CHAPTER 4
ENERGY EFFICIENCY

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Main messages

- **Global trends.** Primary energy intensity, defined as the ratio of total energy supply to gross domestic product (GDP), is the main global indicator for energy efficiency. In 2023, global energy intensity reached 3.76 megajoules per US dollar (MJ/USD[24]), but the annual improvement rate slowed to 1.5 percent—down from a stronger 2.4 percent in 2022. This slower global pace masks strong gains in some countries and regions (e.g., the European Union, the United States, Republic of Korea, Türkiye, and the United Kingdom), where strong policy action, increased investments, and shifts in consumer behavior drove improvements well above the average global rate.
- **2030 target.** Despite significant global policy action, energy intensity improvements continue to fall short of the United Nations' Sustainable Development Goal (SDG) target 7.3, which calls for the global rate of energy intensity improvement to double by 2030 relative to the 1990–2010 average. Given the pace of recent years, energy intensity now needs to improve at about 4.2 percent a year on average between 2024 and 2030 to reach target 7.3.
- **Regional highlights.** Energy intensity varied notably across major economies in 2023, reflecting differences in economic structure, efficiency levels, and climate. Between 2010 and 2023, no major region achieved the 2.6 percent annual improvement rate set by SDG 7.3.[25] Northern America and Europe came closest at 2.3 percent, followed by Oceania at 2.2 percent. Eastern and South-eastern Asia remained around 2 percent, while Central and Southern Asia posted the strongest GDP growth and improved primary energy intensity at roughly the global average in 2023.
- **Trends in the 20 countries with the largest total energy supply.** From 2010 to 2023, energy intensity improved rapidly (relative to 1990–2010) in 15 of these 20 countries. Still, only six met the 2.6 percent annual reduction in energy intensity required by SDG 7.3. The United Kingdom recorded the highest average annual improvement, with a reduction of 4 percent in energy intensity.
- **End-use trends.** Progress in energy intensity across all end-use sectors accelerated in 2010–23 relative to 2000–10, though the industrial sector slipped back in 2023. The buildings sector improved steadily at an average annual rate of 1.4 percent over 2010–23. Passenger vehicles' annual progress rate rose from 0.7 to 1.6 percent, while heavy-duty trucks saw a smaller change, from 0.4 to 0.5 percent.
- **Electricity generation trends.** Between 2010 and 2023, the efficiency of fossil-fuel generation increased by around 4 percent, while overall power generation efficiency rose by 11 percent, driven largely by the growing share of renewables in the electricity mix. Average electricity generation efficiency increased to around 47 percent over the same period, an improvement compared to the more modest increase from 40 to 42 percent observed in 1990–2010.

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24 Based on 2021 purchasing power parity (PPP) rates.

25 When target 7.3 and indicator 7.3.1 were defined, the annual average rate of global energy intensity reduction stood at 1.3 percent for the baseline period of 1990–2010. Based on this figure, the target of doubling this average was set at 2.6 percent per year. Due to data revisions, the baseline annual improvement stands at 1.2 percent, but to avoid variations in the numerical target, the custodians of this indicator—IEA and the United Nations Statistics Division—decided to keep the target fixed at 2.6 percent.

Are we on track?

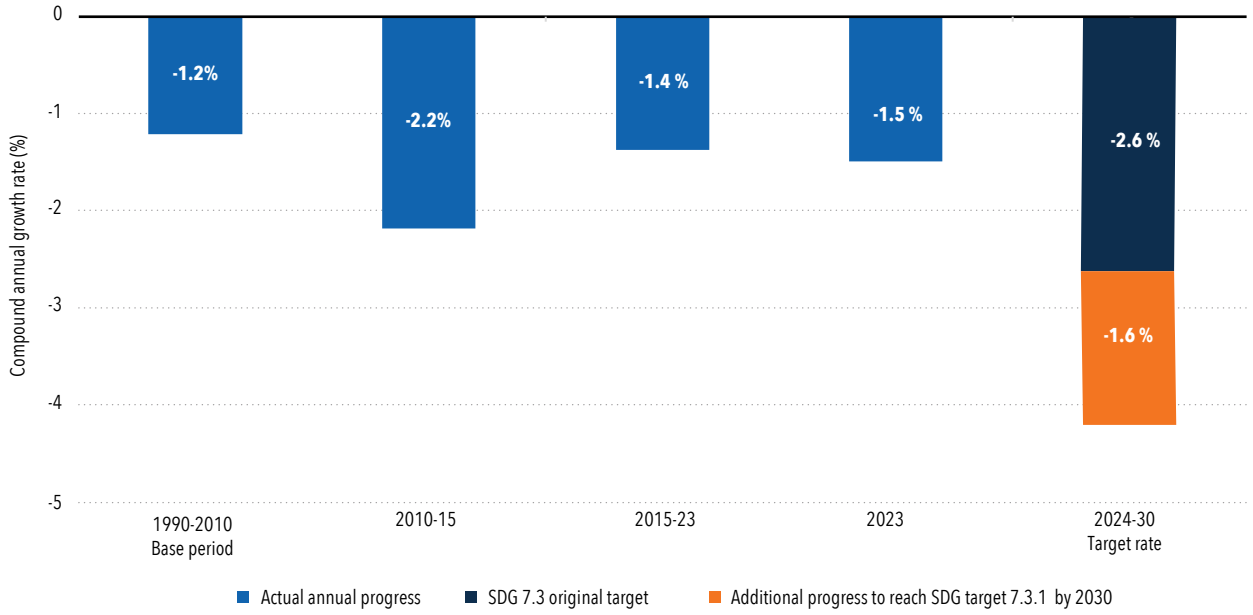
SDG 7 commits to ensuring universal access to affordable, reliable, sustainable, and modern energy. Target 7.3 calls for a doubling of the global rate of energy intensity improvement relative to the 1990–2010 average.

Energy intensity is the ratio of total energy supply to GDP, thus revealing the energy consumed per unit of wealth created. Energy intensity helps track changes in energy consumption and the factors influencing them, for example, changes in economic structure, weather, and behavior. All such factors being equal, as energy efficiency improves, energy intensity decreases.

Progress toward SDG target 7.3 is measured by the year-on-year percentage change in energy intensity. Initially, the United Nations recommended an annual improvement of 2.6 percent between 2010 and 2030 to achieve target 7.3. However, given the slow pace of global progress in all years except 2015, energy intensity now needs to improve at an annual rate of 4.2 percent from 2024 onward to achieve SDG target 7.3.

Global energy intensity improved by 1.5 percent in 2023, to reach 3.76 MJ/USD (2021 PPP)—down from 2.4 percent in 2022. While the effects of the global energy crisis are still being felt, the slowdown in energy intensity improvements is increasingly driven by stronger global economic activity, particularly in China, and record-high temperatures that have boosted cooling demand. With progress again subdued in 2023, the world is not yet on track to meet SDG 7.3 by 2030 (figure 4.1).

Figure 4.1 • Average annual change in global primary energy intensity, by period, 1990–2030



Source: IEA 2026; UNSD 2025.

SDG = Sustainable Development Goal.

Looking beyond the main indicators

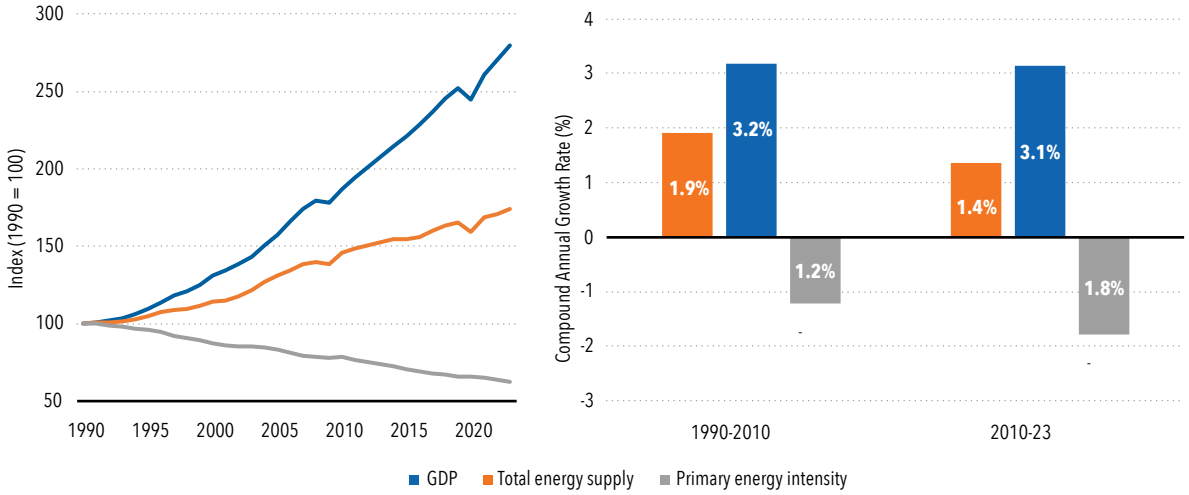
Component trends

Global energy intensity continues to show a gradual decoupling of economic growth from energy demand: GDP grew faster than energy supply, leading to a further decline in overall global energy intensity.

Longer-term data show a sustained structural shift. Annual economic growth averaged 3.1 percent in 2010–23, almost identical to the 3.2 percent over 1990–2010 (figure 4.2). Energy demand, however, grew far more slowly: 1.4 percent per year in 2010–23 versus 1.9 percent in 1990–2010. As a result, global GDP rose 49 percent between 2010 and 2023 while total energy supply rose only 19 percent. Over the full 1990–2023 period, global energy intensity fell by more than a third, allowing the global economy to achieve comparable annual GDP growth rates while utilizing significantly less energy than in the past.

This continued decoupling reflects both structural changes in the global economy and the accelerated deployment of efficient technologies. For example, heat pump sales jumped 75 percent in the first half of 2023 compared with the same period in 2022. This broader uptake of efficient technologies across sectors shaped 2023 results and should drive further gains in the years ahead.

Figure 4.2 • Changes in the components of global primary energy intensity, 1990–2023



Source: IEA 2026; UNSD 2025.

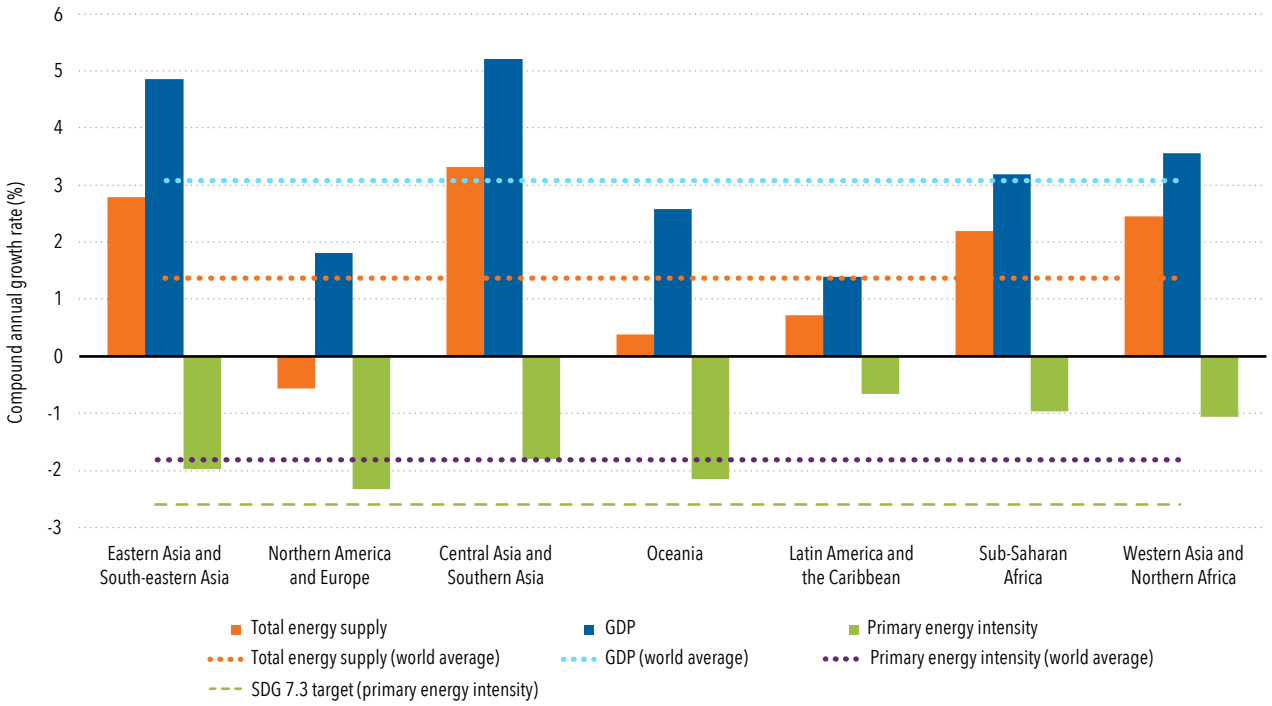
GDP = gross domestic product.

Regional trends

As the global energy crisis eased, GDP expanded in four of the seven major regions and primary energy intensity improved globally. As in 2022, total energy supply grew at a slower rate than GDP in all major regions in 2023. In 2010–23, Latin America and the Caribbean experienced the slowest GDP growth of any major region, at around 1.4 percent. Meanwhile, growth in both energy (3.3 percent) and GDP (5.2 percent) was the fastest in Central and Southern Asia.

Growth reached around 4.9 percent in Eastern and South-eastern Asia and 3.6 percent in Western Asia and Northern Africa, contributing to a global annual average of 3.1 percent over 2010–23 (figure 4.3).

Figure 4.3 • Average annual changes in total energy supply, GDP, and primary energy intensity, by world region, 2010–23



Source: IEA 2026; UNSD 2025.

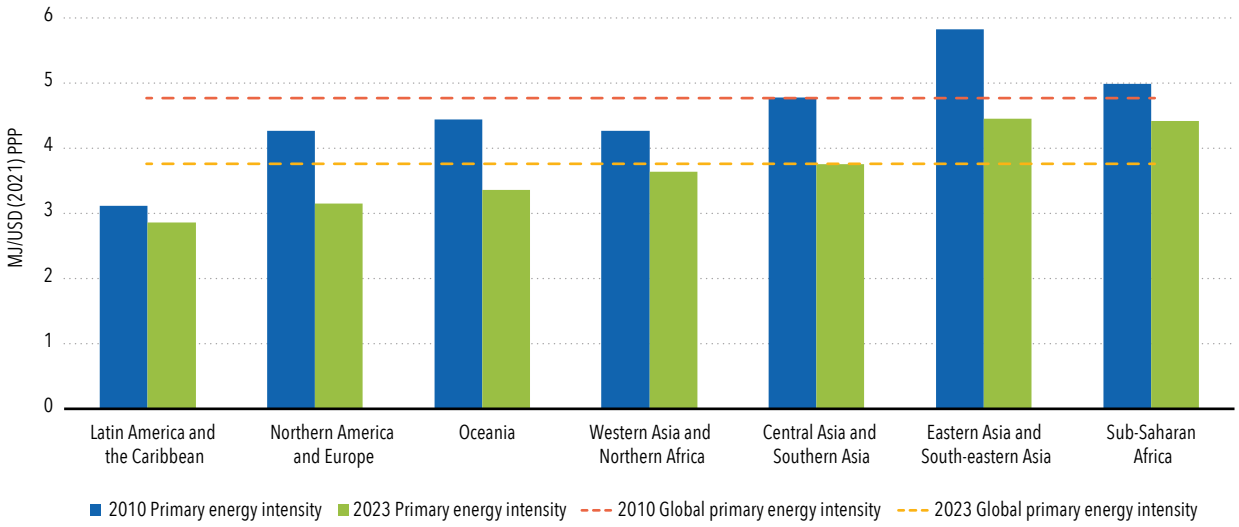
GDP = gross domestic product; SDG = Sustainable Development Goal.

Economic growth outpacing growth in energy demand resulted in energy intensity improving across all major regions, albeit at different speeds. Northern America and Europe came closest to the original improvement target of 2.6 percent, at 2.3 percent over 2010–23, followed by Oceania at 2.2 percent. Eastern and South-eastern Asia remained around 2 percent, while Central and Southern Asia improved more slowly at 1.8 percent, amid strong GDP growth.

Energy intensity was the lowest in Latin America and the Caribbean, which consumed around 2.9 MJ/USD of GDP (2021 PPP) in 2023. Although primary energy intensity in Eastern and South-eastern Asia has declined significantly since 2010, from 5.8 MJ/USD of GDP, it remained unchanged at around 4.5 MJ/USD of GDP in 2023 compared with the previous year.

Primary energy intensity in Northern America and Europe fell from around 4.3 MJ/USD to around 3.1 MJ/USD between 2010 and 2023—a 26 percent improvement. This marks the largest level of progress recorded in any region to date, partly attributed to shifts in consumer behavior and government policies during the global energy crisis. A similar decline was recorded in Oceania, of about 25 percent, from 4.5 MJ/USD to 3.4 MJ/USD. In Western Asia and Northern Africa, primary energy intensity rose 0.8 percent in 2023 after falling nearly 3 percent the previous year, leaving an overall decline of about 13 percent between 2010 and 2023.

Figure 4.4 • Primary energy intensity, by world region, 2010 and 2023



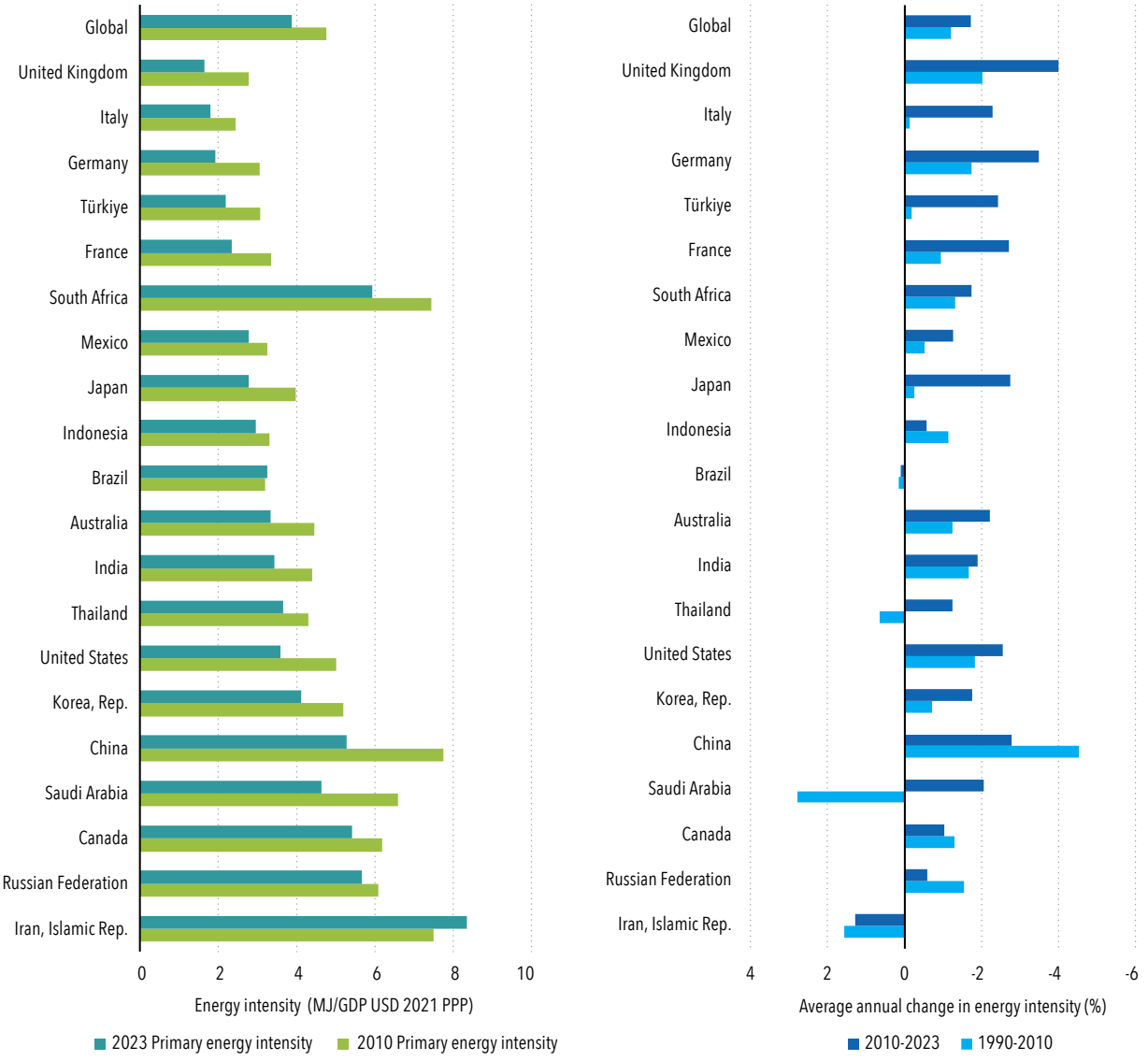
Source: IEA 2026; UNSD 2025.

MJ = megajoule; PPP = purchasing power parity.

Trends in the 20 countries with the largest total energy supply

Improving energy intensity in the top 20 energy-consuming countries is central to realizing SDG target 7.3, given that these countries represent 75 percent of both global energy use and GDP. Between 2010 and 2023, energy intensity rates improved relative to the baseline period of 1990–2010 in 15 of these countries. Six of them—China, France, Germany, Japan, the United Kingdom, and the United States—reached annual improvement rates at or above the SDG target of 2.6 percent. Absolute levels of energy intensity differ widely: European countries such as the United Kingdom, Italy, and Germany posted the lowest levels in 2023, at around 1.9 MJ/USD (2021 PPP) or less. Conversely, five of the top 20 countries exceeded 5 MJ/USD (figure 4.5).

Figure 4.5 • Levels and changes in primary energy intensity in the 20 countries with the largest total energy supply



Source: IEA 2026; UNSD 2025.

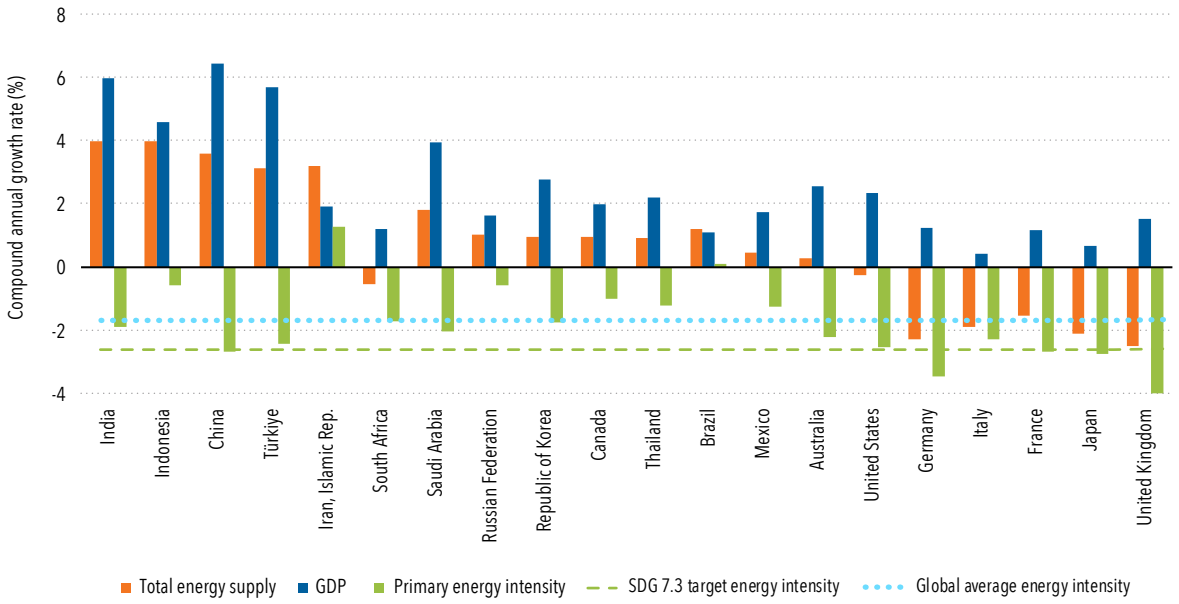
GDP = gross domestic product; MJ = megajoule; PPP = purchasing power parity.

In absolute terms, the energy intensity of 7 of the top 20 energy-consuming countries has remained above the global average over the past decade (figure 4.6). Two of these—the Islamic Republic of Iran and Russia—are also among the world's most energy-intensive economies.

Among the top 20, China, Türkiye, Australia, India, the Republic of Korea, and Saudi Arabia have improved their primary energy intensity at a rate higher than the global average, while recording **an increase in total energy supply**. Their economies grew despite a decrease in energy use, indicating a decoupling of economic growth from energy consumption. These gains reflect advances in industrial efficiency, stricter efficiency standards, and the expansion of renewable energy, among other factors.

By contrast, the United Kingdom, Germany, France, Italy, Japan, and the United States improved primary energy intensity faster than the global average **while also reducing total energy supply**. The United Kingdom led with a 4 percent intensity reduction alongside a 2.5 percent drop in energy supply. Germany, France, Japan, and Italy also showed similar patterns, with reductions in primary energy intensity of 3.5, 2.7, 2.7, and 2.3 percent, respectively.

Figure 4.6 • Average annual changes in total energy supply, GDP, and primary energy intensity in the 20 countries with the largest total energy supply, 2010–23



Source: IEA 2026; UNSD 2025.

GDP = gross domestic product; SDG = Sustainable Development Goal.

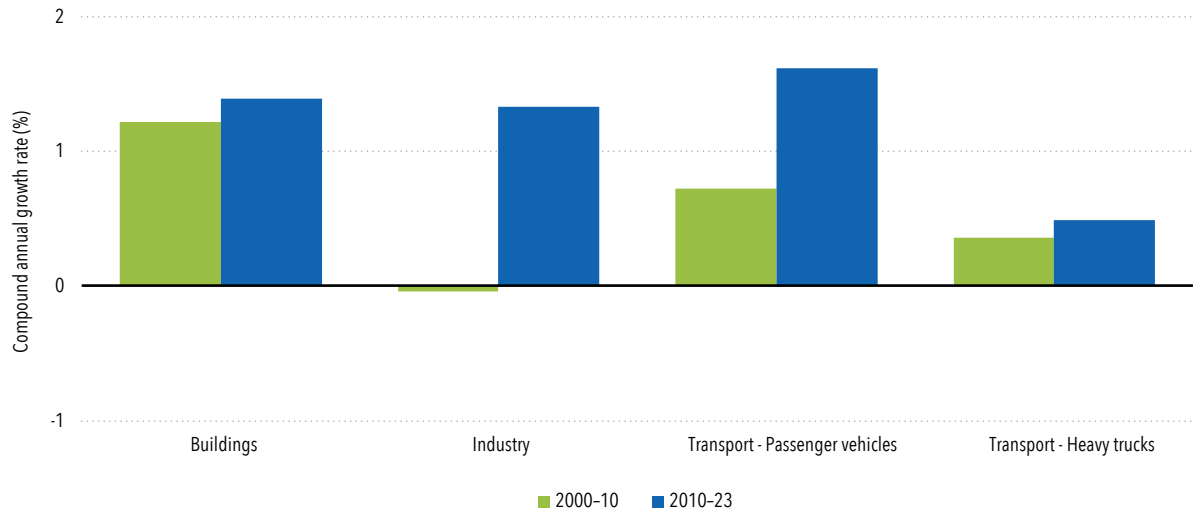
Efficiency trends in end-use sectors

Next to overall energy intensity improvement, it is useful to analyze progress in different end-use sectors. Between 2000 and 2010, the buildings sector experienced the most significant progress in energy intensity, followed by passenger transport and heavy trucks. In contrast, the industrial sector became only slightly more energy intensive. Between 2010 and 2023, energy intensity improved across all end-use sectors relative to the previous decade, though certain sectors achieved more rapid gains than others.

Industrial energy demand has surged in recent years as efficiency improvements have stalled and economic output growth has slowed. Both heavy and light industries have seen energy consumption rise at a faster pace compared to the previous decade. Over 2010–19, growth in average annual energy demand was 1.1 percent in heavy industry and 0.7 percent in light industry. However, this growth roughly doubled in 2019–23, reaching 1.8 percent and 1.9 percent, respectively. Global industrial energy intensity improved by just 0.2 percent per year between 2019 and 2023, down sharply from nearly 2 percent during 2010–19. This decline in efficiency momentum has led to a significant increase in energy demand, which has averaged 1.8 percent per year since 2019—almost twice the historical rate of around 1 percent recorded between 2010 and 2019. This acceleration occurred despite a slowdown in industrial output growth, which has decreased to 2.2 percent per year since 2019, down from 2.8 percent over 2010–19.

Electric vehicle (EV) sales surged in 2023 to about 20 percent of global car sales. However, the continued shift toward larger and heavier vehicles—particularly SUVs, which made up 48 percent of total car sales—offset much of the efficiency gains. Passenger car fleet efficiency improved by 1.6 percent in 2023, despite a significant increase in sales, in line with the average rate observed from 2010 to 2022. Electrification of heavy-duty vehicles lagged, at 3 percent of bus sales and 0.9 percent of truck sales, and energy intensity in that segment was flat in 2023 (figure 4.7).

Figure 4.7 • Average annual change in energy intensity, by sector, 2000–10 and 2010–23



Source: IEA 2026; UNSD 2025.

Note: Energy intensity is estimated as the ratio of total final energy consumption for each end-use sector to a sectoral activity indicator: floor space (buildings), value-added (industry), passenger-kilometers (passenger vehicles), or tonne-kilometers (heavy trucks). These indicators are obtained from IEA's Global Energy and Climate Model. Their positive values denote an improvement (decrease) of energy intensity. For more details, see IEA (2025a).

Trends in the efficiency of electricity generation

In addition to improvements in end-use efficiency, supply-side efficiency gains also count toward energy intensity targets. These include lower transmission and distribution losses from modernized supply infrastructure, more efficient fossil-fuel generation, the phase-out of inefficient power plants, and a larger share of renewables in the electricity generation mix.

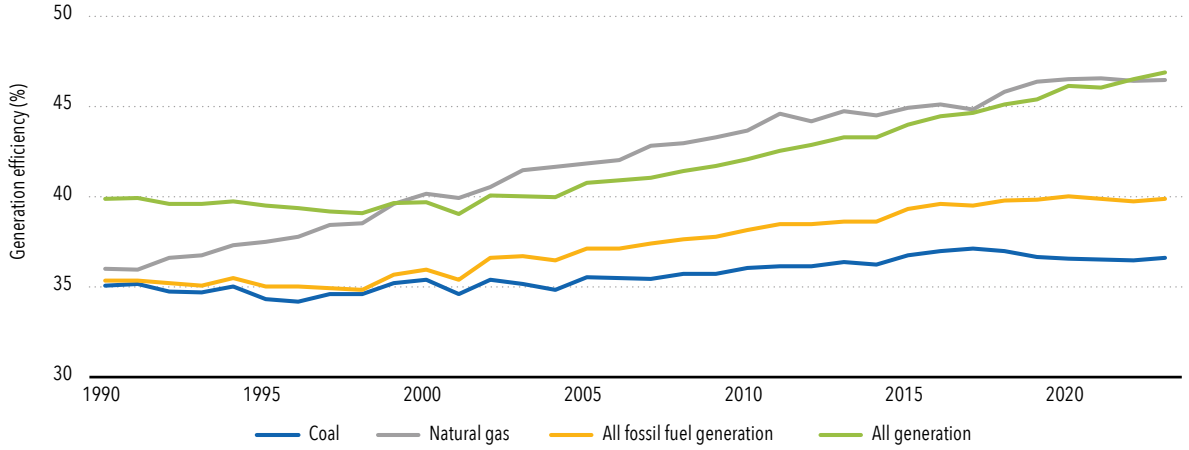
Overall efficiency of the two main fossil fuels used for electricity generation—coal and natural gas—improved steadily between 2000 and 2023, after stagnating in the 1990s. In 2023, fossil-fuel generation efficiency increased by 0.2 percent compared to the previous year, lifting overall generation efficiency across all sources to 46.9 percent (figure 4.8).

Coal-fired generation efficiency fell in 2021 and 2022, but rebounded in 2023 to its 2020 level.

Natural gas-fired generation posted strong efficiency gains in 2019–20, followed by a relatively stable performance over the following three years.

Renewables also play an important role in supply efficiency: a larger renewable share in the electricity mix lifts overall generation efficiency. Therefore, the rapid expansion of renewable energy over the past 15 years has significantly improved the efficiency of the electricity system.

Figure 4.8 • Global electricity generation efficiency, by fuel type and overall efficiency, 1990–2023



Source: IEA 2026; UNSD 2025.

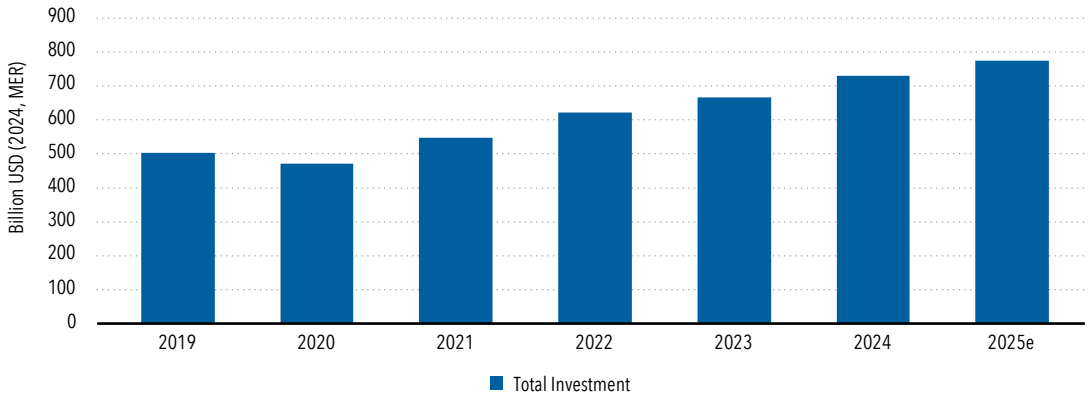
Investment in efficiency, electrification, and end-use renewables

Annual investment in energy efficiency, electrification, and end-use renewables reached about USD 729 billion in 2024, up USD 63 billion from 2023. Total investment expanded by 72 percent over 2015–25, with more than half (54 percent) of that increase coming in the last five years—indicating sustained growth after 2020. Industry grew the fastest in 2024, at around 30 percent, while the transport and buildings sectors experienced more modest increases of 13 percent and 5 percent, respectively. Buildings still account for the largest share in absolute terms, at USD 381 billion (figure 4.9).

Investment in global end-use efficiency remains concentrated in the United States, Europe, and China, which together accounted for around three-quarters of the global total. Although the rapid growth of their building stock represents a significant opportunity, emerging markets and developing economies contributed a smaller share of efficiency-related investments—just 34 percent of global investment in building energy efficiency.

Transport electrification hit new highs—one in five new cars sold globally is now electric—lifting end-use-related investments in transport to USD 312 billion, double the pace of 2023. Nearly two-thirds of total EV sales were in China, followed by North America at 18 percent.

Figure 4.9 • Global investment in energy efficiency, electrification, and renewables for end uses by sector, 2019–25e



Source: IEA 2025b.

Note: An energy efficiency investment is defined as the incremental spending on new energy-efficient equipment or the full cost of refurbishments that reduce energy consumption. The intention is to capture spending that leads to reduced energy consumption.

2025e = estimated values. MER = Market exchange rate. Total investment covers industry, transport and buildings sectors.

Energy efficiency investment within the buildings sector rose steadily, although the pace of growth has slowed. Spending on electric appliances—particularly residential cooling units—held overall investment up, while retrofits and envelopes stagnated or declined. The most substantial shift in 2024 occurred in Europe, where government-backed programs were drastically reduced. In contrast, energy efficiency investment in the United States, especially in retrofits and envelopes, remained stable.

Policy recommendations

Energy intensity improved by just 1.5 percent in 2023, down from a stronger 2.4 percent in 2022. This is well short of SDG target 7.3, which calls for a 2.6 percent annual improvement in energy intensity between 2010 and 2030. To make up this shortfall, the annual improvement rate must increase to 4.2 percent from 2024 onward.

Energy efficiency policies and investments in cost-effective measures need to be scaled up significantly if the global target is to be met. Global investment in energy efficiency and electrification increased rapidly over 2021–23, and this upward trend is projected to continue, reaching roughly USD 800 billion in 2025 (IEA 2025c).

Government support is crucial to enable consumers to invest in energy-efficient technologies, which can significantly lower energy bills. Universal access to electricity and clean cooking, increased electrification, and the incorporation of renewable energies can improve energy intensity by making energy end uses significantly more energy efficient and reducing supply-side inefficiencies. More joint efforts are needed to leverage the synergies between the various SDG 7 targets.

Energy efficiency can deliver many shared benefits to people, such as lowering energy bills, improving health outcomes, and creating new jobs. A strong, early focus on energy efficiency is essential to achieve net zero emissions by 2050. But despite the many benefits of energy efficiency, there are still obstacles preventing people and businesses from investing in energy efficiency improvements. Faster progress in efficiency requires a people-centered approach to ensure fair outcomes, improve skills, create decent jobs, and bring about social and economic development, while engaging people as active participants.

In all sectors, the greatest efficiency gains are achieved by a package of policies that combine three main types of mechanisms: regulation, information, and incentives. Careful policy design and implementation will help leverage energy efficiency's full potential to bolster energy security, create jobs, increase living standards, cut energy bills, and reduce emissions. Successful examples of implementation have the potential to be replicated to boost energy efficiency globally. IEA has published an Energy Efficiency Policy Toolkit summarizing the main tools to be used across sectors (IEA 2024a). Both the technologies and the resources to double energy efficiency improvement by 2030 are available (UN 2021). While countries should work to develop a framework that includes different instruments and covers multiple sectors, in the short term, prioritization can be useful. Some policies can be implemented faster or can have larger effects. This depends on national circumstances, such as the existing policy mix, the structure and size of the economy, available fiscal space, and the country's institutions.

Buildings

Between 2015 and 2024, energy consumption in the buildings sector grew by 1 percent annually, as rising demand for heating, cooling, and appliances outpaced the benefits of efficiency improvements (IEA 2025d). This trend has been driven largely by increased demand for air conditioners and appliances, particularly in emerging markets. Given the affordability stakes, policies targeting energy efficiency within the buildings sector are crucial.

Building energy codes set minimum requirements for a building's energy use and, when comprehensive, can improve efficiency in buildings, lower bills, and ensure optimal comfort. They may establish energy efficiency requirements of an entire building (performance-based codes) or of individual building components such as insulation, lighting, or heating and cooling systems (prescriptive codes). Around 60 codes currently include mandatory requirements for space cooling in residential buildings (IEA 2025c). Beyond energy savings, these codes can enhance overall flexibility of the electricity market by incorporating requirements for on-site renewable energy production, energy management, and integration of smart appliances and equipment that enable a demand response .

Energy performance certificates (EPCs) document a building's energy efficiency level and energy demand. EPCs typically include an A-to-G energy efficiency rating, recommendations for improvements, and estimates of annual energy use based on standard usage patterns (IEA 2025e). They can assess the overall energy performance of the real estate market as well as guide specific policies for different building types, such as targeted retrofit grants for residents of low-performing buildings, or tax benefits and favorable financing terms for high-performing ones.

Retrofit grants can promote efficient technologies by lowering the upfront cost of efficiency upgrades, making them more accessible and affordable. These grants are particularly important for improving the efficiency of existing building stock. Grants can direct investments from stakeholders toward specific energy efficiency measures and motivate them to exceed minimum standards by reducing upfront costs through innovative technologies and best practices. This incentive can target a specific subset of the population that needs the most support.

Appliances

Air conditioners and refrigerators, which account for over 45 percent of electricity demand in buildings, have around 90 percent of their energy use covered by regulation—but significant gaps remain in other areas. In many emerging economies, less than 60 percent of energy use for lighting and cooking falls under regulatory measures (IEA 2025c). Wider coverage and tighter standards are needed to unlock the full potential of energy efficiency gains.

Minimum energy performance standards (MEPS) for appliances establish a minimum efficiency threshold to address efficiency improvement barriers. Products that fall below it cannot be sold, which removes inefficient models from the market. MEPS are one of the longest-standing energy efficiency policy instruments and have proven quite cost-effective in improving the energy efficiency of products.

Labelling programs help consumers make informed decisions while purchasing more energy-efficient products and effectively complement MEPS through additional guidance. Comparative labels, which are often mandatory on similar products, feature a classification scale that enables consumers to compare the energy performance of different items. Endorsement labels, which are voluntary, are found only on best-in-class models or those exceeding a certain efficiency level. These two label types can also complement each other.

Loans and rebates help lower the up-front investment costs of appliances by offering financial support. They encourage consumers to buy more efficient products and motivate suppliers to produce them. These incentives also drive innovation and adoption of new technologies and practices. However, rebates can be expensive for governments, and require careful design. Low-cost loans offer up-front funding for highly efficient models. Often, the eligibility criteria require the scrapping of an old but functioning appliance.

Industry

The industry sector accounted for over 170 exajoules (EJ) of total final energy consumption in 2023 (IEA 2024b). However, there is substantial scope for rapid and large-scale efficiency gains through the following policy actions.

MEPS for industrial electric motors are a regulatory instrument in the industry policy package. They set the minimum level of energy efficiency that electric motors must meet to be sold in a given jurisdiction. Thresholds are calibrated to the motors' size, type, and application. Motors that meet or exceed these thresholds are considered compliant. Noncompliant models cannot be sold in the market.

The stringency of MEPS programs varies widely across countries. Enhanced international cooperation would help governments introduce new standards, draw on others' experience, and adopt best practices. Regional harmonization is also essential as it eases compliance, lowers implementation costs, curbs cross-border dumping of inefficient products, and expands markets for more efficient ones.

As of 2025, one-third of all countries have MEPS for electric motors (2025c). However, the level of stringency among them varies significantly, and overall progress has been relatively slowly. Consequently, new motors on the market are often only about half as efficient as the best ones available.

Other policies to improve energy efficiency include **Industrial Energy Efficiency Networks (EENs) and Energy Management Systems (EnMSs)**. EENs are effective tools for facilitating the exchange of knowledge and information on energy efficiency. These networks vary in structure, but typically consist of energy managers from different industrial sites who meet regularly to share their experiences and strategies for improving energy efficiency. EENs guide industries in becoming more efficient, in line with government policies, and provide governments with valuable industry-specific insights to develop more effective policies. On the other hand, EnMSs enable consumers to manage their energy consumption with greater efficiency and cost savings. A key framework for EnMSs is the international standard ISO 50001, which is based on a continuous cycle of monitoring, targeting, and implementing efficiency measures. Companies adopting ISO 50001 report average savings of 11 percent over the first three years. Light and heavy industries also report consistent energy savings, averaging 4 percent every subsequent year (IEA 2025f).

Transport

Transport accounted for about 122 EJ of total final energy consumption in 2023 (IEA 2026). Private cars and vans were responsible for more than 25 percent of global oil use and around 10 percent of energy-related CO_2 emissions in 2023 (IEA 2025e). Meanwhile, EV sales continue to increase and are expanding beyond passenger cars to include medium and heavy-duty trucks, though this growth is occurring at a slower pace.

Fuel economy standards regulate the efficiency of new vehicles by setting annual corporate average standards, or targets, for fuel economy (miles per gallon or kilometer/liter) or greenhouse gas (GHG/CO_2) emissions (in grams per mile/kilometer). Designs vary, but most apply a uniform standard to all auto manufacturers, for every year that the regulation applies. Some countries offer flexibility mechanisms, such as credits for over-compliant manufacturers, which they can use in the future or trade with underachieving manufacturers. These standards have increasingly incorporated provisions to facilitate the adoption of EVs (including battery electric and plug-in hybrids) and fuel cell vehicles, and can be especially beneficial for heavy-duty trucks. Countries that already have standards in place can tighten them to accelerate progress.

Vehicle efficiency labels help consumers in selecting more energy-efficient vehicles and complement fuel economy standards. These labels come in various formats, including those displayed on vehicles in showrooms and online. Increasingly, EVs now feature labels that include metrics such as a vehicle's driving range. National comparison websites further aid potential buyers by identifying the most fuel-efficient vehicles by category. In addition to information on

fuel economy, labels may also include information on CO_2 and air pollutant emissions, along with fuel cost savings, enabling buyers to choose vehicles that cost less to run.

Subsidies for passenger EVs play a key role in accelerating electric car sales, especially among early adopters, by narrowing the price gap between EVs and internal combustion vehicles. Subsidies usually take the form of discounts or rebates, and can also be implemented as tax reductions through income tax credits. Discounts and rebates are the most common incentives used to lower the purchase price of EVs. These can be fixed direct discounts deducted from a vehicle's cost at the point of sale, or rebates/refunds assigned once a vehicle has been purchased. Subsidies have been implemented in most major markets to boost EV adoption, though the incentive levels and eligibility requirements vary. As a result, consumers can select from a range of EV models that are either more efficient or more affordable.

Cross-cutting

With electricity demand rising and renewables taking a larger share of generation, effective demand-side management is increasingly critical, and future energy systems are likely to rely on multiple interconnected flexibility services. Digitalization and artificial intelligence can sharpen energy management by enabling consumers to monitor, optimize, and adjust their electricity use. As peak loads come under greater pressure, demand-side flexibility will be essential for system reliability, efficiency, and cost-effectiveness.

Energy efficiency obligation (EEO) schemes require designated "obligated parties" to achieve energy or emission savings targets across their customer portfolios. Obligated parties include energy utilities, retail energy sales companies, energy distributors, transport fuel distributors, and/or transport fuel retailers. EEO schemes are market-based instruments: obligated parties can choose which measures to deploy to meet their set targets, within set limits. Some EEO schemes include "white certificates" (also called energy savings certificates), which certify that a specified reduction in energy use or emissions has been achieved. White certificates can typically be traded between over- and underperformers, and are usually combined with an obligation to achieve a certain energy or emission savings target.