4

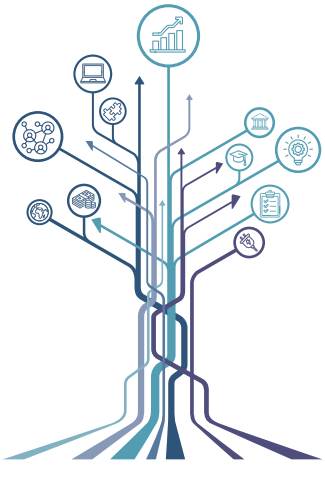
Energy

Country Case in Brief: The United Kingdom

As countries embark on a transition to lower carbon emissions and clean energy, the United Kingdom stands out among the high-income countries (HICs) because it has fundamentally shifted its energy mix several times. It has undergone three historical transitions in primary energy source: from wood to coal in the nineteenth century; from coal to oil and, mainly, natural gas in the twentieth century; and, in the twenty-first century, from fossil fuels to renewables.

The First Transition: From Wood to Coal

Why did the industrial revolution of the eighteenth century begin in the United Kingdom rather than in some larger, more populous, and richer nation of the period? Contemporary observers believed the answer was obvious. "Coal," wrote one French official sent to uncover the secret of the country's industrial strength in 1738 (Allen 2009). Modern scholarship corroborates the visiting official's verdict: the combination of high real wages and an abundance of cheap, easily exploitable energy in the form of high-quality black coal. The high wages provided a compelling incentive to economize on labor. Cheap coal meant that it was cost-effective to do so by substituting new, energy-intensive machinery. Other countries enjoyed one or other of these conditions. None enjoyed both, at least initially.



Coal was the feedstock for the coke blast furnaces with which Abraham Darby revolutionized iron smelting at the pioneering Coalbrookdale iron works in 1709. Coal fueled the first commercial steam engine, invented by Thomas Newcomen in 1712. Coal-powered steam turned Richard Arkwright's spinning jenny into the

basis of the factory system of cotton production, the parent of all subsequent manufacturing. And, in the nineteenth century, coal became the soul not only of manufacturing, but of a modern services sector, too.

The Second Transition: From Coal to Natural Gas

According to the prevailing wisdom after World War II, the fundamental economic importance of the energy sector rendered nationalization and the vertical integration of production and supply the only reasonable ways to organize the sector. Though initially successful, this structure became problematic as oil gained position as the dominant input for industrial and transport technologies. By the early 1970s, the United Kingdom's dependence on the domestic coal industry for nearly half of the country's primary energy requirements had become a weakness. Costs were high; fractious industrial relations led to disruptive supply shortages; and a growing reliance on imported oil and gas after successive price hikes by the Organization of the Petroleum Exporting Countries contributed to the country's need for an International Monetary Fund bailout in 1976.

The situation was transformed by three related developments. The first was the discovery of exploitable oil and gas in the United Kingdom's area of the North Sea in the mid-1970s. The second was the radical restructuring of the economy from low-end manufacturing to services following the election of Prime Minister Margaret Thatcher's Conservative government in 1979, which led to a dramatic downward revision of the trajectory of UK energy demand. In 1970, it had been predicted that the country would require 100 gigawatts of electricity-generating capacity by 1995; in fact, only a little over half of that was needed (Brown 1971). The third was the parallel reorganization of the UK energy industry. Large state-owned enterprises (SOEs) were privatized from 1986 to 1994, accompanied by price incentives for competing, private companies in energy markets, supervised by independent regulatory agencies in determining investment, production, and consumption (Rhodes, Hough, and Butcher 2014).

Together, these three developments transformed the United Kingdom's energy use. Between 1970 and 2010, coal's share of the country's primary energy mix fell from 44 percent to 14 percent, while the contribution of natural gas rose from 5 percent to 40 percent. In the power sector, the transition from coal to natural gas was especially rapid. After 1990, the share of UK power generated from coal dropped by half, to slightly more than 30 percent in 2010, while the contribution of natural gas from mostly domestic sources grew from near zero to slightly less than 40 percent.

The economic impact of the transition from coal to natural gas was huge. The final energy costs among households and industry fell; the United Kingdom's external accounts improved dramatically; and new tax revenues were spawned. There was also a major environmental dividend: the country's per capita territorial carbon dioxide emissions dropped by 30 percent from 1970 to 2010. More than half the

decline was derived from the lower carbon intensity of the new primary energy mix. Pollution plunged by almost 80 percent, creating a substantial health dividend (Tiseo 2024).

The Third Transition: From Fossil Fuels to Renewables

By the turn of the millennium, shrinking the energy sector's environmental impact was becoming a central policy objective. The 2008 Climate Change Act legislated an 80 percent reduction in the country's overall territorial carbon emissions by 2050, a target later widened to require net-zero carbon emissions. Fully decarbonizing the power sector became subject to a more ambitious deadline of 2035. This set the stage for the United Kingdom's third energy transition, from fossil fuels to renewables.

The United Kingdom's strategy has once again been to harness the power of liberalized, but regulated, energy markets to incentivize private investment in an abundant domestic primary energy resource—this time, wind—using new regulatory and financial instruments, such as carbon credits and auctions of guaranteed long-term offtake prices. With rapidly declining prices for renewable energy, the results have been impressive. By 2022, renewables provided nearly 20 percent of the UK's primary energy, up from less than 5 percent in 2010. In the power sector, renewables have overtaken natural gas as the largest source of electricity generation. In 2020, the United Kingdom became the first G20 economy to cut carbon emissions by half.

Yet, the country's third transition is far from complete. Formidable technological obstacles exist in substituting fossil fuels in industrial uses, domestic heating, and transport. In the power sector, policy makers are grappling with the trade-offs between decarbonization and the competing policy objectives of security in supply (given the intermittency of wind energy) and affordability (because of the scale of investment required). As in the earlier transition from coal to gas, the United Kingdom's regulatory framework has had to adapt to unexpected technological and geopolitical changes.

Lessons from the United Kingdom's Energy Transitions and the Main Questions for Europe and Central Asia

The UK experience offers several useful lessons for the countries of the Europe and Central Asia (ECA) region. The first lesson revolves around the fundamental role the energy sector plays in a country's evolution toward a sustainable, secure, high-income future. The transition of the United Kingdom from wood to coal underpinned the industrial revolution, and the transition from coal to natural gas occurred as the economy was undergoing substantial structural change. Without that change, facilitated by government policies and by markets, such an energy transition would not have been possible.

A second lesson is that, with abundant resources, a country can use natural gas as an important fuel on the road to net-zero carbon emissions because of the technology options available for producing lower greenhouse gas emissions, which also results in less air pollution. The Russian Federation's invasion of Ukraine has altered the way energy security is perceived, however, and this assessment has been profoundly revised. In most ECA countries, already highly reliant on natural gas, the lack of domestic gas sources means that natural gas consumption may have peaked or is about to peak. Most ECA countries are preparing to transition to cleaner energy sources directly rather than using natural gas as an intermediate fuel. Still, natural gas will be essential in high value added areas in the region for at least another two decades (World Bank 2024c).

A third lesson is that diversification in primary energy sources is crucial. In the United Kingdom, the shift to renewables has returned primary energy supply to domestic sources, but the intermittency of these sources challenges the security of supply, at least until connectivity and storage at scale become more affordable.

The fourth, overriding lesson is that policy matters and must be adaptable. The United Kingdom's historical experience demonstrates how choices over policy priorities, industrial organization, market design, and regulatory institutions drive outcomes: privatization and liberalization in the 1980s and decarbonization policy in the 2000s and 2010s. Yet, there are no once-and-for-all solutions. In the United Kingdom policy experience, the only constant has been change—and sound policy making.

This chapter addresses the question of how the ECA countries can achieve high-income status, while managing the transition to lower emissions and affordable, abundant, and secure energy. The shift toward the more efficient use of energy and lower carbon emissions involves the infusion of foreign technologies, capital, and expertise and fundamental transformations in the structure of economic activity. These changes offer many opportunities for substantial savings among households and enterprises, thereby allowing room to scale up production, boost growth, and achieve more rapid convergence. The pinnacle of these overlapping transitions is the participation of firms in the ECA countries in global value chains for technologies that improve energy efficiency and lower emissions. This participation will depend on the pace of structural change and the availability of skilled labor at home.

Introduction

Building on the above history, this chapter is focused on the following questions.

First, are ECA countries reducing carbon emissions, while ensuring abundant, affordable, and secure energy supply? Supported by a profound structural shift from

manufacturing to services and from state-run to more market-oriented economies, ECA countries have greatly slowed the pace of carbon emissions growth, even in an environment of robust economic expansion. In these countries, an increase in gross domestic product (GDP) of 103 percent between 2000 and 2020 led to a rise in carbon emissions of 9 percent over the same period, whereas, among the middle-income countries (MICS), an increase in income of 178 percent led to a rise in carbon emissions of 134 percent, and, among HICs, an increase in income of 41 percent led to a reduction in emissions of 12 percent during the same period. Nonetheless, the region's economic expansion has been largely driven by fossil fuels, extensive emissions, and declining, but still high energy intensity. However, a shift toward abundant renewable energy and modern transmission grids as aging energy assets are replaced, combined with improvements in energy efficiency, should ultimately lead to a sizable decline in carbon emissions and energy intensity in the region.

Second, does the transition to affordable, more secure, and lower-emission energy represent an opportunity for the MICs in the region to boost economic growth and transition to high-income status? The positive impact of lower-emission innovation on GDP growth is visible in China, Europe, and the United States, but not so much in the ECA region. It is most visible in the ECA countries in which the transition to a market economy and integration with global markets has advanced the most and in which the pressure of incumbent firms is more well contained and young and dynamic firms enjoy a level playing field. The ECA region is the most energy-intensive developing world region, largely because of its historical reliance on heavy industry and fossil fuels. It also has some of the world's highest energy subsidies, and the average age of coal plants in 13 ECA countries is more than 30–35 years.[1] Innovations in energy efficiency and reductions in emissions—linked, notably, with the infusion of foreign technologies—offer ample growth opportunities. However, policy barriers, underdevelopment of markets and regulations, and the resistance of incumbents often hinder the move to energy efficiency. If these can be overcome (generally through more competitive markets and prices, continued structural transformation, greater macroeconomic stability, and training and retraining), some ECA countries could become low-emission technology adopters, while others could lead in innovation.

Third, have the MICs in the region strengthened the forces of creation sufficiently to ensure that the transition to lower emissions and increased energy efficiency will support the growth to high income? The infusion of lower-emission technologies is much slower among the MICs in the region and among other emerging and developing countries than among HICs, with the exception of the take-up of solar and wind in the ECA Convergers—Croatia, Poland, and Romania—and in Türkiye.[2] Raising the share of energy generated by solar and wind to more than 15 percent in 2022, these are the only ECA countries with solar and wind penetration above the global average of 12 percent. Most ECA countries will also encounter problems in

participating in lower-emission global value chains and will be, at least in the near term, largely consumers rather than producers or innovators of greener technologies. How to become part of these value chains is a top challenge facing policy makers.

Fourth, have the MICs in the region weakened the forces of preservation that raise obstacles to the more-efficient and lower-emission energy needed along the path to high-income status and beyond? Powerful SOEs are an element of the energy transition, but, in the region, they control 100 percent of energy transmission, more than 80 percent of fossil fuel generation, and more than 65 percent of electricity distribution, though they are less present in low-carbon technologies. The region's high natural gas and coal subsidies are also tilting the playing field in favor of fossil fuel technologies. Subsidies for fossil fuels are among the greatest market disincentives for decarbonization and the green transition. Eliminating them is a key step to more efficient, lower-carbon, and cleaner energy. These subsidies also raise barriers to economic growth through the associated misallocation of human, physical, and financial capital to less productive sectors.

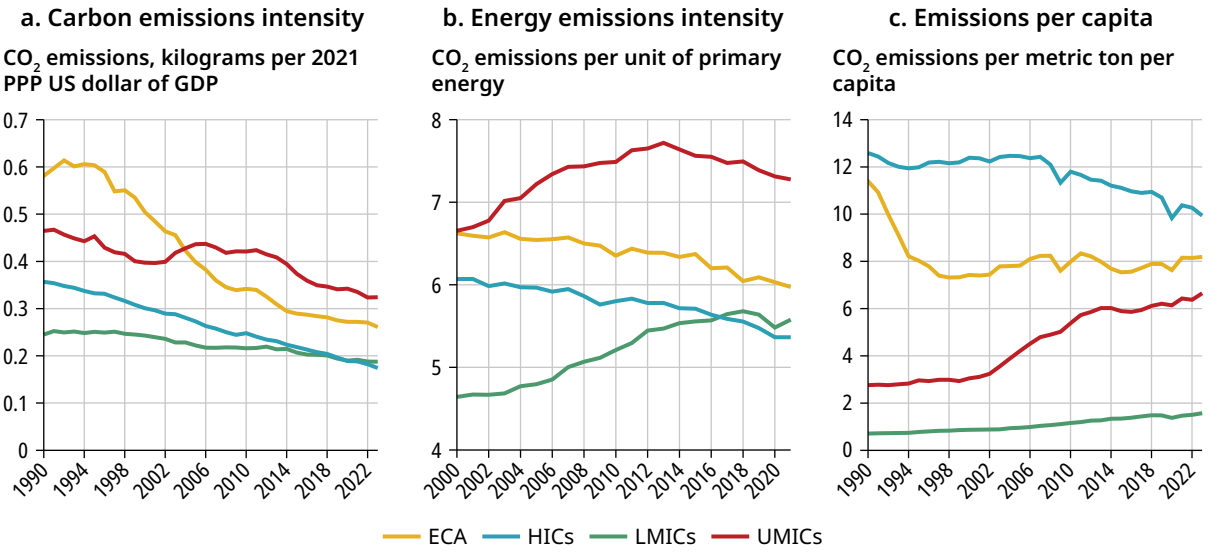
Carbon Emissions and Energy Intensity

The region has a unique development experience in energy use and carbon emissions. Owing to natural endowments and the economic organization of the Soviet Union and its satellite states, most ECA countries were exhibiting high rates of energy and carbon intensity by the 1990s. Abundance (and the subsidized pricing) of fossil fuels fostered energy systems that relied almost exclusively on oil, natural gas, and economic specialization in energy-intensive sectors, such as heavy industry. Meanwhile, at the time, no one worried about carbon emissions.

Emissions per dollar of GDP have been on a steeply declining trend since the mid-1990s. Emissions per unit of primary energy have been declining slowly in the ECA region, in contrast to lower-middle-income and upper-middle-income countries, which have been on an upward trajectory (refer to figure 4.1, panels a and b). Emissions per capita in the region have shown a slight increase relative to HICs and in absolute terms since 2000, but the increase has been greater in countries in other income groupings (refer to figure 4.1, panel c).

In 2000, countries in the ECA region were about 35 percent more energy intensive than upper-middle-income countries and more than 65 percent more energy intensive than HICs (refer to figure 4.2). By 2009, energy intensity in the region was substantially lower than the energy intensity of upper-middle-income countries, but was still greater than the energy intensity among the HICs back in 2000. Energy intensity leveled off in the ECA region after 2015, which is a source of concern.

FIGURE 4.1 Carbon and energy emissions intensity and emissions per capita



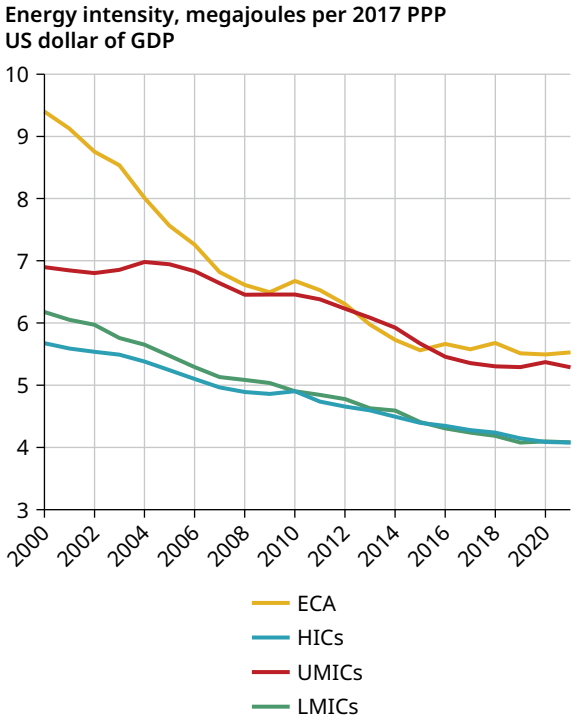
Source: WDI (World Development Indicators) (dashboard), World Bank, Washington, DC, https://datatopics.worldbank.org/world-development-indicators/.

Note: LMICs = lower-middle-income countries; PPP = purchasing power parity; UMICs = upper-middle-income countries.

There is a tight correlation between GDP and energy use across countries and over time (refer to figure 4.3). Only among the HICs and the ECA Convergers has there been some decoupling between average GDP and average energy use since the global financial crisis of 2007–09. Among the MICs in the ECA region and other developing regions, energy demand has continued to grow along with GDP.

Per capita emissions in the ECA region changed little between 2000 and 2020, after declining 36 percent in the 1990s, when the transition from planned to market economies was initiated. The broad stability in per capita emissions after 2000 contrasted with increases in the MICs and declines in the HICs (refer to figure 4.4, panel a). Even with the decline in the 1990s, the ECA region is still among the world's largest carbon emitters per capita, at about 7.6 metric tons of CO_2 per inhabitant in 2020, or 71 percent more than the world average. Per capita carbon emissions can be decomposed into a product of three factors: per capita economic growth, energy intensity (energy use per unit of output) to account for energy efficiency, and the emissions intensity of energy (carbon emissions per unit of energy used) to account for the role of energy sources (refer to figure 4.4, panels b, c, and d). Several messages are thus embedded in the decomposition.

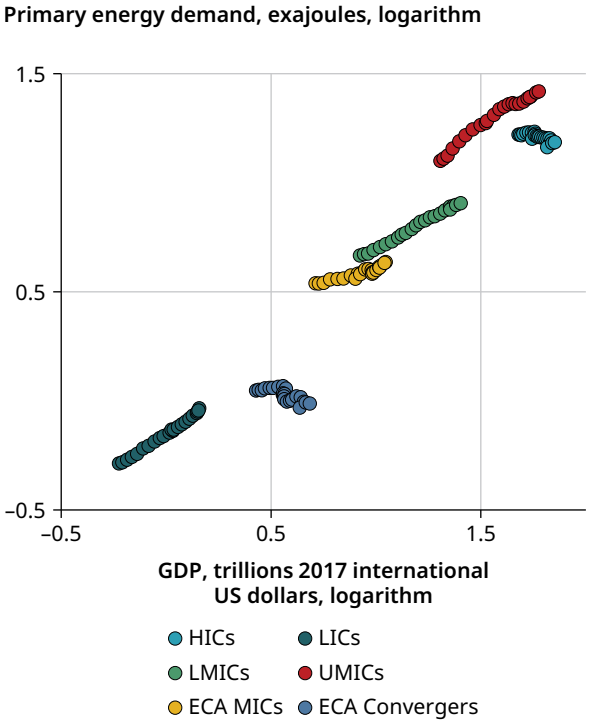
FIGURE 4.2 Energy intensity, primary energy



Source: WDI (World Development Indicators) (dashboard), World Bank, Washington, DC, https://datatopics.worldbank.org/world-development-indicators/.

Note: PPP = purchasing power parity.

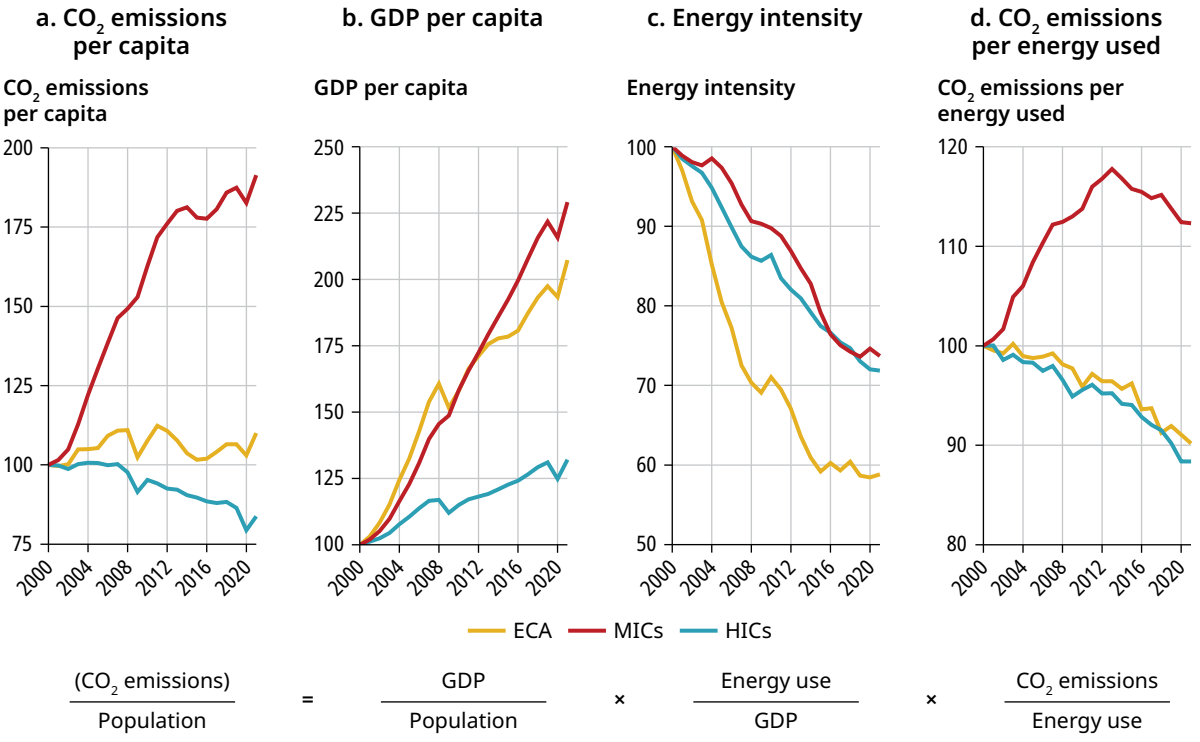
FIGURE 4.3 GDP and energy use, ECA and comparators, 2000–19



Source: World Bank calculations based on Data and Statistics (dashboard), International Energy Agency, Paris, https://www.iea.org/data-and-statistics.

Despite substantial improvements in energy intensity in the ECA region since 2000, more efficient use of energy—that is, lower intensity per unit of GDP—is still required. The region has reduced energy intensity more quickly relative to other regions because of the structural transformation of the ECA countries during the transition from planned economies to market economies. Most of the reduction in the region occurred before 2015 (refer to figure 4.4, panel c). Energy intensity declined by 40 percent from 2000 to 2015. Yet, despite the reduction, energy intensity is still greater in the ECA region than in the MICs. To produce a unit of GDP, the region requires 1.4 times more energy relative to South Asia and more than 1.6 times more energy than Latin America and the Caribbean. Compared with the European Union (EU), the ECA region consumes 1.9 times more energy to produce a unit of output.

FIGURE 4.4 Decomposing per capita carbon emissions, index, 2000 = 100

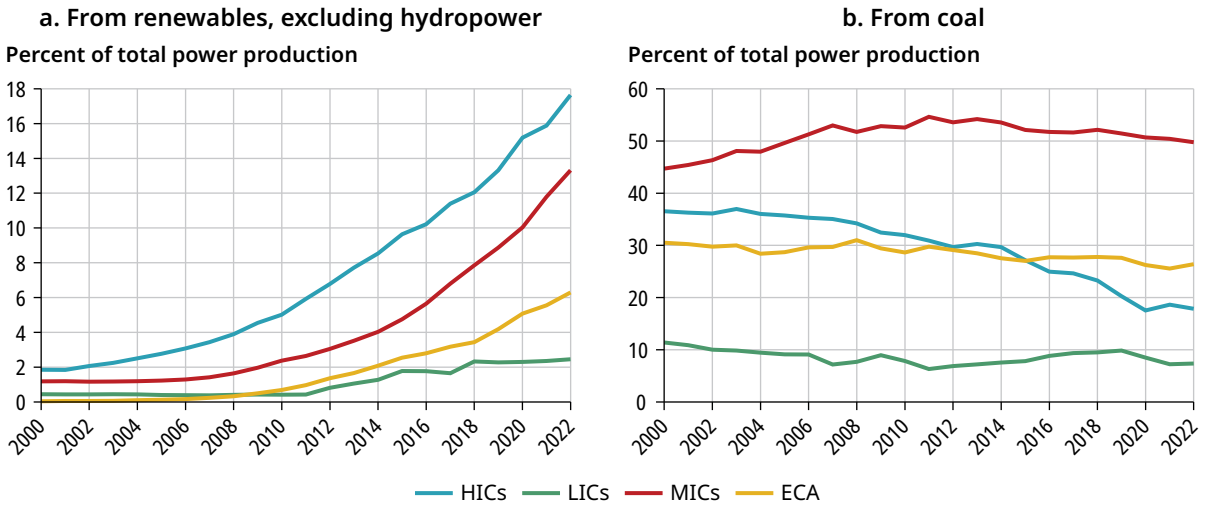


Source: World Bank calculations using data from WDI (World Development Indicators) (dashboard), World Bank, Washington, DC, https://datatopics.worldbank.org/world-development-indicators/.

The region reduced the emissions intensity of energy in 2000–20 by about 10 percent, or as much as the HICs, although from a higher level. The reduction contrasts with an increase in the emissions intensity of energy among MICs around the world (until 2013), also starting from quite different levels, however. Regardless of the overall reduction in the emissions intensity of energy, coal still accounts for an oversized share of primary energy demand in the region, especially in electricity generation (refer to figure 4.5, panel b). Moreover, several countries in the region have experienced substantial increases in the emissions intensity of energy since 2000 even as their energy intensity declined.

Large energy subsidies are an important incentive behind the high carbon intensity of energy and the continued substantial dependence on fossil fuels in the region. Subsidies support lower prices among final consumers, but also represent a lifeline for thermal power generation, mostly linked to SOEs. Fossil fuel subsidies in the region amounted to an oversized $110 billion in 2020 (3.6 percent of regional GDP), even before the surge in subsidies, along with prices, in 2022 (World Bank 2024b).

FIGURE 4.5 The changing structure of electricity production



Source: World Bank 2024b.

ECA Transitions and Foundations

The transitions among the ECA MICs demand deliberate policy choices to ensure that the policies are complementary and the transitions smooth. The first transition—to affordable, secure energy—was more difficult because of the largest supply shock ever experienced in natural gas markets worldwide. The shock was associated with the surge in the prices of natural gas and wholesale electricity in 2022 following Russia's invasion of Ukraine. The impact was exacerbated by the heavy reliance on Russian natural gas and the coupling of Asian and European markets. The energy shock underscored the need to (1) diversify the sources of energy supply, (2) heavily cut dependence on imported oil and natural gas, (3) dramatically improve energy efficiency, and (4) utilize domestic low-cost renewables. Energy security is now a top policy priority in many countries in the region and around the world.

The second transition—to lower emissions—involves the infusion of modern foreign technologies and products. It should be complemented with efforts to decarbonize transportation, heating, industry, and other sectors through energy efficiency, behavioral changes, and technology shifts, starting with electrification. The investment needs associated with the adoption of the new technologies—as with the adoption of any new technology—are projected to be substantial and will be accompanied by losses mostly in stranded state-owned fossil fuel generation assets. The International Energy Agency estimate of global energy transition investment needs is $4 trillion per year until 2030, or about 4 percent of global 2023 GDP (IEA 2023b, 2023c). The World Bank Climate

Change and Development Reports on the ECA region indicate that the additional investment needs in reducing carbon emissions to net zero may be up to 2 percent of GDP a year (World Bank 2023a).

These transitions must support economic growth and foster the shift to high-income status. Facilitating the ongoing structural transformation of ECA economies will help bind enterprises more tightly into global markets and buttress the infusion of the new capital, technologies, and management expertise that are required to shift away from productivity stagnation to productivity gains across the region. Creating or completing markets and allowing energy prices to reflect the true underlying cost should help households and enterprises become more energy efficient, the latter benefiting from a bump in profitability. Increased energy security should underpin a more predictable business environment and facilitate new business entry, especially in countries where unreliable power supply and frequent outages are damaging business prospects. Additional investment in transmission should help improve reliability and ultimately reduce power costs, although this is a development with a longtime lag.

The cost of additional investment is substantial, but will be similar to the requirements accompanying any technological change, including the adoption of automobiles, computers, and mobile phones. It must also be considered against the cost of inaction: the rising economic cost of air pollution, stepped-up health spending, and adaptation. Climate change damage in the region is already estimated to account for 1 percent to 2 percent of GDP a year in Azerbaijan, Kazakhstan, and Romania and over 10 percent of GDP in Uzbekistan.

How would the transition to more secure, more energy efficient, and cleaner technologies aid economic growth? The positive impact of the transition derives from the higher energy efficiency, lower energy costs, and reduced externalities associated with lower emissions. These positive impacts will all help companies scale up the production of existing products or services or introduce new product lines, thereby creating new job opportunities and stimulating innovation across sectors. As with every technological transition, however, higher initial investment costs will be borne by consumers, enterprises, and the government. The transition will change all parts of the economy that produce or consume energy. In all ECA countries, large infusions of foreign capital, technology, and expertise will be needed to make the transition to lower energy intensity and lower emissions a reality.

Strengthening the Forces of Creation

The bulk of the new investment in greater energy efficiency and lower carbon emissions is expected to be realized by the private sector. Critical to the success of this endeavor will be the ability of firms to integrate more closely into the

global economy and infuse new foreign technologies, expertise, and capital. Entrepreneurs must also be able to identify new opportunities and to innovate. The foundations of these efforts include contestable markets in energy, public transport, housing, and, indeed, in all sectors of the economy that produce, transport, or utilize energy. The continued integration of domestic firms into global markets will help reshape enterprises and make them more energy efficient. How to become part of the global value chains related to the green transition, with a huge impulse for innovation and economic growth, is both a challenge and a priority for the ECA MICs. Past technological transitions reveal an accelerating pace of technology diffusion from advanced to developing countries, but countries need to be ready and to have established adequate foundations.

Competitive Markets and Prices

The first foundation requires competitive markets for energy inputs and outputs and prices that provide the appropriate signals to households and firms about the true cost of products. Fossil fuel subsidies should be phased out, and administered energy prices must be rationalized to cover costs and avoid quasi-fiscal deficits. Market mechanisms, including carbon taxes, can help internalize externalities and contribute to changing consumer and firm behavior.

Carbon Pricing

Explicit carbon pricing that reflects the negative externalities of emissions and pollution can encourage efforts to reduce carbon emissions. Two types of explicit carbon pricing exist: a carbon tax, that is, a tax on the carbon content of fuels, and an emissions trading system (ETS). Under the more widespread version of an ETS (cap-and-trade), an overall level of emissions is set for regulated entities.[3]

Carbon pricing instruments cover almost one-fourth of global emissions, though most systems fail to price carbon at a level consistent with achieving the temperature goals of the Paris Agreement (World Bank 2023d). In the ECA region, besides the four EU member states, other countries have moved more slowly on introducing carbon pricing instruments. Given the trade relations with the EU and the accession aspirations of several ECA countries, the EU ETS may be the most relevant instrument for them.[4] Türkiye, Ukraine, and the countries of the Western Balkans are either planning, considering, or implementing ETSs.

The carbon policies of EU trading partners will be affected by the introduction of the EU Carbon Border Adjustment Mechanism in 2026, which will coincide with the phaseout of the allocation of free allowances under the EU ETS. The impact of the mechanism, especially in the initial stages, on the exports and GDP of individual countries is likely to be modest, as the countries will probably quickly adjust their production and exports. For example, a recent report estimated

the negative impact on GDP at about 3.7 percent of GDP in Bosnia and Herzegovina and 0.2 percent in Serbia (World Bank 2023e).

Among the EU candidate countries, adopting an EU-aligned carbon trading system will be an important accession requirement. The other ECA countries may decide in favor of other carbon pricing models, for example, the model of California, which uses carbon pricing as a backstop if other climate policies fail to deliver the expected reductions. Türkiye plans to launch an ETS in 2025. Indications are that it will involve an economy-wide carbon price that rises from $11 to $211 per metric ton of CO_2 equivalent by 2040. These prices are consistent with the ECA energy futures report's shadow carbon price for a 2060 net-zero scenario (ESMAP et al. 2024).

Carbon pricing or higher taxation on fossil fuels should be implemented after a substantial reduction or, better, elimination of fossil fuel subsidies. In practice, this sequencing has been difficult to achieve. Most subsidies are long-standing, though some were introduced during the pandemic, and others were introduced during the 2022 energy crisis and have yet to be lowered. The subsidies, which are substantial, offset the impact of carbon pricing or of other efforts aimed at reducing the use of high-emission technologies (refer to the discussion on fossil fuel subsidies that follows).

Continued Structural Transformation

The second foundation is the continued structural transformation of enterprises and the progressively tighter integration of firms into global markets. Despite the substantial heterogeneity across the ECA region, the main challenges to business dynamism are similar across the region. Countries will need to upgrade the competitive environment, dramatically boost the quality of education, and strengthen the availability of finance. Deepening trade and investment integration is crucial to accelerating the adoption of modern technologies and strengthening the ability of firms to overcome the limits they face to potential growth because of the small size of many economies in the region.

Sustained structural transformation will lead to more links with global value chains and open avenues for greater investment and infusion of foreign knowledge. The resulting reduction in inefficiencies—including in the use of energy and the energy mix—and the profound misallocations in the economy should result in an acceleration investment. Investment growth at a more rapid pace will help revamp the capital stock with machines and equipment that are more productive and energy efficient (refer to chapter 2).

In terms of the economic structure, industry accounts for about 20 percent of carbon emissions in the region, and the infusion of new capital and technologies holds the key to reducing both emissions and energy intensity. Besides continued structural transformation and integration into the global economy, measures in this direction include the promotion of energy management systems such as the

ISO 50001; capacity building and training for industrial energy auditors and managers; targeted research and development (R&D) incentives; the use of automation, software, robotics, and artificial intelligence; and the availability of financing programs.[5] Regulatory instruments could also be deployed (such as mandatory audits) and target and performance setting (Dobrotkova, Lukas, and Singh 2018; World Bank 2023b).

Macroeconomic Stability and the Cost of Capital

The third foundation is macroeconomic stability and investor certainty. Given the huge funding entailed in implementing the transition to lower and, ultimately, zero emissions and the long horizons involved, domestic and foreign investors require certainty that their property rights will be respected and that the macroeconomic environment will be supportive of their engagement. The effort to de-risk economies through prudent macroeconomic and financial policy should help improve the credibility of countries in international capital markets and the availability of finance. Some ECA countries face macroeconomic obstacles, including the incomplete market transition, the still outsized role of the state, and the inadequate rule of law. These should be addressed to ensure that private capital flows in to finance energy efficiency and the green transition.

The cost of capital for clean energy projects is higher in most ECA countries than in advanced economies, often deterring investment given the high up-front costs that most greener technologies require. The regional average cost of capital in advanced economies is between 4.4 percent (Europe) and 5.4 percent (North America), but 5.6 percent in East Asia and the Pacific and 6.9 percent in Latin America.

Energy Efficiency

Improving energy efficiency is the first mile of the agenda on lowering emissions and achieving more rapid economic growth. It is the most important and lowest cost option in providing affordable energy services, reducing carbon emissions, and realizing the climate commitment of countries. Improved energy efficiency will contribute to better energy security; enhanced competitiveness; the easing of budget constraints on households, businesses, and governments; reduced burdens on power systems; and, of course, reduced carbon emissions. The International Energy Agency (IEA) has estimated that, among single energy sources, energy efficiency has made the greatest contribution in meeting energy demand since the 1970s (IDA 2024; IEA 2022b).

Regulatory policies, including mandates for energy efficiency, are essential. These also include structural changes to energy demand in the heating sector through retrofitting, housing building codes, and improved standards on appliances. The global use of LED lightbulbs in 2017 alone, for instance, reduced carbon emissions by 570 million metric tons, or nearly 2 percent of total emissions (World Bank 2023f).

About one-fourth of energy demand in the region is for space heating. Improving energy efficiency in this area will have a marked impact. Almost three-fourths of that heating is for residential housing, and more than four-fifths is produced from fossil fuels, both coal and natural gas. Enhancing the energy efficiency of heating in buildings, along with decarbonizing the sources of heat and replacing them with cleaner sustainable heating sources, must be a top priority among policy makers (IDA 2024).

Green Subsidies and Industrial Policy

Many green industries are still in the early stages of maturity. Their development thus creates positive spillovers that are not fully captured by the original investors, which may lead to underinvestment (Rodrik 2014). Green technology adoption and innovation may not arise on their own because of market failures and various externalities, including the cost of carbon emissions or pollution, that are not internalized in energy prices.

Subsidies are one response. A key issue is whether industrial policy is another response to help economies advance in the green transition. China, the EU, the United States, and other advanced economies are, by a large margin, the leaders in implementing industrial policies and are using generous tax incentives, support for R&D, and other measures, including subsidies. Some MICs, too, in recent years have begun to pursue industrial policy interventions, the number of which rose from a low level in 2011 to nearly 1,600 in 2022 (Juhász, Lane, and Rodrik 2023).

Another argument for the deployment of subsidies or engagement in industrial policy by ECA governments is the dearth of innovation in the private sector in many countries. But will subsidies augment the modest private sector effort or crowd it out? It is also important to consider whether subsidies should be offered for frontier innovations or for the infusion of green technologies or whether SOEs should be eligible to receive subsidies. Spending scarce public resources on such policy interventions should be carefully weighed against alternative policies and alternative uses for these resources. These include the need to improve the quality of education, the opportunities for firms to connect with global value chains, and the broader business environment for attracting foreign investment.

A crucial question in designing today's green industrial policies is whether the spread of such policies in China and advanced economies will hurt MICs by limiting the scope for MICs to participate in global green value chains. In such an environment, MICs will likely face more difficulties in producing intermediate products and in learning by doing. This may slow decarbonization in MICs because they will be increasingly troubled by the cost of investment in green technologies to which they cannot contribute. Governments in many smaller MICs are worried that they will be saddled with substantial debt if they import technologies wholesale without the opportunity to be part of the production process.

The Cost of Scaling-Up Renewables and Other Clean Technologies

The transition to renewable power generation and other clean technologies will require substantial investment. A recent IEA report estimated that about $1.1 trillion globally was invested in unabated fossil fuel supply and power (IEA 2023c). About $1.7 trillion was invested in renewable energy. Another IEA report concludes that, worldwide, reaching net-zero emissions by 2050 will require the investment of $10 in clean energy for each $1 invested in fossil fuels (IEA 2023a). Focusing only on low-income countries and MICs and excluding China, a recent World Bank report indicated that power sector investment "must quadruple from an average of $240 billion annually in 2016–20 to $1 trillion in 2030" (World Bank 2023c, iv).

Regional ECA investment needs are huge, too. These range from 5.2 percent of GDP by 2030, excluding energy efficiency, to 4.0 percent of GDP per year by 2060, including energy efficiency (Rozenberg and Fay 2019; World Bank 2024c). These needs, however, must be calibrated based on the complementary reforms governments will introduce. Countries with functioning energy markets and no fossil fuel subsidies will certainly require less additional investment. Kazakhstan's private and public sectors are likely to need an estimated $1.15 trillion in 2025–60 (6 percent of cumulative discounted GDP) to reach net-zero emissions by 2060, and Türkiye, about $644 billion (around 4.8 percent of cumulative discounted GDP) to reach net zero by 2053 (World Bank 2022a, 2022b).

Globally, the private sector is expected to account for 70 percent to 80 percent of the total investment in decarbonization (Ananthakrishnan et al. 2023; IEA 2021). In the ECA region, the estimates are broadly similar: about 60 percent to 90 percent of all investment needs are likely to come from the private sector, and a larger share of the investments will reflect inflows of foreign direct investment and other capital in countries that are more well integrated in global markets.

Globally, the scale-up of renewable electricity generation technologies has been rapid, and the decline in the prices of the technologies has been substantial. In 2023, the world added 50 percent more renewable generation capacity than it had added in 2022 (IEA 2023a, 2024). This is reshaping how government authorities think about energy security, energy production, and economic growth. Because the energy transition begins with the decarbonization of electricity production, this remarkable progress is welcome news. The share of electricity produced by renewables reached 30.0 percent in 2022, up from 21.3 percent in 2012. Within this rise, there have been significant increases in generation from solar photovoltaics and wind energy driven by supportive policies in many regions (Arkolakis and Walsh 2023).

The economic growth benefits of creative destruction occurring because of the emergence of solar photovoltaics and wind technology have been particularly notable in China, Denmark, Germany, and the United Kingdom (Hasna et al. 2023).

China has become a global leader in photovoltaics and wind turbine manufacturing, relying on its large-scale production capabilities to innovate and drive down costs. The United States has witnessed substantial growth in the domestic solar industry, particularly in solar panel installation and innovation. California has led the way in solar adoption, creating thousands of jobs and fostering a robust solar market.[6] Germany's early and sustained investment in solar power, driven by the Energiewende (energy transition) policy, has made the country a leader in solar technology and installation, while Türkiye has leapfrogged many other countries in solar panel manufacturing (refer to box 4.1), and Poland has become one of the world leaders in adopting heat pumps (refer to box 4.2).

BOX 4.1 Solar Panel Manufacturing in Türkiye

Türkiye is the fourth-largest manufacturer of solar panels in the world, benefiting from years of policy support, a large domestic market, and strong domestic demand. Installed capacity grew from 250 megawatts in 2015 to 12,200 megawatts in early 2024.

The Turkish government created incentives for the domestic production of solar panels in 2010 by providing bonus payments on top of the regular feed-in tariffs if modules had a certain share of domestic content (most recently, 55 percent). This arguably led to the establishment of the first wave of domestic panel manufacturers in 2011–13. In 2016, the first Chinese manufacturer, the state-owned enterprise HT Solar Energy, built a factory in Istanbul's Tuzla Free Trade Zone, which produced mainly for export.

To protect its emerging technologies from low-cost modules from China, the Turkish government introduced import tariffs on solar modules. While the introduction of more protection has been paralleled with a surge in new manufacturers, it is not yet clear whether these manufacturers will be competitive given that the export of Turkish solar panels is restricted to Europe and the Middle East. Joint ventures with East Asian firms may also have helped create Türkiye's technical capacity.

In the next phase of foreign market expansion, one manufacturer in 2023 announced a factory opening in Romania, and two firms will build factories in the United States. However, Turkish manufacturers—still unable to compete against the prices offered by Chinese companies—have indicated that the domestic-content credits offered by the Inflation Reduction Act of 2022 in the United States have facilitated their investment.

Sources: World Bank elaboration based on Bellini 2023; *Daily Sabah* 2020; Ernst 2023; IRENA 2023; Kesikli 2020; Stantec 2021.

BOX 4.2 Poland's Rapid Adoption of Heat Pumps

Domestic sales of heat pumps grew rapidly in Poland in 2018–22, from 25,000 units to more than 200,000 units, almost as many as the 236,000 sold in Germany that year. Poland's global share of heat pump manufacturing more than tripled, to 2.3 percent, in 2020–21.

This robust growth has been enabled by a raft of government support programs. The €25 billion Clean Air Program is the main one. Launched in 2018, it aims to help households enhance energy efficiency by replacing old coal heaters with modern systems through the provision of subsidies of up to Zl 66,000 (€14,420) per home. The government has more recently added heat pumps as supportable technology under the My Electricity Program, which provides the equivalent of up to €12,322 per home. The government also developed a heat-specific program in 2021—Moje Ciepło—that supports the purchase and installation of heat pumps in new single-family homes, with up to €4,711 in subsidies.[a]

The expectation that demand in Poland would grow prompted Daikin, a Japanese multinational that is the world's largest manufacturer of air conditioners, to invest €300 million in a factory that employs around 1,000 people and started production in 2025. Likewise, Bosch, a German multinational engineering and technology company, invested €255 million in a factory that employs around 500 people and will start production at the end of 2025 or early 2026.

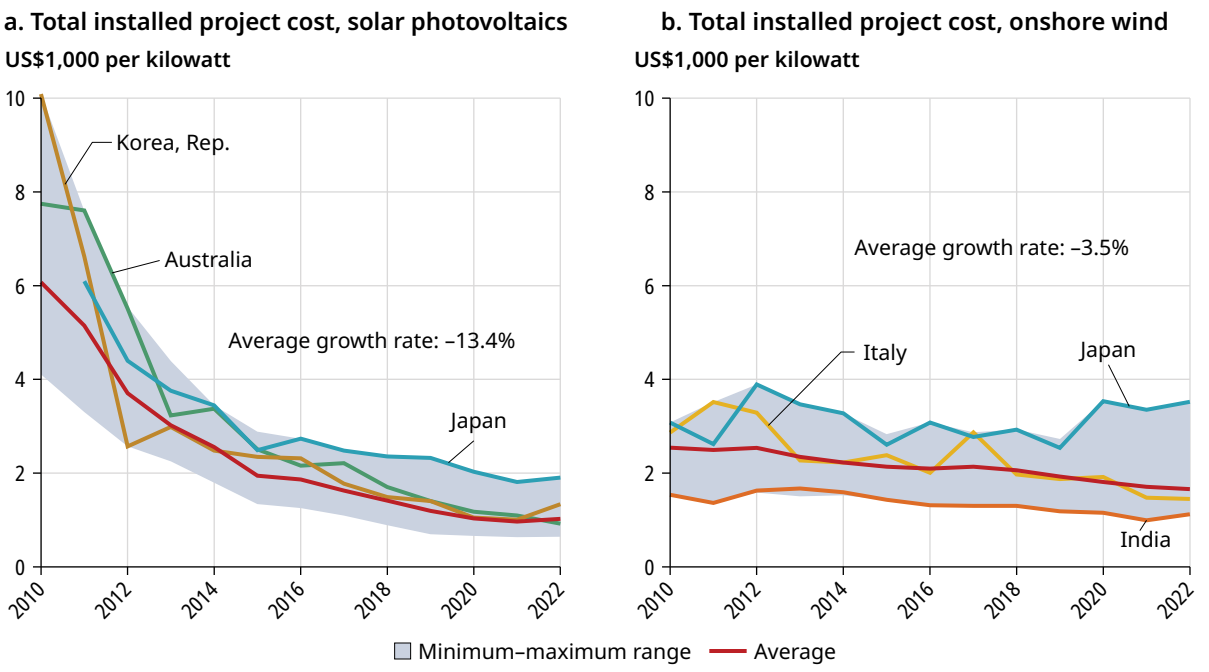
Sources: World Bank based on IEA 2022a; Kurmayer 2024; Ptak 2023.

a. Refer to Moje Ciepło Program (dashboard), National Fund for Environmental Protection and Water Management, Warsaw, https://mojecieplo.gov.pl/o-programie/.

The cost of installing renewable energy has plunged. The costs of electricity production from solar and wind are now among the lowest among all potential energy sources in many parts of the world (refer to figure 4.6, panels a and b). Prices are likely to continue to decline with the ongoing surge in capacity, innovation, and the infusion of knowledge into previously less highly saturated markets.

In the ECA region, the adoption of solar and wind technologies has advanced quickly in a few countries. Hydropower accounts for 20 percent of electricity generation, although its contribution is constrained by periodic water shortages. The other renewable sources have been growing rapidly, but extensive development is so far concentrated in the few countries with a favorable policy framework, principally the four EU member states and Türkiye. Among the ECA solar and wind frontrunners (Croatia, Poland, Romania, and Türkiye), the share of renewable energy in electricity generation has risen to 15 percent, in line with the global average, though it is below the 30 percent share of the global frontrunners, including Germany and the United Kingdom.

FIGURE 4.6 Solar energy and onshore energy costs



Sources: Hallegatte et al. 2024; IRENA 2023; World Bank 2023c.

Note: The sample includes Australia, Canada, China, France, Germany, India, Italy, Japan, Republic of Korea, Spain, the United Kingdom, and the United States.

Lower marginal costs in the generation and rapid spread of renewable energy do not automatically translate into lower prices among final consumers or an opportunity to boost economic growth. To accomplish these goals, a large scale-up in energy storage, including battery storage, is necessary. While there has been substantial progress in battery storage, the technologies are still not sufficiently mature. Transmission and distribution grids also need to be modernized.

Policies for Accelerating the Adoption of Renewables

At the top of the concerns of policy makers is an acceleration in the adoption of renewable technologies, some that are mature and some that will still evolve. Both are useful in their own right, but bare separate risks (that is, path dependence and obsolescence). And it is likely that, among ECA countries that do not yet participate in global value chains, the technologies will need to be imported and adapted by local service providers who will need to install, embed, and maintain the new technologies. Policies will initially have to support infusion (that is, adoption and diffusion) of the new technologies and later innovate. Policies that strengthen markets, sustain structural reforms, and foster integration into global markets are the foundation of these efforts. These policies may be categorized as supply-side and demand-side policies (refer to table 4.1).

TABLE 4.1 Policies to support the adoption of green technologies

Foundational policies	Sector-specific policies
• Create competitive markets • Improve efficiency and effectiveness in the judiciary • Regulate investment • Educate and upskill the workforce • Discipline incumbent SOEs • Improve SOE governance and harden budget constraints	*Supply side* • Provide innovation support for sector-specific R&D • Set sectoral standards, for example, in efficiency • Establish sectoral regulations, such as open access, and develop regional markets for electricity • Train workers on specific technologies • Get energy prices right • Phase out fossil fuel subsidies • Introduce a carbon price *Demand side* • Procure energy through feed-in tariffs and auctions • Establish energy efficiency regulations, for instance, on housing stock, appliances, industry, and transport • Establish consumer incentives for technology replacement, for example, financing and subsidies • Educate consumers about specific programs

Source: World Bank.

Note: Sector-specific policies refer to sectors that are most relevant for the green energy transition. This includes sectors that produce or deliver energy (such as oil and gas extraction, electricity generation, gas, and electricity networks) and energy-consuming sectors (such as industry, transport, housing, and agriculture). SOEs = state-owned enterprises.

A simple, transparent, and predictable energy transition policy package and regulatory environment can reduce risks and the cost of capital. The cost of capital reflects the risks perceived by independent power producers once their mitigants, such as targeted public support or risk-mitigation instruments, are accounted for (World Bank 2024d).

Complementary sectoral regulations may be needed to support success in additional interventions and to overcome barriers erected by incumbent firms. The substantial presence of SOEs in the economy—a set of usually powerful incumbents that may not be supportive of change and investments in lower-carbon technologies—is important. These incumbents are often a powerful force against change, influencing government policy and limiting reforms in regulation or the competitive environment. Rules on access to the electricity grid are thus needed to allow the developers of renewable technologies to connect to the market. This frequently closely depends on the capacity of the transmission system and the views of incumbents on new entrants who may disrupt the profitability of their businesses.

On the demand side, support can be provided for the procurement of green technologies to overcome incorrect economic pricing. For example, electricity generated from sources of renewable energy could be purchased through feed-in tariffs (only in the case of less mature technologies or if the projects are small) or through competitive auctions. The European Commission's guidelines on state aid offer an example of support schemes provided for renewable technologies at various stages of maturity.[7] Consumer incentives may be needed to replace older equipment, such as removing a gas-fired boiler to install a heat pump. This support might involve financing, including on-bill financing, or subsidies whereby the subsidy is justified because of the existence of incorrect economic pricing or to protect vulnerable customers. Information and consumer education are needed to attract support for green technologies and programs.

On the sector-specific supply side, inadequate regulatory policies are a key obstacle. Policies should include efforts to unbundle integrated electricity and natural gas systems, asset decommissioning, and enhancement of the quality of climate-related data to help investors make climate-related decisions. Such policies would result in better governance and greater efficiency among utilities, as well as better emissions tracking. Mandates should be established on energy efficiency, such as structural changes in energy demand in the heating sector (through retrofitting and development of residential building codes) and improved standards for appliances. A better policy framework for public–private partnerships and independent power producers is crucial to enhancing competition.

Training and Retraining

Investment policies will alter the nature of labor demand, shifting labor from sectors intensive in greenhouse gas emissions to lower-carbon sectors. Because the skills required by the two types of jobs differ, workers will need to be retrained, and training in new skills will need to be offered. Active labor market programs to retrain workers whose skill sets are ill matched to the requirements of green jobs will be required.

Weakening the Forces of Preservation

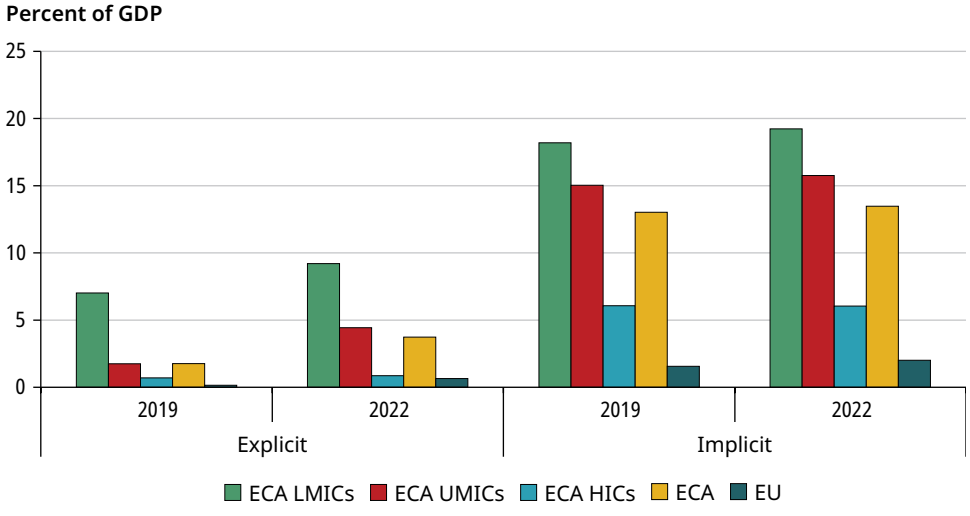
The ECA MICs have not yet weakened the forces of preservation that often stymie the production of lower-emission energy. The dominant SOEs in the region benefit from some of the world's highest fossil fuel subsidies. In several countries, SOEs still fix prices below cost recovery. The influence of SOEs hampers the scale-up of low-carbon technologies and incentivizes the continued inefficient use of energy. To protect them from closing, many ECA governments assign preference to generation by state-owned coal producers with higher marginal costs than generation using renewable resources. This results in the substantial misallocation of human, physical, and financial capital, operational inefficiencies, and market distortions.

Fossil Fuel Subsidies

Subsidies for fossil fuels are among the worst market disincentives for reducing energy intensity and emissions. They promote underpricing in two ways. First, the market prices paid for fossil fuels do not account for externalities, including damage from greenhouse gas emissions and local air pollutants. Second, in many countries, exploration, production, and consumption subsidies artificially lower the costs of supply or of prices paid for fossil fuels and key related products: electricity, diesel fuel, and gasoline. These subsidies increase the attractiveness of investing in fossil fuels and using these sources rather than clean energy alternatives.

Fossil fuel subsidies in the region are among the world's highest. They reached $110 billion in 2020, equivalent to 3.6 percent of regional GDP.[8] Russia accounted for $78 billion of these subsidies (5.2 percent of GDP), while Azerbaijan, Kazakhstan, and Ukraine all provided energy subsidies of more than 4.0 percent of GDP in the same year. By comparison, the EU countries, excluding Poland, spent 0.2 percent of GDP. In 2022, governments in the ECA region and the EU raised energy subsidies in response to surging energy prices, but started to reduce them by mid-2023 thanks to the mild winter of 2022–23. On average, among the ECA HICs, explicit subsidies were under 1 percent of GDP in both 2019 and 2022, while subsidies in the ECA upper-middle-income countries and lower-middle-income countries were higher (refer to figure 4.7).

FIGURE 4.7 Explicit and implicit subsidies, ECA region



Source: Black et al. 2023.

Note: ECA HICs = Bulgaria, Croatia, Poland, and Romania. Group aggregates are calculated as total subsidies, divided by total GDP for each group. The ECA sample includes 20 economies. LMICs = lower-middle-income countries; UMICs = upper-middle-income countries.

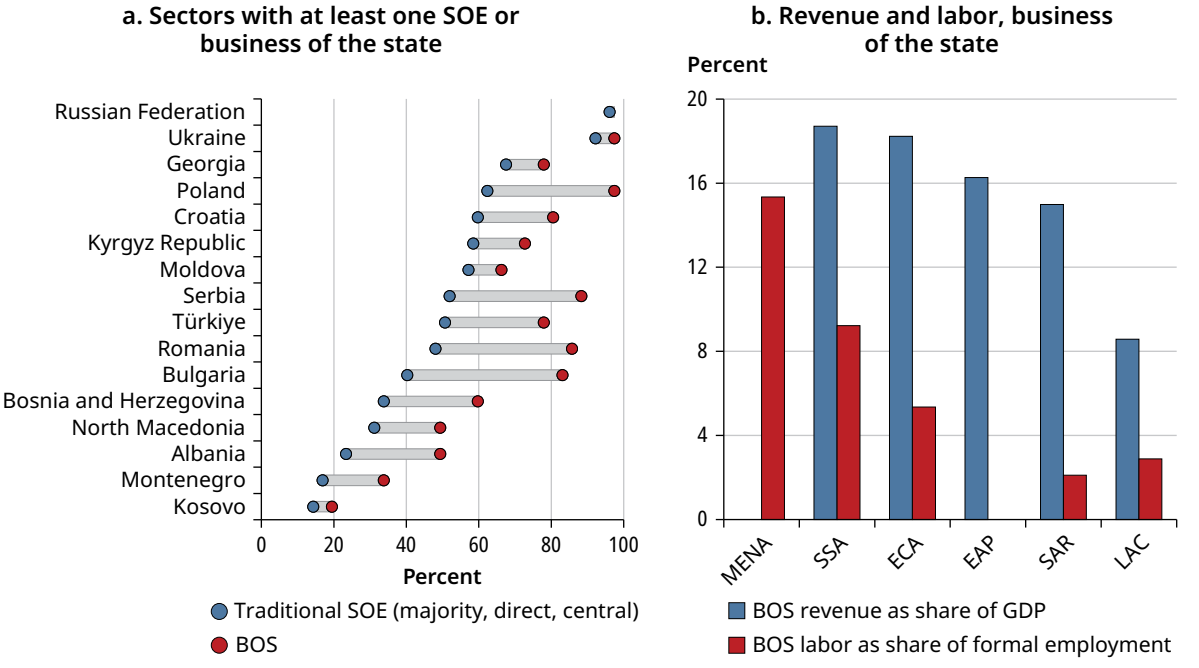
Despite significant declines in gas subsidies over the previous decade, the ripple effects of the European energy crisis resulted in a sharp increase in 2021–22. The rise of natural gas subsidies was especially pronounced in 2022, when the market price of gas (against which subsidy rates are calculated) reached high levels. Even countries with few or no subsidies, such as Croatia, Poland, and Ukraine, adopted measures to protect consumers from damaging price spikes amid the energy crisis.

Currently, natural gas is the backbone of the ECA energy system, accounting for 46 percent of primary energy supply—far higher than the EU's 24 percent—and accompanied by the highest subsidy allocation among energy sources. The orderly removal of fossil fuel subsidies is a precondition for leveling the playing field for low-carbon emission technologies.

State-Owned Enterprises

SOEs account for an oversized ownership share in energy markets in the region. SOEs own all transmission networks, more than 80 percent of fossil fuel generation, nearly 75 percent of hydropower generation, and more than 65 percent of distribution networks. The SOE presence is even more extreme in the energy sector than in the broader economy, where enterprises in which the state has a share are active in more than half the sectors of the economy in more than half the countries (refer to figure 4.8).[9] In solar and wind, however, SOEs account for less than one-fourth of ownership.

FIGURE 4.8 The state is present in many economic sectors, ECA region



Source: Global BOS (Businesses of the State) database (internal database), World Bank, Washington, DC.

Note: Traditional SOEs are SOEs in which the central government holds direct, majority ownership. BOS = businesses of the state; EAP = East Asia and Pacific; LAC = Latin America and Caribbean; MENA = Middle East and North Africa; SAR = South Asia; SOE = state-owned enterprise; SSA = Sub-Saharan Africa.

SOEs account for a much larger share of investment in energy in developing countries than in advanced economies (OECD 2022). In 32 developing economies, one-third of energy investments were made by governments or SOEs in 2019. The SOE investment share in electricity networks, oil and gas supply, and fossil fuel generation was 73 percent in developing countries and 17 percent in advanced economies. For renewables and energy efficiency, it was about 27 percent and 3 percent, respectively.

For a successful energy transition, incumbent SOEs will be pivotal in decarbonizing electricity supply and electrifying energy demand. They will need to increase the share of renewable energy in their generation mix, modernize networks to integrate these variable power sources in the grid, and manage the ever-more varied and complex power needs of consumers. Utilities will need to be at the forefront of an accelerated push to provide electricity access in lagging areas. To meet these demands, ensuring reliable and affordable electricity service will require financially sustainable utilities that (1) can access inexpensive long-term financing, (2) are viable offtakers for private power investors, and (3) have the technological and management capacity to harness the opportunities created by an increasingly modern, distributed power system (World Bank 2024a).

Besides the large subsidies, a crucial obstacle to the transition to lower emissions is the profitability across energy SOEs in the region and their ability to scale up. On average, 29 percent of SOEs in this sector are unprofitable, which is a far higher rate than in other MICs (14 percent) or HICs (12 percent). This weak profitability is creating risks for private firms that seek to invest in clean energy generation in the region.

Market participants believe that most electricity transmission companies do not have the capacity to allow additional connections by independent renewable power producers in the region. In a recent survey among private companies in the region, 88 percent of the stakeholder respondents deemed grid access as a high or remarkably elevated risk (World Bank 2024d). Stakeholders expect most ECA countries to encounter issues in integrating the planned solar and wind volumes without substantial additional investment in transmission and distribution networks. The risk is greater in remote areas with small population densities and high renewable energy potential.

Nonetheless, the large state presence in sectors relevant to the green transition also means that governments can influence the trajectory of these sectors by helping turn SOEs into agents of change. One positive example is the United Kingdom, where privatized transmission and distribution companies that were once SOEs and new regulations that promote innovation competition have increased R&D activity and helped foster the adoption of modern technologies, such as smart grids (Ribeiro and Jamasb 2024). This has enabled a larger share of renewable energy to be incorporated into the grid.

Several studies have explored how climate action can be incorporated into the operations of SOEs. The main approaches involve integrating guidance and requirements on emissions reduction by SOEs within legislative documents; incentivizing SOE shareholders to prompt SOEs to respond to climate change; or supporting SOEs through various programs, alongside support for the private sector (Benoit 2019; De Kleine Feige 2021; Gonguet et al. 2021).

Economic Merit Order

Economic merit order is a method to determine which electricity producers will sell power to the electricity grid. It is based on marginal cost, starting with the lowest cost producer. The electricity price selected is therefore equal to the price of the most expensive dispatched producer, which, in the ECA region, is typically a coal- or gas-fired plant.

If the economic dispatch system is properly implemented, it should incentivize renewable producers and reduce the revenues of coal-fired plants. However, rather than selecting lower marginal cost generators, many ECA countries assign preference to generation by state-owned coal-fired producers with higher marginal costs to protect them from closure. Often, this preference also reflects the need to have backup generators given the slow progress in the installation of battery storage. Thus, while market distortions persist and shift the balance in favor of coal in the ECA countries in which economic dispatch is implemented (including Bulgaria, Poland, and countries in the Western Balkans), the original goals of merit dispatch cannot be met.

In Poland, the government introduced economic dispatch in the power sector in early 1990 as part of its market reforms. Today (and likely in the future), coal is generally the most expensive marginal resource in the Polish power system. However, the coal plants have remained dominant even if electricity prices are lower in neighboring countries and the unit cost of solar and wind has declined to levels below that of coal generation. This stems from limited interconnector capacity to access cheap electricity abroad in moments of system stress. Lignite plants also have must-run status that overrides merit order to ensure that these plants are working at least at 60 percent capacity, the cutoff for them to be profitable. Lower-cost renewable generation is curtailed during system stress because of the lack of flexibility of the coal-fired plants.

Cushioning the Impact of the Forces of Destruction

The transition to lower energy intensity and carbon emissions may create losses among some consumers, workers, and businesses as industries and sectors adjust and so may lead to resistance to the transition. If energy is costlier (say, owing to

the introduction of carbon taxes or the costs of new infrastructure), vulnerable households may ration energy consumption, while energy-intensive firms may lose competitiveness. Many households and small firms may be credit constrained and unable to undertake the up-front capital spending that would allow them to benefit from the operating cost savings of low-carbon energy. The affected groups will push back against well-intentioned reform, with possibly destabilizing consequences. This may lead voters to elect governments that promise to maintain the forces of preservation, entrenching dependency on fossil fuels and making subsequent reforms even more difficult.

Protecting Vulnerable Populations

Addressing these political economy concerns requires careful policy sequencing so that reforms impose no unbearable burdens on any group. There is a trade-off: unambitious reforms that are unlikely to create a backlash may not lead to the emergence of new firms and the destruction of the old. In Kazakhstan, for instance, the level of the carbon price is so low, at slightly above $1 per ton of CO_2 emitted, that it does not force hard choices on major actors.[10] Nor does it shift the economy away from fossil fuels. Identifying more ambitious, but nondestabilizing policies can better serve the purpose of creative destruction.

An important way to make the forces of destruction acceptable to vulnerable groups is by accompanying them with compensatory policies. Reductions in fossil fuel subsidies can be balanced among vulnerable groups by income support that leaves the groups with higher effective income, while saving the government money (because most fossil fuel subsidies apply to all population groups, including the most affluent). And because destruction also involves job losses, as in coal mining, cushioning policies must go beyond income transfers and create new opportunities for workers in affected sectors.

One example is the coal phaseout in Poland agreed to in 2021. The destruction of mining jobs for a complete phaseout by 2049 is to be cushioned with a "social contract" in which workers losing their jobs could elect to continue to receive 80 percent of their salary if close to retirement or receive a severance payment and retraining. In addition, investment in transforming the structure of the most coal-dependent region, Silesia, would be financed through the EU Just Transition Fund.

A Just Transition

Countries such as Bulgaria, Poland, and Romania will benefit from the EU Just Transition Mechanism. Other non-EU economies, including the major fossil fuel exporters in Central Asia or the South Caucasus, need to ensure sufficient fiscal space to fund their just transitions as global demand for fossil fuels declines.

The EU Just Transition Mechanism was unveiled in January 2020 as a regional development initiative. It aims to deliver specialized assistance to EU regions that will face significant adverse impacts from the shift toward a carbon-neutral economy. In Bulgaria, Poland, and Romania, the mechanism will fund just transition–related activities in 13 geographic areas and emphasize the development of small and medium enterprises. Other focus areas are the rehabilitation of industrial sites and coal mine–contaminated land and developing renewable energy, while emphasizing job creation.

Although the current just transition initiatives in the region are still at an initial stage, lessons can be drawn from previous coal phasedowns during the second half of the twentieth century in Eastern Europe, Germany, and the United Kingdom (World Bank 2021). The region has around 450,000 direct coal jobs. A key difference between the historical phasedowns and the current transition is that the former were driven by the declining competitiveness of coal, whereas the latter is associated with the dual challenge of replacing power capacity and creating jobs.

The first lesson is that the scope of just transition support needs to be as holistic as possible, covering entire supply chains of directly and indirectly affected jobs and vulnerable households. This may mean a stark broadening in the scope of the supported population. In Poland, the indirectly affected jobs from a coal phaseout range between 57,000 and 130,000 compared with 158,000 directly affected jobs (Christiaensen et al. 2022).

A second lesson is that there is a trade-off between periodic and lump-sum income support. While lump sums are initially attractive, evidence from Poland and Romania shows that they are often rapidly used up and can lead to wide income shortages absent new employment opportunities. In 1998, Poland introduced the Mining Social Package, which provided options for the voluntary departure of mining workers. Of the people who took the package, most selected a one-time payment (Szpor and Ziółkowska 2018).

The third lesson is that skills, preferences, and wages—key factors in reemploying affected populations—need to be aligned with newly available jobs. The skills and preferences of workers may not be aligned with alternative jobs with the highest overlap in tasks and skills (Christiaensen et al. 2022).

The Role of Government as an Enabler

The primary role of government in the energy transition is to provide certainty in policies, incentivize the private sector, and provide any necessary public investment. The government also has to ensure that transition costs are palatable to all segments of the population that are impacted by the transition, This can be accomplished through social assistance and support in the development of human capital. These tasks require coordination across government, industry groups, and the affected segments of the population.

Conclusions and Policy Recommendations

The transition to lower carbon emissions and, ultimately, net zero has the potential to support higher growth in productivity and output among the ECA MICs. But this link is not automatic and will require deliberate, well-sequenced steps to facilitate technology adoption; the infusion of foreign capital, knowledge, and management expertise; and for some, opportunities for frontier innovation.

A few essential prerequisites are more evident. The first is to create or complete markets for energy, while enabling prices to reflect the true economic and social cost. Governments need to phase out explicit and implicit fossil fuel subsidies that tilt the playing field in favor of high-carbon emission and energy-intensive technologies. This is a priority among the countries of the South Caucasus and Central Asia because of their larger subsidies. Introducing a carbon tax or instituting an ETS also needs to be considered. EU candidate countries are focusing on this at present. Maintaining subsidies while imposing carbon taxes will be hugely inefficient and needs to be avoided.

The political economy challenges are formidable. Many ECA MICs have neither a carbon tax, nor an ETS. The imminent launch of the EU Carbon Border Adjustment Mechanism is likely to have only a modest macroeconomic impact in most countries, although the impact on certain emission-intensive sectors or certain areas or income groups may be more significant (World Bank 2022a, 2024e). Countries may consider a more palatable set of measures, at least initially, by increasing energy taxes. These taxes already cover a significant share of global emissions and send much stronger carbon price signals than their direct counterparts. They also raise much-needed revenue, which can be used to fund vital government services and support vulnerable groups in adjusting to higher energy prices.

The second prerequisite is for governments to help sustain the economy's structural transformation to allow enterprises to integrate more tightly into global markets and value chains. Structural transformation should be aided by stepped-up energy efficiency measures in housing, transport, and other economic sectors. Upgrading enterprise technologies should help raise productivity, while reducing energy use, thereby improving energy efficiency. Institutional capacity in managing energy efficiency is the highest in the EU member states and Türkiye, while there needs to be more efforts in Central Asia, the South Caucasus, and the Western Balkans. The need for standards and regulations is greater in the first two. All ECA countries must strengthen financing mechanisms.

The most crucial step in the transition to lower emissions and more rapid economic growth will require enterprises to participate in global value chains that produce cleaner technologies. Many ECA MICs will find leading on clean

innovation challenging. The experience will be at least as difficult as the adoption of other new technologies in the past; most MICs are now consumers of such technologies. Most ECA countries spend little on R&D and receive few patents relative to China, the advanced economies of the EU, and the United States. And innovation is a path-dependent process not only globally, but also nationally. It depends heavily on the availability of previous innovations, markets, institutions, and talented workers.

This is where the recommendations in the previous two chapters come together. Speeding up the market transition of the ECA region, reinvigorating private enterprise, and dramatically improving the quality of education and mobility are essential to achieving stepped-up innovation, tighter links with global markets, and participation in global value chains, all of which will drive the transition to lower emissions and more rapid economic growth.

Given the prevalence of SOEs, realizing secure and affordable energy while reaching high-income status must involve policies to discipline incumbents. New competitors need to be able to enter the market without hindrance. Policies to facilitate this approach include both ex ante regulation, such as the streamlined design of interconnection charges and strict adherence to economic cost dispatch, and ex post regulation, such as efforts to detect and counteract abuses of dominance. The competition framework, including auctions, access to network connections, and grid integration, are more advanced in the EU member states and Türkiye.

The appropriate mix of policy recommendations depends on the context faced in each country. For this purpose, countries are sorted into four groups, given the heterogeneity in terms of energy that the ECA MICs grouping encompasses (refer to table 4.2): (1) ECA EU members states (Bulgaria, Croatia, Poland, Romania); (2) EU candidates (Georgia, Moldova, Ukraine, Western Balkans); (3) Türkiye, which is also an EU candidate but has a different energy profile and merits presentation separate from (2); and (4) Central Asia and South Caucasus (Armenia, Azerbaijan, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan).

- *For ECA EU members, the key priority areas* revolve around ETS implementation and preparedness for the ETS2 by 2027, disciplining incumbents, removing barriers to entry created by authorization processes and network issues, and dynamically leveling the playing field to nurture innovation and new technologies as they pass through R&D, demonstration, and pilot phases toward commercial viability. This is in addition to the long-term strategic priorities of energy efficiency and the reduction of fossil fuel use, where there has been remarkable progress. For instance, the EU demand for natural gas fell by 18 percent between August 2022 and May 2024, enabled by efficiencies and the scale-up of renewables and supported by a just energy transition (World Bank 2021).

TABLE 4.2 Energy and emissions: summary of recommendations

Recommendation	ECA EU	EU candidates	Türkiye	South Caucasus	Central Asia
Get prices right, fully reflecting economic and social costs					
Phase out explicit subsidies	Medium	Medium	High	High	High
Phase out implicit subsidies	Medium	Medium	Medium	High	High
Introduce CTs and/or ETS	High	High	Medium	Medium	Medium
Create energy markets for renewables					
Support entrants	Medium	Medium	Low	Medium	Medium
Investment framework	High	Medium	Low	Medium	Medium
Regulatory environment	Low	Low	Low	Medium	High
Competition	Medium	High	Low	High	Medium
Economic merit dispatch	Medium	Medium	Medium	High	High
Discipline incumbents	High	High	High	High	High
Energy efficiency across the board					
Standards and regulations	Medium	Medium	Medium	High	Medium
Introduction of more stringent energy efficiency standards for appliances	Low	High	Medium	High	High
Financing	High	High	High	High	High
Reduce fossil fuel usage	High	High	High	High	High
Research and development spending	Medium	High	Medium	High	High
Protect the vulnerable during the transition	High	High	High	High	High

Source: World Bank.

Note: Central Asia: Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan. ECA EU: Bulgaria, Croatia, Poland, Romania. EU candidates: Albania, Bosnia and Herzegovina, Georgia, Kosovo (potential candidate), Moldova, Montenegro, North Macedonia, Serbia, Ukraine. (*Türkiye* is mentioned separately. See text for details.) South Caucasus: Armenia, Azerbaijan, Georgia. The priority ranking of low, medium, or high should be viewed relative to the progress already achieved and relative to other priorities. CT = carbon tax; ETS = emissions trading system.

- *For EU candidates*, the key priority areas revolve around the facilitation of private investments and integration with EU markets (including power and gas markets, ETS, and the carbon border adjustment mechanism), together with strengthening competition and disciplining incumbents to provide space for new entrants and start-ups, while protecting the vulnerable during the transition. Other high priorities include deepening financial markets to attract expertise and investments in highly efficient and low-carbon technologies, which typically offer essential air pollution co-benefits as well.

- *For Türkiye*, which is also an EU candidate, but has a different energy profile, the key priority areas revolve around the phase out of explicit subsidies, while protecting the vulnerable, disciplining incumbents, and attracting financing for the promotion of high-efficiency technology adoption and renewables.
- *For the countries of Central Asia and the South Caucasus*, the key priorities involve getting the foundations right by phasing down explicit coal, power, gas, and district heating subsidies, as well as implicit subsidies, while protecting the vulnerable. Additional priorities are facilitating private investments, reducing the state footprint, disciplining incumbents, strengthening competition through the development of domestic and regional power markets for increased power trade, and introducing economic dispatch for power generators. Improving incentives for high-efficiency and low-carbon technology adoption in building, transport, and industry are also key areas of priority to reduce energy and carbon intensity.

Notes

1. Data reported in 2022. Refer to GCPT (Global Coal Plant Tracker) (dashboard), Global Energy Monitor, Covina, CA, https://globalenergymonitor.org/projects/global-coal-plant-tracker/.
2. The Convergers are the formerly planned economies of Central and Eastern Europe that have achieved high-income status since the 1990s (refer to chapter 1).
3. The other form of an ETS is the baseline-and-credit system. Under such a system, "there is no fixed limit on emissions, but polluters that reduce their emissions more than they otherwise are obliged to can earn 'credits' that they sell to others who need them to comply with regulations they are subject to" (OECD 2021).
4. Refer to EU ETS (European Union Emissions Trading System) (dashboard), European Commission, Brussels, https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en.
5. Refer to ISO 50001: Energy Management (dashboard), International Organization for Standardization, Geneva, https://www.iso.org/iso-50001-energy-management.html.
6. The California Solar Initiative has provided incentives for homeowners and large-scale commercial projects to install solar panels. According to another policy that took effect in 2020 under the California Solar Panel Law, the state mandates "that new single-family homes and multi-family dwellings up to three stories high install solar panels" (Lozanova 2024).
7. State Aid (dashboard), European Commission, Brussels, https://competition-policy.ec.europa.eu/state-aid_en.
8. Globally, fossil fuel subsidies amounted to $7 trillion (7.1 percent of GDP) in 2022 versus $5 trillion in 2020 (Black, Parry, and Vernon 2023).
9. In this chapter, SOE and business of the state refer to any enterprise with direct or indirect government ownership of at least 10 percent.
10. State and Trends of Carbon Pricing Dashboard, World Bank, Washington, DC, https://carbonpricingdashboard.worldbank.org/compliance/price.

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