countries where the carbon intensity of space heating decreased have seen the share of heat pumps in the heating stock grow. In Finland, for example, space heating became 6% per year less carbon-intensive from 2015 to 2019, with annual growth in heat pump deployment of around 1% per year. When heat pump deployment growth accelerated to around 10% per year from 2019 to 2023, the carbon intensity of space heating decreased around 14% per year. District heating also accounts for a large share (around 45%) of heat energy supply in Finland.

In 2025, heat pump sales are growing further in several major heating markets. Estimated heat pump sales in Germany grew 55% year-on-year in the first half of 2025, surpassing gas boilers for the first time, and Belgium saw a growth of 16% year-on-year over the same six months. China also released a heat pump action plan this year, promoting the uptake of heat pumps. This includes a target to improve the efficiency of produced heat pumps by over 20% in 2030.

Carbon intensity for residential space heating (left) and heat pump penetration in residential buildings (right) in selected countries, 2015-2023



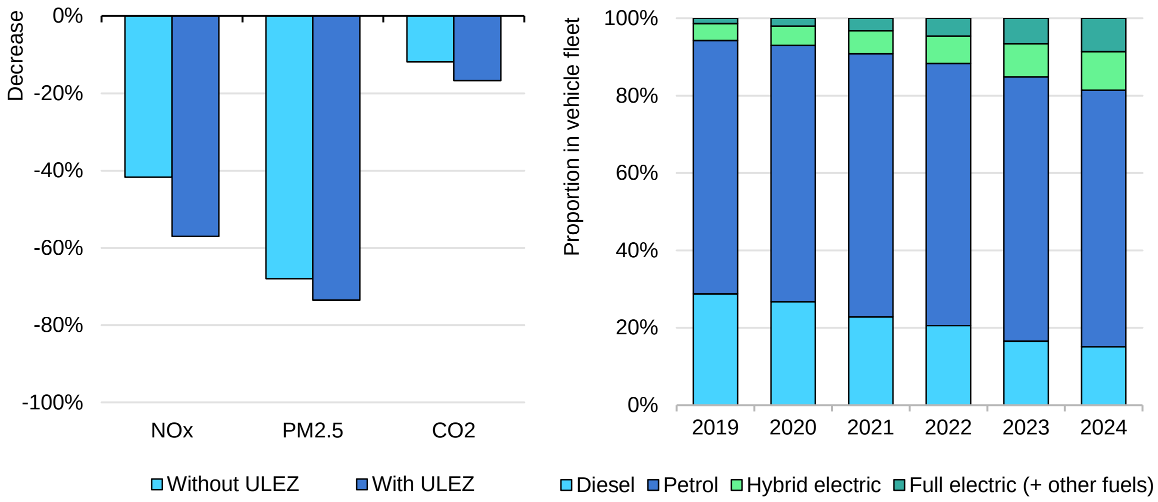
Sources: IEA (2025) Energy End-uses and Efficiency Indicators; Natural Resources Canada (2025); and Netherlands Central Bureau of Statistics (2025).

Cities in at least 10 countries introduced new or updated low emission zones or congestion pricing in 2025

Transport policies, such as low emission zones (LEZ) and congestion charging, disincentivise the use of older, more polluting and less efficient vehicles. Between 2019 and 2022, the number of low emission zones in Europe grew by 40% to over 320. Today, many large cities such as Beijing, Seoul, Singapore and Paris have low emission zones in place. In 2025, France strengthened its regulations earlier this year in many cities, and New York City became the first US city to implement a congestion charge. Vehicle emissions within the congestion zone decreased by 2.5% within the first six months. In India, several cities are preparing to establish low emission zones by 2026, a first in the country.

Low emission zones can be linked to a modal shift towards more efficient transport. The share of electric and hybrid cars in the total passenger vehicle fleet in London, for example, has increased from about 6% in 2019 to 19% in 2024, while the share of diesel cars halved from 29% to 15%. Similarly, in Madrid, the LEZ, which has been in place since 2018, is linked to a 28.5% reported decrease in car use and a rise in public transport use (+8.9%) and other active modes of transport (+8.2%). Furthermore, low emission zones can have positive distributional effects: for some of the most deprived communities living near London's busiest roads, there has been an estimated 80% reduction in people exposed to illegal levels of pollution. Similar results were found in Germany, with the lowest-income groups seeing the higher improvements in air quality.

Reduction in emissions (left) and vehicle fleet composition (right) in London in 2019-2024



Notes: ULEZ = Ultra-low emission zone. With ULEZ is based on measured data, while without ULEZ is estimated data. Vehicle kilometres include all road transport in London.

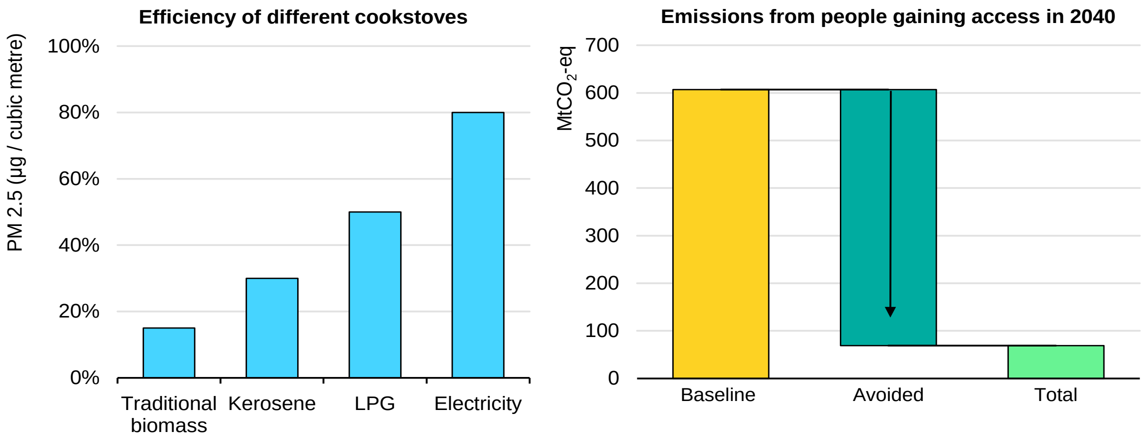
Sources: London municipality (2025), London-wide Ultra Low Emission Zone One Year report; Department for Transport (2025), Vehicle licensing statistics data tables.

Universal access to clean cooking in Africa could reduce cooking energy intensity by 80% between now and 2040

In households that lack access to clean cooking, air pollution is linked to around 3 million premature deaths a year globally. As outlined in the new IEA ACCESS Scenario, universal access to clean cooking could prevent up to 4.7 million premature deaths in sub-Saharan Africa by 2040 compared to today's trajectories. Clean cooking methods significantly boost cooking efficiency in sub-Saharan Africa. Traditional cooking methods are highly inefficient, typically wasting 85-95% of the input energy, while liquefied petroleum gas (LPG) and electric cookstoves are at least three to five times more efficient. By 2040, total energy demand for cooking in the IEA ACCESS Scenario falls by almost 75% compared to today, despite a population growth of nearly 50%. The adoption of modern cookstoves reduces per capita cooking energy intensity to 20% of today's level by 2040.

Since 2024, eight countries in Sub-Saharan Africa have launched new clean cooking strategies, and nine more have committed to do so by the end of 2025. For instance, Kenya increased the clean cooking access rate from 10% in 2013 to 32% in 2023 and launched a National Cooking Transition Strategy. The African Development Bank also announced funding for clean cooking in Rwanda, Tanzania and Uganda. In Southeast Asia, Indonesia promoted the shift from traditional biomass and kerosene to LPG stoves, and in recent years, introduced a programme to improve cooking efficiency, including by distributing electric rice cookers to low-income households. Meanwhile, Mexico also launched a new programme in 2025 to replace wood stoves with more efficient stoves.

Emissions and efficiency of cooking fuels (left) and emissions in 2040 from universal access to clean cooking in sub-Saharan Africa in the IEA ACCESS Scenario (right)



Notes: LPG = liquefied petroleum gas. Emission savings are based on the IEA ACCESS Scenario. For more details, see IEA (2025), Universal Access to Clean Cooking in Africa.

Sources: IEA (2025), Global Energy and Climate Model; Khavari, B., C. Ramirez, M. Jeuland et al. (2023), A geospatial approach to understanding clean cooking challenges in sub-Saharan Africa.

3.2 Energy security

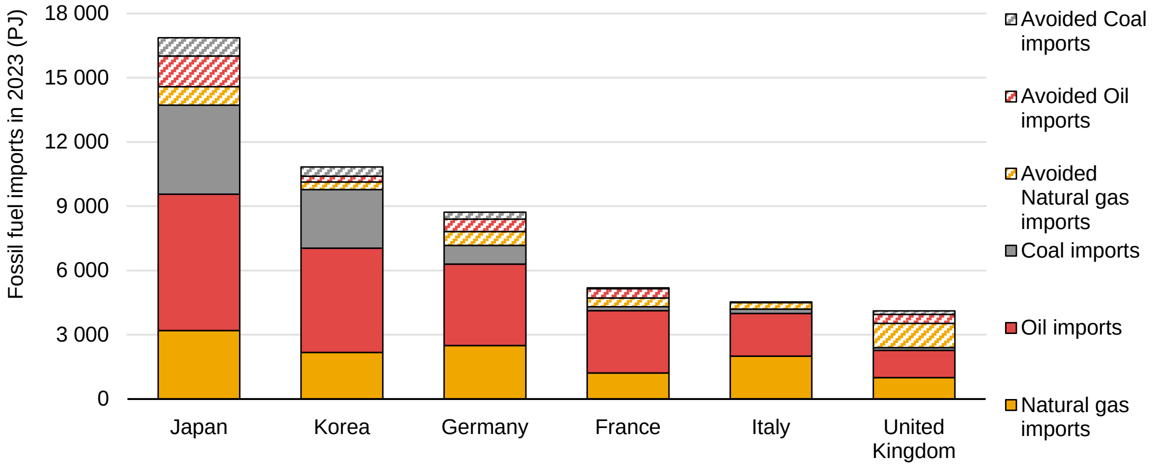
Since 2000, efficiency has reduced the need for fossil fuel imports by 20% among energy-importing countries

Long-lasting energy-efficiency policies have helped reduce consumption and imports of fossil fuels by up to 20% in major energy-importing countries across the world. Japan has reduced oil imports by 18% thanks to successful efficiency policies in the transport sector, such as the Top Runner Programme, first implemented in 1998. Meanwhile, the United Kingdom has cut in half the need for imported natural gas through efficiency progress in buildings and industry. This enhances energy security and has an important economic value. For example, the European Union spent nearly USD 410 billion on energy imports in 2024 alone.

In recent years, in part driven by heightened geopolitical uncertainties, several countries have turned to energy efficiency as a tool to contribute to enhancing energy security. For example, Türkiye's Energy Efficiency 2030 Strategy mentions energy security as a key objective, and the European Union's 2025 RePowerEU Roadmap also calls on efficiency to improve its energy independence.

In 2025, the IEA and the UK government hosted the Summit on the Future of Energy Security. The landmark event brought together decision makers from 60 governments and over 50 major energy companies and highlighted the importance of energy security and the need for a holistic approach to mitigate security risks, including demand-side measures.

Annual imports and annual avoided imports due to energy-efficiency progress in selected IEA countries, since 2000



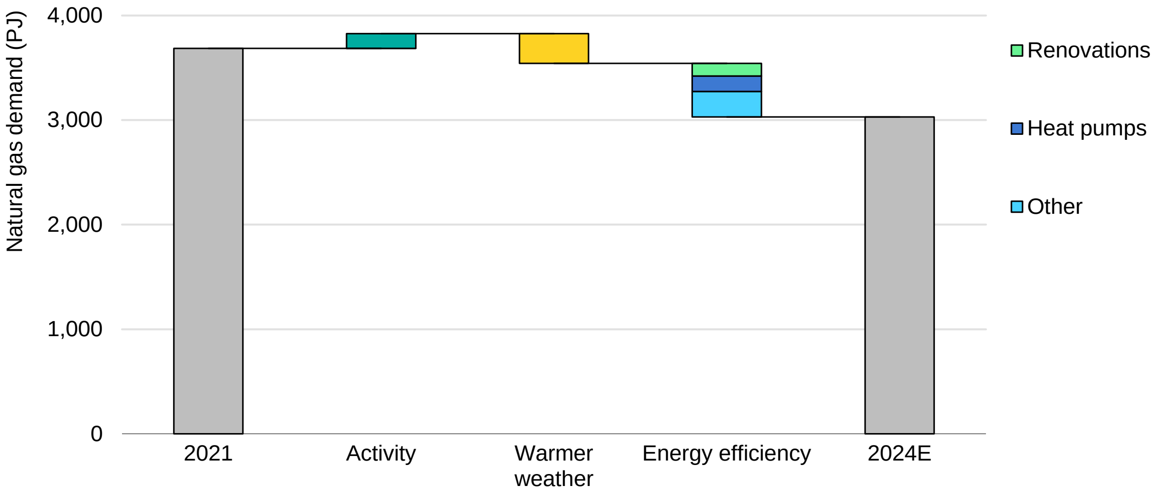
Notes: Estimation is based on energy demand decomposition analysis starting in 2000, disaggregating the activity, structural and intensity effect per demand sector (buildings, industry and transport). Savings associated with the intensity effect were assigned to the different fossil fuels based on the sectoral fuel mix and the electricity mix.

New data shows efficiency's role in reducing gas imports in the European Union after the 2022 energy crisis

The Russian Federation's full-scale invasion of Ukraine in February 2022 disrupted global energy markets, with gas markets in Europe experiencing a severe shock. In response to this, the European Union launched the REPowerEU Plan in May 2022 to reduce their dependence on Russian gas and increase energy security. Energy efficiency was a key pillar of this strategy, as highlighted in the IEA 10-Point Plan. For instance, member states agreed to implement Co-ordinated Demand Reduction Measures, to reduce gas demand by 15%. As a result of combined actions, and users' reaction to rising prices, annual natural gas demand in the European Union fell by around 13% in 2022. This allowed European countries to avoid major supply disruptions.

In the residential sector, the demand reduction has been sustained after the initial price shock. Residential natural gas demand was 18% lower in 2024 than in 2021. On the one hand, this was due to the positive impact of a warmer winter, reducing heating needs and contributing to about 35% of gas savings. On the other hand, most savings, reaching nearly 500 PJ, came from energy efficiency-related measures. Heat pump sales reached a peak of 2.8 million in 2022 and continued well above 2020 levels until 2024, with around 2.3 million sales. The uptake of building renovations had a similar impact, with many governments tripling their grants between 2021 and 2024. Other energy saving actions, such as turning thermostats down to a slightly lower temperature and adjusting boilers' settings, contributed further.

Decomposition of natural gas demand in the European Union's residential sector



Note: Activity reflects a growth in population and built area. "Other" includes other fuel switching (excluding electrification), behavioural change and longer-standing energy efficiency policies.
Source: IEA analysis based on Enerdata, IEA Weather for Energy Tracker and Eurostat.

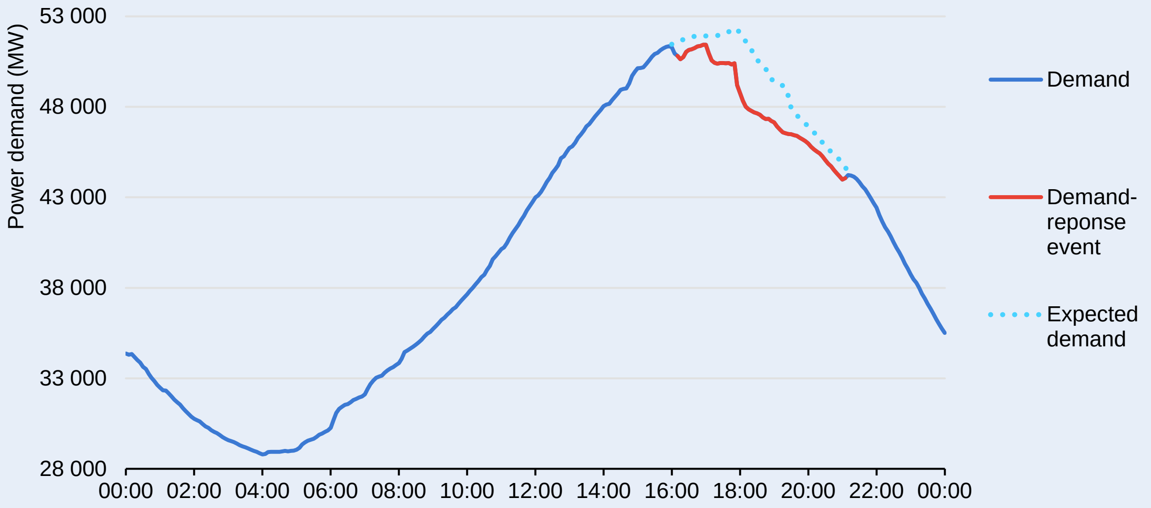
Energy security in the Age of Electricity: demand-response measures have helped prevent outages

Energy efficiency and electricity demand are closely linked. This year's report therefore explores the role of energy efficiency in the Age of Electricity.

Demand-side measures play an important role in strengthening electricity security by reducing overall energy demand and alleviating stress on power grids, particularly during supply constraints. Demand-response mechanisms, including load-shifting and peak-shaving, help stabilise the system and have been effective in preventing failures in the past years. For example, in 2022, California's grid was breaking demand records, as temperatures reached over 45°C, outpacing the forecasted demand. This led to an emergency alert, which caused utilities to implement temporary rolling outages. However, a simple text message asking residential users to conserve energy resulted in a quick 5% demand reduction, restoring operating reserves and avoiding both the need for rolling blackouts and any major grid disturbances.

The contribution from residential consumers continues to be driven by manual actions, showing the potential for automation via smart devices to maximise the impact. In 2025, the implementation of demand-response programmes and digitalisation continues to increase. Singapore mandated smart meters for all households by 2026, to enable demand-response measures. In Quebec, nearly 10% of residential clients participated in demand-response programmes during the heating season. Large-scale response programmes, such as South Africa's Power Alert updates, have effectively mobilised consumers during critical periods.

California demand-response event on 6 September 2022



Note: Expected demand was estimated based on hour-ahead and day-ahead demand forecasts.

Source: IEA analysis based on data from CAISO Outlook.

3.3 Affordability

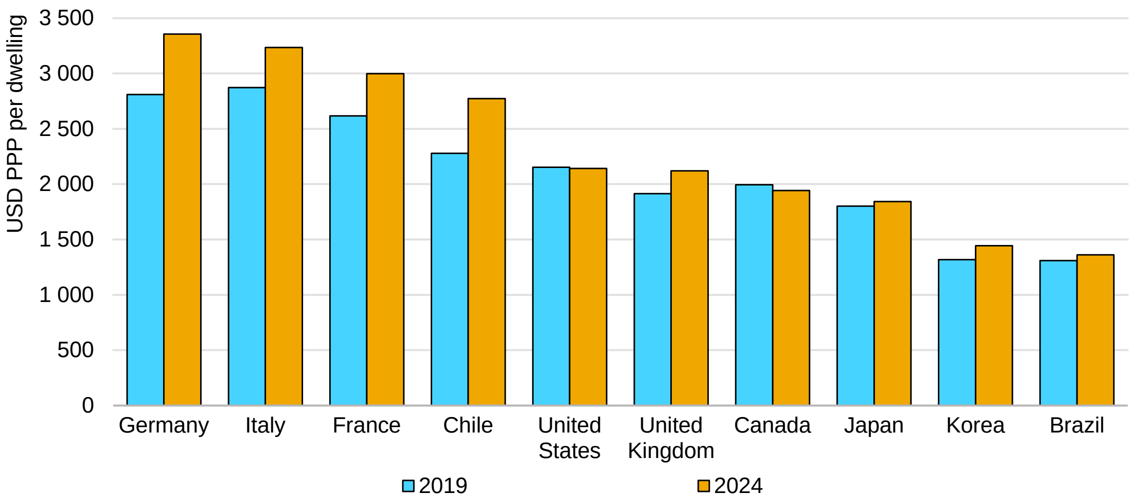
In several major economies, particularly in Europe, household energy bills remain above 2019 levels

Household energy costs remain above 2019 levels in several major economies, particularly in Europe. Compared to 2019, the average residential energy expenditure per dwelling in 2024 is nearly 20% higher in Germany, around 15% higher in Italy and France, and around 10% higher in the United Kingdom. In Canada, Japan and the United States, household energy costs are at roughly the same level as 5 years ago.

Rising prices have been the main driver in higher energy expenditure in recent years in these countries, while consumption patterns have remained relatively unchanged. Despite wholesale gas and electricity prices coming down in 2024 and 2025 from their record levels during the global energy crisis, consumer prices often remain higher than pre-crisis. In the first half of 2025, the OECD consumer price index for energy, which considers household energy and transport fuel bills, was on average still over 40% higher than in 2019.

Energy efficiency has been part of several policy interventions to improve energy affordability this year. For example, efficiency is a key pillar of the European Commission's 2025 Action Plan for Affordable Energy. Supported by the broader uptake of efficiency solutions, the plan is estimated to lead to savings up of up to USD 175 billion per year in 2030.

Residential energy expenditure per dwelling, by country/region, 2019-2024



Note: Expenditure is expressed in USD per dwelling at constant 2020 prices and purchasing power parity (PPP).
Sources: IEA analysis based on IEA (2025), Energy Prices, accessed October 2025; IEA (2025), Energy End-uses and Efficiency Indicators, accessed October 2025; IEA (2025), World Energy Balances, accessed October 2025.

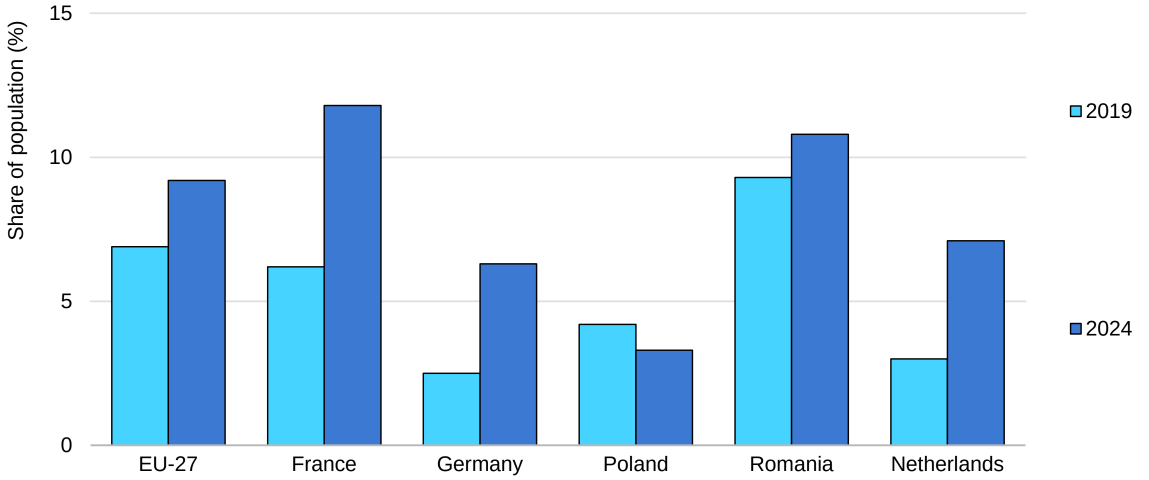
Energy affordability issues increased across Europe in the past 5 years because of the recent energy crisis

As a result of the 2022-2023 energy crisis, affordability issues have risen rapidly in many places across the European Union. This has driven many households into situations of energy poverty, whereby they are unable to use adequate amounts of energy to meet their needs. For example, the share of households that report being unable to keep their home adequately warm in winter, a possible indicator of energy poverty, rose from 6.9% to 9.2% on average.

In several EU countries, such as Germany and the Netherlands, the share of households unable to keep adequately warm in their homes has more than doubled in the past five years and has reached their highest levels since the beginning of this century. However, the definition of energy poverty is important to consider as it can lead to different conclusions about the situation in a country or region, depending on the underlying assumptions. For instance, Statistics Netherlands (CBS) defines energy poverty as households with a lower income that have high energy costs and/or live in a home of low energy quality. Based on this definition, the share of energy poor households in the Netherlands has decreased between 2019 and 2024 from around 8.6% to around 6.1%.

Similarly, a recent study shows that depending the indicators used, the share of the population facing energy poverty in the European Union can range from 8% to 16%.This highlights that considering various indicators, such as households' ability to afford basic energy needs or the share of disposable income spent on energy, is important to gain a fuller understanding of the energy poverty situation in a country.

Reported inability to keep homes adequately warm, European Union, 2019-2024



Source: EU Energy Poverty Hub (2025).

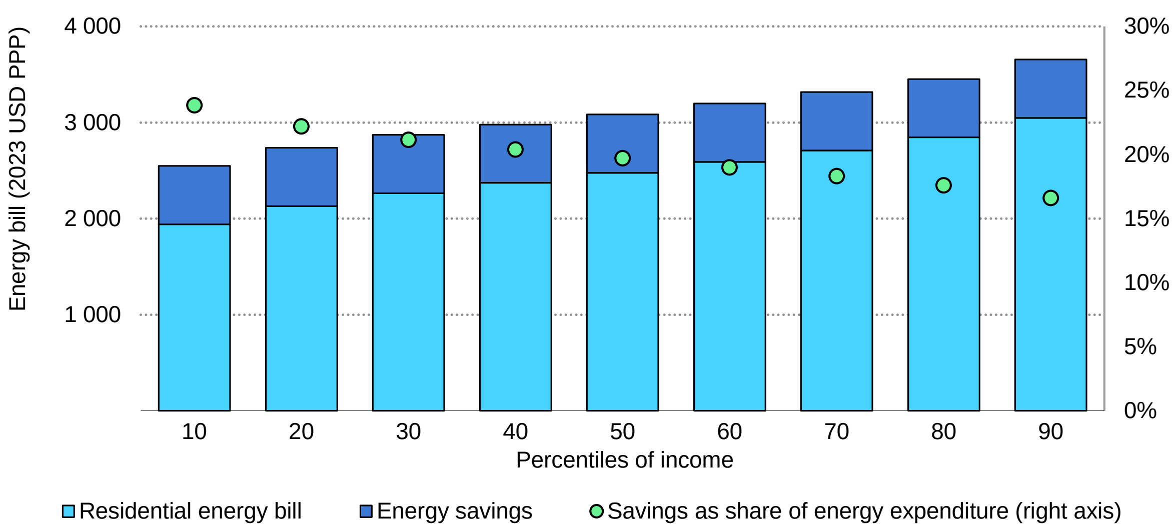
Energy bills would be 20% higher in advanced economies were it not for efficiency actions of the past two decades

Over the last 25 years, energy efficiency measures have structurally lowered household energy bills by up to 20% compared to what they would have been without these measures in advanced economies. These effects are more pronounced (up to 25%) in lower-income households, which spend a larger share of their income on energy. In upper-income groups, which tend to use more energy but also live in better quality housing, savings represented around 15% of their total energy bill.

For many appliances, highly efficient models use less than half of the energy of low-efficiency models, making the operating costs lower. IEA analysis shows that just half of the people in sub-Saharan Africa can afford the energy costs of key appliances if these are low-efficiency models, while 80% could afford them if they had access to the most efficient models. Lowering the upfront costs of those appliances can unlock long-term savings for households, especially those who can afford them least, and bring additional benefits, such as indoor comfort.

In 2024, G7 countries spent approximately USD 14 billion to make energy-efficiency measures more affordable to consumers. Many of these programmes remain in place in 2025, with additional initiatives launched in Canada and the United Kingdom. Efficiency measures in G7 countries, such as the installation of new heating systems and better insulation, have led to energy bill savings per household of between USD 240 and USD 950 per year.

Average annual household savings on energy bills due to efficiency gains since 2000 and share of household income saved, by income decile, advanced economies



Source: IEA (2025), Energy End-uses and Efficiency Indicators and Energy Prices.

In 2025, countries representing 38% of global energy use put in place efficiency policies to address affordability

Government spending on short-term, untargeted energy bill support, which many countries implemented during the global energy crisis, has fallen from over USD 500 billion in 2022 to about USD 9 billion in 2025. Instead, some governments have turned to efficiency to lower bills, and are specifically targeting lower-income households, who face the most affordability issues. In 2025, over 11 countries introduced efficiency policies to help those most affected by affordability issues.

New or updated energy efficiency policies in 2025 specifically addressing affordability

Country	Policy
Australia	The USD 800 million Social Housing Energy Performance Initiative funds energy performance upgrades for more than 100 000 social housing units until 2029, including thermal upgrades and efficient electric appliances.
Canada	The Canada Greener Homes Affordability Program provides USD 584 million in 2025-30 to deliver fully funded energy retrofits for low- to median-income households, including renters with landlord consent.
Chile	The My Warmth, My Home programme finances efficiency upgrades, with a pilot of 100 social houses, and it prioritises vulnerable households.
China	The Trade-in Programme was expanded in 2025. It allows consumers to replace inefficient appliances with more efficient models. It could generate savings of up to USD 943 million on household cooling bills in 2025.
European Union	The Affordable Energy Action Plan sets out measures to reduce energy costs and support vulnerable, low-income households. It provides financial support for efficiency and other measures to protect consumers.
Germany	The Federal Funding for Energy-Efficient Buildings programme provides financial incentives for retrofits and efficient new buildings based on income, with an extra interest-rate reduction for the lowest-income groups.
Greece	The Save 2025 programme supports energy-vulnerable households with USD 400 million for residential energy upgrades. Beneficiaries can receive 50-100% of their investment costs for home efficiency upgrades.
Malaysia	The CKD Motorcycle Use Promotion Scheme provides a USD 570 subsidy for electric motorcycles, with USD 2.3 million available in 2025. Other measures include tax reductions for home EV charging and EV rentals.
Mexico	The Efficient Wood Stoves for Wellbeing programme promotes replacing traditional biomass stoves with efficient, eco-friendly stoves in over 1 million rural homes, focusing on Indigenous and vulnerable communities.
Portugal	The USD 100 million E-Lar and Sustainable Neighbourhoods programme targets efficiency and thermal comfort in homes, particularly for vulnerable households, through replacement of inefficient appliances and retrofits.
United Kingdom	The UK Warmer Homes Plan directs USD 17.4 billion over 5 years to cut energy bills through insulation and clean heating systems, with a focus on low-income households, with USD 2.3 billion allocated to local authorities.

3.4 Competitiveness

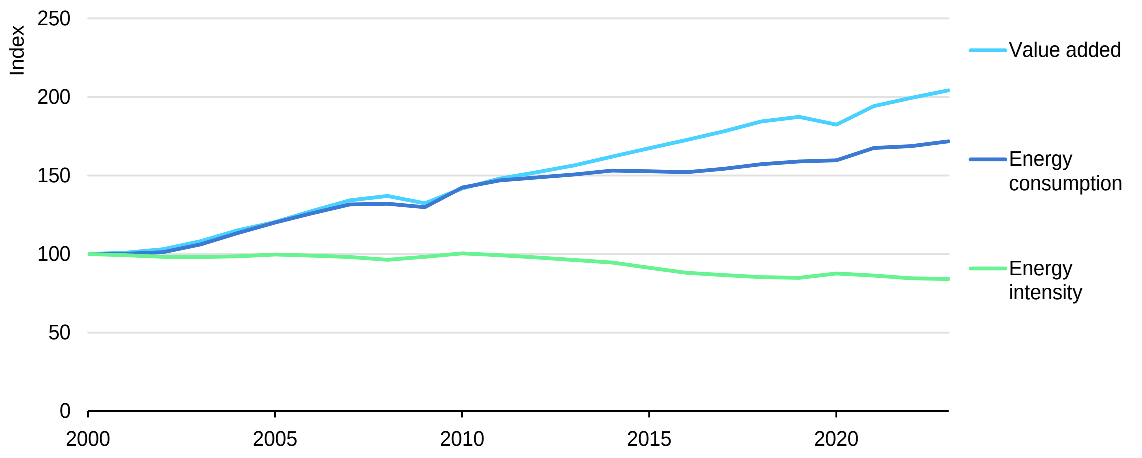
In 2025, industry is producing 20% more value with a given amount of energy than two decades ago

Energy costs have become a key challenge for competitiveness and operational stability, but efficiency is offering solutions, as highlighted in the 2025 IEA report on The Role of Energy Efficiency in Enhancing Competitiveness. Globally, industrial energy intensity has improved by just under 1% annually since 2000, allowing the global industrial sector to produce 20% more value per unit of energy than in 2000.

Part of this is driven by shifts in the structure of the global industrial sector between different sub-sectors and countries, but another part is due to energy efficiency improvements. In the European Union, for example, the manufacturing sector now generates 50% more value while using 25% less energy compared to two decades ago. Around 40% was driven by changes to the structure of the industrial sector, and 60% was driven by efficiency improvements.

New policies seek to accelerate this momentum. In 2025, the European Union launched the Clean Industrial Deal, committing over USD 115 billon with a focus on energy-intensive industries. It also released its 2028-2034 EU budget, which aims to further accelerate competitiveness in clean technology manufacturing. Canada's Green Industrial Facilities and Manufacturing Program also released a new round to co-fund industrial retrofits, audits and other energy efficiency solutions.

Global industry sector energy intensity changes, 2000-2023



Source: IEA (2025), Energy Efficiency Progress Tracker (accessed October 2025).

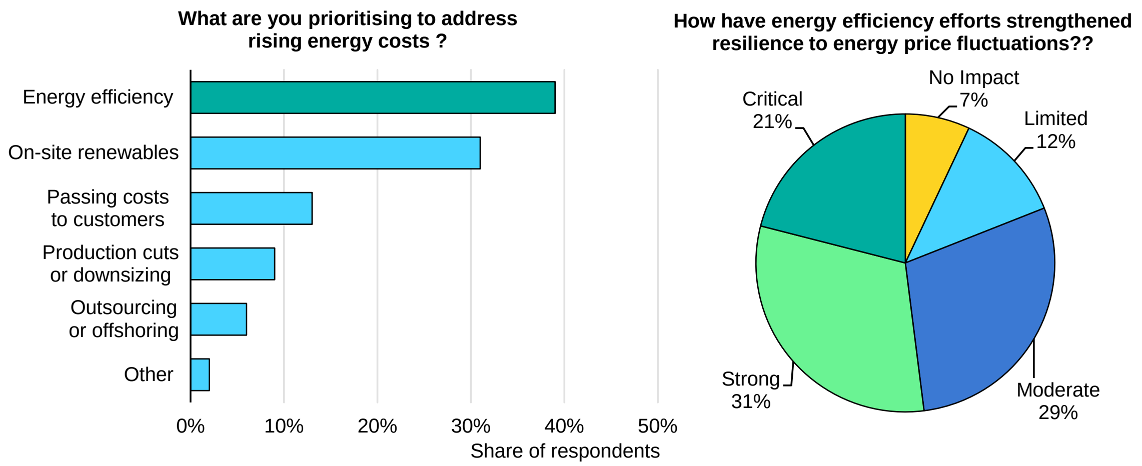
Firms report efficiency as the first line of defence against price volatility and cost resilience

Energy is an important component of production costs in many industrial sectors. Geopolitical tensions and trade pressures in 2025 have increased gas and electricity prices in many regions and have also increased price volatility, which has put pressure on industrial output. Differences in prices between regions also mean that there are sometimes cost disparities in the same industrial category. Energy costs can represent up to 35% of the value of total sales in food manufacturing, around 20% in textiles and 25% in the non-metallic manufacturing sector, for instance.

There are also differences in energy intensity levels within the same industrial sectors across IEA countries. For example, the most efficient cement facilities are around 50% less energy-intensive than the least efficient facilities. Energy efficiency achieved through energy management systems by implementing ISO 50001 can cut energy use by around 11% with annual savings of up to 60% achievable over time.

According to an IEA survey of 1 000 firms across 14 countries, 39% of industry leaders prioritised energy efficiency as a key response to escalating energy costs, while 52% of all respondents reported experiencing significant resilience benefits from energy efficiency, including enhanced operational continuity and equipment reliability. Among large enterprises, with over 500 employees or annual turnover exceeding USD 1 billion, even higher impacts were reported.

IEA Survey results on industrial competitiveness, 2025



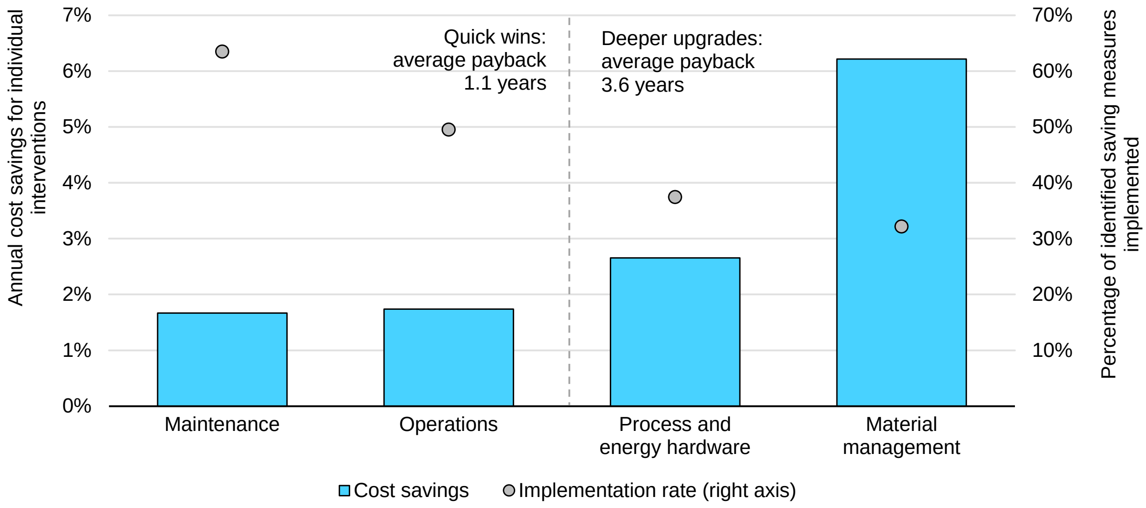
Source: IEA (2025) Industrial competitiveness survey, with sample of 1 000 respondents in 14 countries.

Firms prioritise efficiency actions with short payback periods instead of deeper upgrades with higher savings

The IEA Industrial Competitiveness survey results suggest that acceptable payback periods for energy efficiency investments vary depending on the sector and company size. In the chemical industry, for instance, firms reported a maximum acceptable payback period for efficiency measures of around 2 years, while textile companies reported average thresholds of below 1.5 years. Company size also influences investment criteria. Firms with under 100 employees reported an average acceptable payback period of less than 21 months, compared to over 28 months for large firms, reflecting the impact of financial capacity, investment horizons and risk profiles across the industrial landscape.

Recent IEA analysis of [55 000 industrial energy efficiency measures] in the United States finds that quick wins for energy efficiency that cost little to no money, such as optimising maintenance or operations, yielded average annual cost savings of around 2%. Deeper upgrades, on the other hand, such as material management or upgrading process hardware, achieved cost savings of up to 5% per year, with payback periods of around 3.5 years. Due to the shorter payback periods, a greater proportion of quick wins were implemented (around 60% of all identified measures), compared to just 33% of deeper upgrade measures, despite the latter offering higher potential savings.

Payback period, savings, and implementation of 55 000 efficiency measures grouped into 67 actions and technologies, United States, 2002-2024



Note: Examples of each category include boiler cleaning for maintenance, compressor pressure optimisation for operations, equipment automation for process and energy hardware, and closed-cycle water use for material management.
Source: IEA analysis based on Industrial Assessment Centers (2002-2024), IAC Database.

Annex

Abbreviations and acronyms

AC	Air conditioner
CAGR	Compound annual growth rate
CDD	Cooling degree days
CO_2	Carbon dioxide
EMDEs	Emerging markets and developing economies
ESCO	Energy service company
ETS	Emissions trading scheme
EV	Electric vehicle
GDP	Gross domestic product
HVAC	Heating, ventilation, and air conditioning
LEZ	Low emission zone
LPG	Liquefied petroleum gas
MEPS	Minimum energy performance standards
MER	Market exchange rate
NDC	Nationally determined contribution
PPP	Purchasing power parity
RD&D	Research, development and deployment
SEER	Seasonal energy efficiency ratio
SME	Small and medium-sized enterprise
TES	Total energy supply
TFC	Total final consumption
VSD	Variable speed drive

Units of measure

EJ	exajoule
Gt	gigatonne
Gt/yr	gigatonnes per year
Gt CO_2	gigatonnes of carbon dioxide
GWh	gigawatt hour
kW	kilowatt
mb/d	million barrels per day
MBtu	million British Thermal unit
Mt	million tonnes
Mtoe	million tonnes of oil equivalent
MW	megawatt
MWh	megawatt hour
PJ	petajoule
t CO_2-eq	tonne of carbon dioxide equivalent

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