

Green transition: what have CESEE EU member states achieved so far?

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Scientific evidence and political commitments require decisive measures to both mitigate and adapt to climate change. This stock-taking exercise sheds light on the green transition to climate neutrality in Central, Eastern and Southeastern Europe (CESEE), comparing the EU members in CESEE in the aggregate with the group of other EU countries. Over the last three decades, CESEE economies have converged substantially to EU averages with respect to both carbon intensity and income per capita – on the back of their profound and painful restructuring process mainly in the first decade of their transition to market economies. Analyzing the development of greenhouse gas emissions in CESEE from 1990 to 2018, we find that energy intensity dropped markedly, the share of transport sector emissions increased sharply and reliance on coal, while still substantial, declined. Industry electricity prices before taxes in CESEE are roughly on a par with the EU average, but household energy prices before taxes are still moderately lower in nominal – but clearly higher – in real terms (adjusted for income levels). At the same time, (implicit) CO₂ prices are below EU average levels. Comparing EU member states' climate policy commitments, we find that both the CESEE and the other EU members are very likely to have met the long-standing targets for 2020 on aggregate, with the targets for the CESEE region having been relatively modest. We conclude that despite their still lagging behind somewhat, CESEE economies are generally well positioned to advance their green transition at relatively low costs and to compete for market shares in green industries. However, all EU member states must step up their efforts in the coming years to have a reasonable chance of reaching their net-zero emission target in 2050 and the intermediate target to reduce net emissions by 55% up to 2030. Our assessment is relevant for the ongoing drive in the EU to mobilize finance for sustainable growth – a drive which involves central banks and supervisors in banks' home and host countries.

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Three decades after having embarked on an unprecedented and difficult transition from centrally planned to market economies, EU member states in Central, Eastern and Southeastern Europe (CESEE)² are now increasingly focusing on a new – green – transition. This transition to a low-carbon economy is likely to last another 30 years. Given their experience, CESEE countries are well equipped to embrace transition as a permanent process (Holzmann, 2019). This is also supported by a transition risk assessment comprising exposure and resilience indicators that was conducted by Peszko et al. (2020).

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² In this study, the term CESEE EU member states, in short CESEE EU MS, CESEE countries, CESEE region or CESEE-EU, comprises the following current EU member states: Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia. The group of other EU member states does not include the UK if not mentioned otherwise.

Viewed as an economic priority by the IMF, climate change presents risks to the functioning and stability of economic and financial systems. Meanwhile, the response to this challenge, which has been enshrined in the multilateral Paris Agreement with the goal to limit global warming to well below 2°C above pre-industrial levels and to pursue efforts to keep it to 1.5°C, also offers opportunities for growth and jobs (IMF, 2020a). To be sure, a skill transformation will also be necessary (Strietska-Illina and Tahmina, 2019). The International Energy Agency (IEA, 2021b) calls the Paris-aligned objective of net-zero emissions by 2050 a “monumental task” and points to the implied need to stop issuing permits for new oil or gas fields, to close all inefficient coal-fired power plants by 2030 and to stop selling cars with combustion engines by 2035. In support of this objective, the EU has prepared its Green Deal for Europe to become the first climate-neutral continent by mid-century. To this end, it pursues an intermediate target – cutting net emissions, compared to 1990, by at least 55% by 2030 (EC, 2019 and 2021e; EU, 2021). For the CESEE countries, meeting these targets might be an even bigger challenge in the medium term, given their aspiration to reach above-average growth to ensure convergence.

The exposure of CESEE EU countries to physical climate change damage is likely to be generally below the European average, according to the International Panel on Climate Change (IPCC, 2018), although the Southeastern European subregion is more vulnerable to droughts and other extreme weather events.

In terms of climate awareness, there seems to exist a West-East gap among EU member states (MS). According to an EIB survey (Lecerf, 2021), 33% of all EU residents, but only 22% in CESEE EU MS, perceive climate change to be the biggest challenge in their country.

While the costs of green transition may be perceived to be comparatively high, the long-term costs of inaction are even higher (IMF, 2020a). Short-term incentives to free ride on mitigation notwithstanding, no country can, at the end of the day, claim to be a “winner” by not acting. For the Paris Agreement to succeed, every country must contribute to climate change mitigation, while compensations must ensure that nobody is left behind in a transition that implies higher (shadow) prices for greenhouse gases and energy. This is why the EU’s Green Deal focuses on a just transition to climate neutrality, while maintaining the polluter-pays principle.

That said, transition also offers significant opportunities for CESEE economies in the EU. Compared with other EU MS, their still lower energy efficiency and higher carbon intensity might provide some low-hanging fruit for decarbonization, left over from the previous harvest. Moreover, CESEE’s trade openness and integration in value chains – together with a high stock of human and physical capital – facilitate access to technologies and markets. As the costs for renewable energy, storage and other critical technologies are on a downward spiral, green transition promises productivity gains in certain sectors (IMF, 2020b) and could help enhance energy security in view of the region’s geopolitical environment. Hence, CESEE EU MS have reason to look at the European Green Deal as a window of opportunity rather than as a risk of widening technology and income gaps between Western and Eastern EU members.

The remainder of the article is structured as follows: section 1 takes stock of greenhouse gas emissions in CESEE and their relationship with economic development, energy intensity and energy products. Section 2 discusses international and

EU-related climate policy commitments and their fulfillment to date. Providing an initial stocktaking, the analysis is focused on comparing the aggregate of CESEE EU MS with that of other EU MS. Country-level information is generally limited to ranges for the two country aggregates. The final section summarizes our assessment of the state of play.

1 Comparative stocktaking of greenhouse gas emissions

As a starting point, we look at total greenhouse gas (GHG) emissions (without LULUCF)³ in the context of CESEE EU countries' economic catching-up process. Then, we decompose GHG emissions per capita into emission intensity, energy intensity and GDP per capita (reflecting both GDP and population growth). After highlighting sectoral emissions, we examine energy supply and the role of coal.

1.1 Greenhouse gas emissions and the economy

CESEE's economic transition started in 1990, and that year is also a major reference point for international climate policy commitments. The transition process in CESEE, which was both profound and painful, brought structural change toward services as well as shifts and modernization within the industrial sector, implying a massive wave of decarbonization. As shown in the left panel of chart 1, the CESEE economies went through a sharp transformation recession in the early 1990s. Until the great financial crisis (GFC) in 2008, GDP per capita at PPP grew swiftly and at a markedly higher rate than in the other EU MS. After the GFC, the catching-up process resumed.

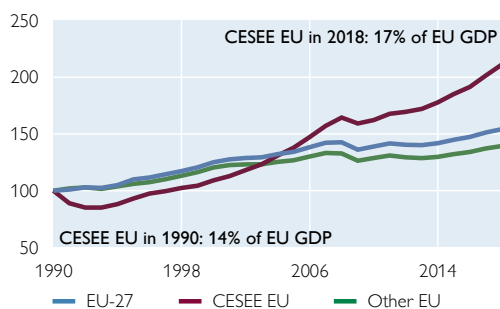
In parallel, from 1990 until the early 2000s, total GHG emissions fell substantially in the CESEE EU MS on aggregate, while they did not decline in the group of other EU MS but remained largely unchanged in this period.⁴

Chart 1

Developments of GDP per capita and total GHG emissions

GDP per capita at PPP

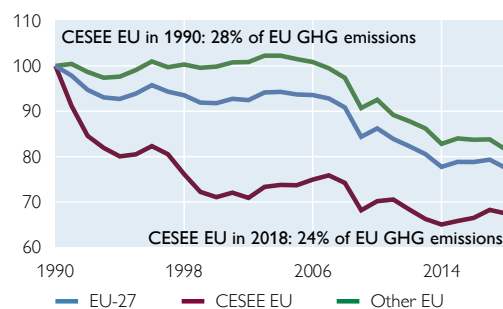
Index, 1990=100



Source: Eurostat, wiw, authors' calculations.

Total GHG emissions without LULUCF

Index, 1990=100



Source: UNFCCC, authors' calculations.

Note: LULUCF = land use, land-use change and forestry.

³ All monitored types of greenhouse gases are included and converted into CO₂ equivalents. Hence, also the term "carbon" (e.g. in "carbon emissions") relates to this concept. LULUCF is short for "land use, land-use change and forestry"; unlike other sectors, this category can be both a source and a sink of carbon emissions, depending on human activity. A country's GHG emissions include emissions related to export production but not those related to imports. The latter are, however, not deducted either – thus, unlike the concept of GDP, that of GHG emissions is more similar to the concept of total final demand.

⁴ Please note that when we talk about CESEE EU MS and other EU MS in this study, we refer to the aggregates of these two regions.

From about 2005, GHG emissions, however, fell much more strongly in the other EU MS than in the CESEE EU MS. The CESEE region even saw an increase in GHG emissions during the years of very fast GDP per capita growth until the GFC, after which GHG emissions declined until 2014, before rising again up to 2017. Over the whole observation period from 1990 to 2018 (at the time of writing the last year for which comprehensive, detailed datasets were available), GHG emissions declined more strongly in the CESEE region than in the other EU MS, which was mainly due to reductions between 1990 and the early 2000s.

To better understand the factors driving emissions, we decompose GHG emissions per capita into (1) emission intensity (GHG/energy use, i.e. GHG emissions per unit of energy used⁵), (2) energy intensity (energy use/GDP at constant prices and purchasing power parities, i.e. energy used per unit of real income produced) and (3) GDP per capita, i.e. real income produced per person (see e.g. OECD, 2012; Köppl et al., 2019). We present these four indicators in charts 2a to 2d, which depict the regional weighted average and the minimum-maximum ranges (with country names in parentheses) for the CESEE EU MS and the group of other EU MS. To visualize both developments over time, all indicators are indexed to the EU-27 level in 1990 (EU-27/1990 level).

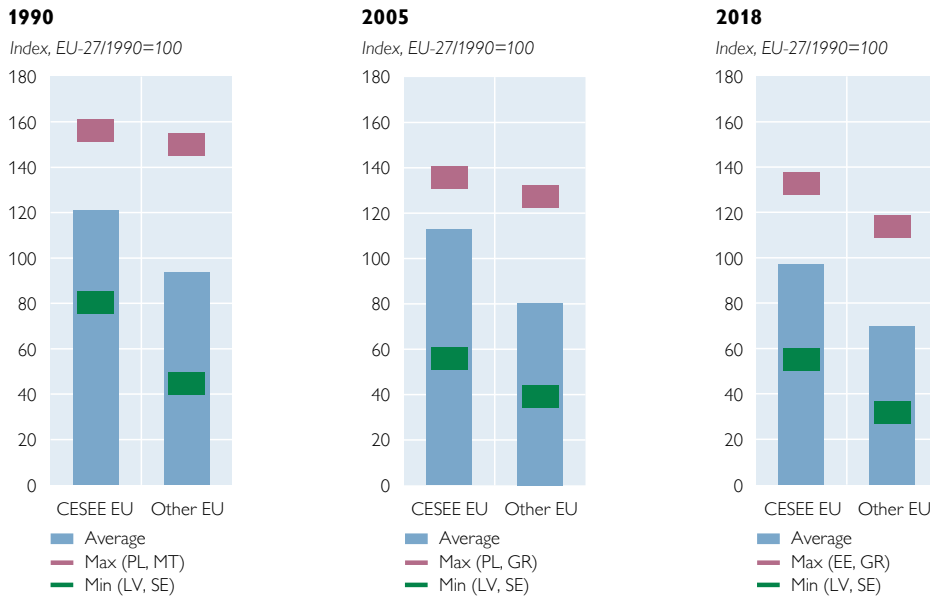
Note that GHG emissions per capita levels in the CESEE region stood only slightly above those in the group of other EU MS in 1990. Yet, the starting position of the CESEE economies was characterized by higher emission intensity and markedly higher energy intensity. At the same time, GDP per capita levels achieved by these economies were much lower compared with those of the other EU MS. Taken together, the lower degree of economic development in the CESEE region almost fully offset the higher degree of carbon intensity (i.e. the product of energy and emission intensities) of its economies, when it comes to GHG emissions per capita. While the CESEE EU countries diverged somewhat less than the other EU MS in terms of emission intensity, which depends mainly on the type of fuel mix used, they diverged much more in terms of energy intensity. The lowest country-specific level among CESEE EU MS stood below the average level of the other EU MS in terms of emission intensity but was close to that level in terms of energy intensity. Overall, the adjustment potential in CESEE was particularly large with respect to energy intensity.

Indeed, in CESEE, the transformation recession and economic restructuring away from energy-intensive heavy industries caused energy intensity to fall sharply, from about 160% of the EU-27 level in 1990 to slightly below that level in 2005. Emission intensity declined only from about 120% of the EU-27 level in 1990 to about 110% of that level in 2005. From 2005 to 2018, energy intensity decreased at a much slower pace and emission intensity at a somewhat faster pace than before.

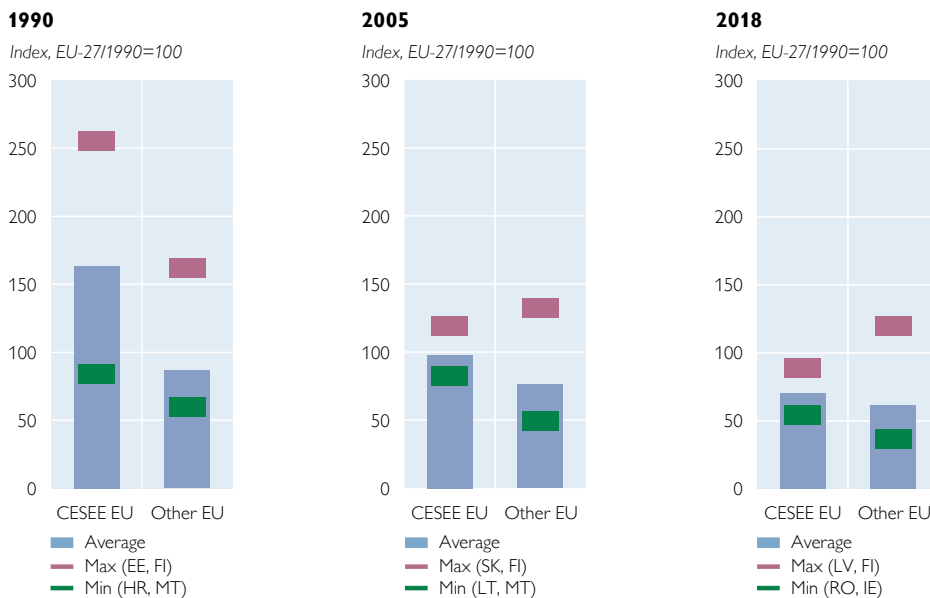
⁵ Energy use relates to “final energy consumption” (FEC), i.e. consumption of all types of fuel by all types of end users (households and companies). Thus, FEC includes as one major component “transformation output” (especially electricity and heat) produced by the energy sector from “transformation input” (e.g. coal, oil and gas), which is excluded from FEC.

Chart 2

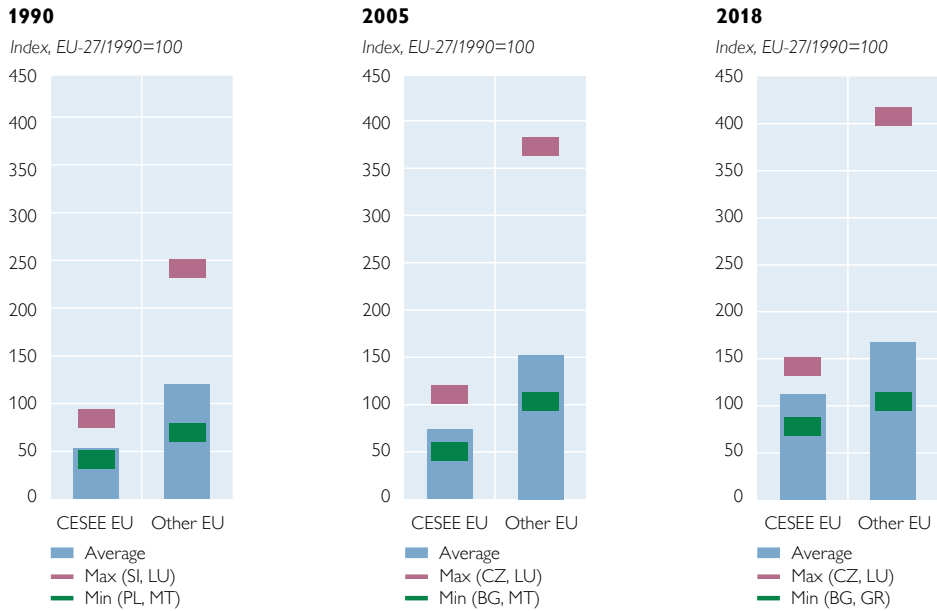
(a) Emission intensity (GHG/energy use) in CESEE EU MS and other EU MS



(b) Energy intensity (energy use/GDP) in CESEE EU MS and other EU MS



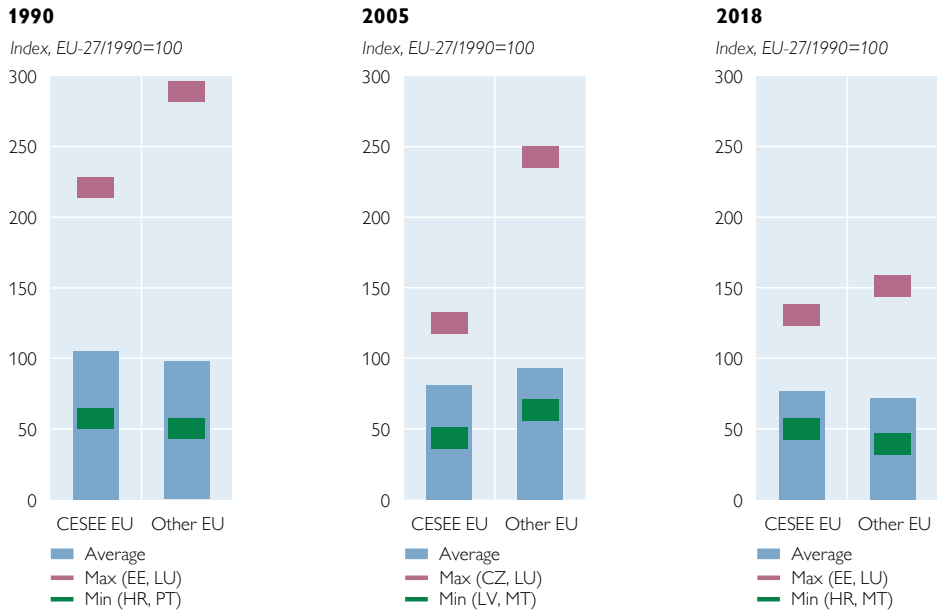
(c) GDP per capita in CESEE EU MS and other EU MS



Source: Eurostat, wiiv, authors' calculations.

Note: GDP calculated at constant prices and using purchasing power parities.

(d) GHG emissions per capita in CESEE EU MS and other EU MS



Source: UNFCCC, Eurostat, authors' calculations.

In the group of the other EU MS, energy intensity's decline accelerated after 2005, but did not match the pace seen in CESEE, while emission intensity's decline continued at an unchanged pace after 2005, equal to the accelerated pace of decline in CESEE. In sum, from 1990 to 2018, the decline in energy intensity was much more pronounced in CESEE than in the comparison group, while the reduction in emission intensity was moderately higher in the other EU MS. Taken both indicators together, carbon intensity declined by 65% in CESEE and by 47% in the group of other EU MS. The strong reduction of energy intensity was broad based across the CESEE region, with the range narrowing considerably, driven by a sharply lower maximum level.

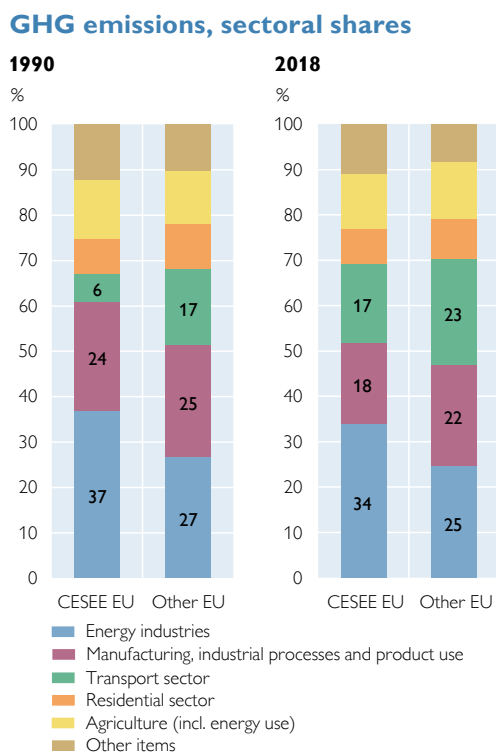
How did the decline in carbon intensity, which went hand in hand with a strong rise in GDP per capita in the CESEE region and a less pronounced rise in the other EU MS (see chart 1), impact on GHG emissions per capita levels? Well, GHG emissions per capita declined roughly equally in both groups from 1990 to 2018. As shown in the right panel of chart 2d, GHG emissions per capita in CESEE stood at slightly below 80% of the EU-27/1990 level in 2018, again only a little above the level of the other EU MS.

The roughly equal decline of GHG emissions per capita in CESEE and the other EU MS translates into a substantially stronger reduction of total GHG emissions in CESEE (chart 1), as the population decreased by 7% in CESEE but increased by 11% in the other EU MS in the period under review.

Let us do a thought experiment to appreciate the decisive role that the decrease in carbon intensity played (mainly through reducing energy intensity): had energy and emission intensities remained constant and GDP grown at the actually registered speed, economic growth would have driven up GHG emissions per capita to more than 220% of the EU-27/1990 level. Thus, economic restructuring in CESEE during transition proved beneficial in terms of both economic convergence (measured by GDP per capita) and carbon efficiency (i.e. the inverse of carbon intensity), with the latter being so pronounced that GHG emissions per capita declined despite substantial economic catching-up. Indeed, from 1991 to 2015, GHG emissions per capita in the CESEE region stood below that in the group of the other EU MS. Thereafter, however, the other EU MS were more successful than the CESEE countries in bringing down GHG emissions per capita by reducing carbon intensity. Overall, as is evident from chart 2, the difference between CESEE and the other EU MS declined considerably for all indicators from 1990 to 2018. Yet, there is still scope for further convergence with respect to both carbon intensity and GDP per capita – and both are moving targets.

A sectoral breakdown of GHG emissions provides further insights into differences between the CESEE region and the other EU MS (chart 3). In both regions, energy industries, manufacturing (including industrial processes and product use) and transport accounted for the bulk of total emissions in 1990 as well as in 2018. While having declined slightly in both regions since 1990, energy industry emissions nevertheless continued to constitute a markedly higher share in total emissions in CESEE. The share of emissions from the manufacturing sector decreased more strongly in CESEE than in the other EU MS as a result of structural change and modernization. The share of transport sector emissions rose considerably in both country groups, and particularly strongly in the CESEE region; the latter's share continued to remain somewhat below the corresponding figure for the other EU

Chart 3



Source: UNFCCC, authors' calculations.

MS in 2018, however. In both groups, transport emissions increased not only in relative but also in absolute terms, while all other sectors registered GHG decreases.

Absolute transport emissions provide the most telling evidence: in the period under review, they rose by 86% in the CESEE region and by 14% in the other EU MS. In 2018, 53% (CESEE) and 58% (other EU MS) stemmed from emissions from passenger cars, which had risen by 125% and 11% in the respective groups. Notably, in the other EU MS, transport sector emissions, which had peaked in 2004, declined up to 2012. Despite a moderate uptick in 2015/2016, they fell clearly short of the 2004 peak level in 2018. By contrast, the rise in transport sector emissions in CESEE accelerated markedly in the early 2000s. The upward trend was only temporarily reversed in the wake of the GFC, after which transport sector emissions increased again strongly.

Having started from less than 50% of the EU-27 average in 1990, CESEE's transport sector emissions per capita almost reached that level in 2018, while the emissions of the other EU MS stood about 20% above that level both in 1990 and 2018 (chart 4). The divergence among CESEE countries widened, as the maximum level moved up more strongly than the minimum level, illustrating very high growth in transport emissions in some CESEE countries. In 2018, divergence among the CESEE EU MS was considerably more pronounced than that among the other EU MS.

1.2 The role of coal as an energy source

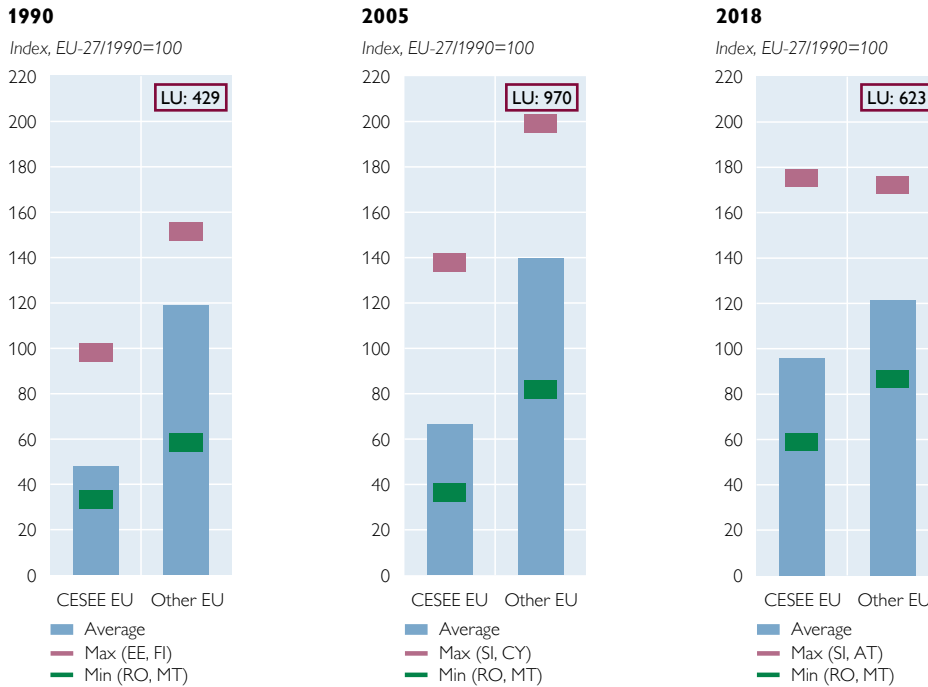
In 2018, fossil fuels (including nonrenewable waste) accounted for 79% (CESEE EU MS) and 69% (other EU MS) of total energy supply⁶. The shares of nuclear energy stood at 8% and 15%, while energy from renewable sources contributed 12% and 16%. Among fossil fuels, coal held a share of 40% in CESEE in 2018, compared to 16% in the other EU MS. This is one of the reasons why emission intensity in CESEE has remained markedly higher than in the other EU MS.

At the start of the transition period in 1990, coal made up 46% of CESEE's total energy supply. This figure was more than double the other EU MS average and even exceeded their maximum country level (chart 5). In the individual CESEE countries, the share of coal ranged from 5% to 76%, and was (well) above 20% in the five largest economies. In CESEE and in the region's five largest economies,

⁶ Total energy supply includes as one major component "transformation input" but excludes "transformation output," and it also includes energy for non-energy use.

Chart 4

Transport sector emissions per capita



Source: UNFCCC, authors' calculations.

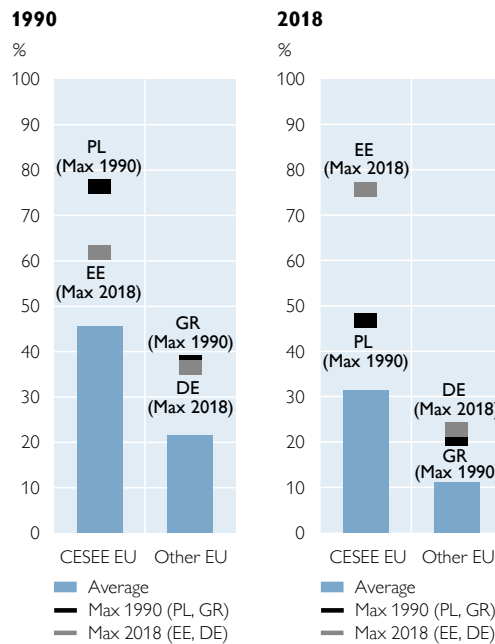
Note: The values for the outlier Luxembourg are shown separately at the top of each panel.

economic transformation led to a considerable decline in the importance of coal as an energy source. Its share fell markedly, reaching 31% in 2018, which, however, still exceeded the level the other EU MS had registered in 1990. In the other EU MS, the share of coal went down to 11% in the period under review. The substantial decline in the share of coal in CESEE is even more remarkable as total energy supply contracted considerably (-18%) at the same time, while the other EU MS saw a 5% increase in total energy supply.

When we take a look at the use of coal in the EU as a whole in 2018, we see that 41% was attributable to CESEE, while the other EU MS accounted for the remaining 59%. The three countries with the highest shares in EU-wide coal use are Germany (32%), Poland (23%) and Czechia (7%) (IEA, 2021a).

Chart 5

Share of coal in total energy supply



Source: IEA, authors' calculations.

Between 2018 and 2020, within the EU only these three countries established new coal-fired power plants, yet only in Poland did the new capacities exceed the retired old ones. In the EU, coal mines operate not only in CESEE countries (Poland, Czechia, Romania, Bulgaria, Hungary) but also in Germany and Greece. New coal mines have, however, been proposed only in Poland, Czechia and Romania (GEM, 2021).

Note in this context that higher shares of (mostly domestic) coal in CESEE have gone hand in hand with lower import shares in total energy supply (42% in CESEE EU MS versus 60% in the other EU MS in 2018), with imports including imports from other countries of the same group.

1.3 Energy prices and (implicit) carbon taxes

For completeness, we want to add that, in CESEE, electricity prices (before taxes) for industry are roughly on a par with the EU average, likely also thanks to the introduction of the EU-wide Emissions Trading System (ETS). Household electricity, natural gas and diesel prices (before taxes) in the region are still moderately lower in nominal but clearly higher in real terms than the respective EU averages (IEA, 2021a). At the same time, (implicit) CO₂ prices in CESEE are below the EU averages (OECD, 2021); these topics merit further research.

2 International commitments and their fulfillment

The Kyoto Protocol to the United Nations Framework Convention on Climate Change of 1992 (UNFCCC) was adopted in 1997 and entered into force in 2005. For 37 countries and the EU, this protocol set the objective to reduce GHG emissions by 5% over the 2008–12 period compared to 1990 levels (ECA, 2017, p. 17). The EU committed itself to reducing its emissions by 8% instead of 5% (Council of the EU, 2002). The countries belonging to the EU at that time (including the UK) did reduce their emissions by 11% on aggregate (with emission levels in 2011–12 even lower than in the crisis year 2009), while the current CESEE EU countries cut emissions by 30% as a result of reductions in the 1990s (see section 1).

2.1 Climate policy targets for 2020

Setting an overall climate policy target for 2020, the EU and its member states committed to reducing their GHG emissions by 20% by 2020 compared to 1990 levels (with a view to cutting emissions by 60% to 80% by 2050 compared to 1990). Following initial political declarations in 2007, this became a unilateral commitment in 2009, and a multilateral commitment under the Doha amendment of the Kyoto Protocol in 2012 (EU, 2009a; ECA, 2017, p. 17)⁷. To fulfill this commitment, the EU chose a three-pronged approach comprising (1) direct subtargets for GHG emissions, (2) targets for the minimum share of energy from renewable sources in total final energy consumption, and (3) targets for the reduction of primary and final energy consumption to advance energy efficiency.

These targets were set both for the entire EU and for each member state (EU, 2009a to 2009c; EU, 2012). The MS targets for energy efficiency (third item in the

⁷ In the international negotiations on further climate policy steps after expiry of the initial Kyoto Protocol, the EU had offered in March 2007 to cut GHG emissions by 30% compared to 1990 levels by 2020. This was on the condition that other developed countries commit themselves to comparable emission reductions and economically more advanced developing countries commit themselves to contributing adequately according to their responsibilities and capabilities (EU, 2009a, Recital 3).

following list) were indicative, i.e. nonbinding, and, having been originally set in 2012/13, they were partly revised later (EC, 2017 and 2020b).

First, binding GHG emission subtargets were set compared to 2005 levels. In the ETS sectors, the aim was to reduce EU-wide allowances by 21%, and in other (non-ETS) sectors, to cap the aggregate increase in CESEE at 14% and to attain an aggregate reduction by at least 13% in the other EU MS (excluding the UK, see footnote 2) and hence by 8% for the EU-27 (see table 1). Emissions in other sectors were allowed to increase in each CESEE country, ranging from +4% (Slovenia) to +20% (Bulgaria), while in the other EU MS, slight increases were envisaged only for Malta and Portugal.

Second, the binding targets set for the shares of energy from renewable sources (particularly hydro, wind, solar, biomass) in total final energy consumption (FEC) were 20% for the EU-28, and (based on country-specific targets) implicitly 17% for the CESEE EU MS on aggregate, 21% for the group of the other EU MS (excluding the UK) and hence 20.6% for the EU-27. Compared to 2005, these target shares implied an increase by 6.5 percentage points for CESEE and by 11 percentage points for the rest of the EU.

Third, the binding 20% reduction at the EU level, when compared to the FEC level projected in 2007 for 2020, implied the need to decrease EU-28 FEC by 9% until 2020 compared to 2005. Eventually, member states set final national indicative FEC targets meant to deliver the agreed reduction on aggregate. The targets implied a maximum aggregate increase (+4.5% against 2005) for CESEE and an aggregate reduction (–11%) for the other EU MS (excluding the UK) and –8% for the EU-27. The increase in CESEE overall was to be due to substantial increases in Poland, Romania and Latvia. Of the other EU MS, three countries likewise envisaged increases, namely Finland, Cyprus and Malta.

Turning to actual changes, we note that all the abovementioned targets were roughly met. First, by 2018, the CESEE EU MS had on aggregate increased their GHG emissions in other (non-ETS) sectors by 5% compared to 2005, while the other EU MS had lowered their GHG emissions by 13% (see table 1). Thus, both groups complied with their target. The said rise in CESEE was attributable to only four (of the eleven) countries, two of which exceeded their respective established limits for increases. Among the other EU MS, only Malta registered an (excessive) increase, but eight other countries clearly failed to reduce GHG emissions in the non-ETS sectors to the extent required. At the EU level, the 2020 target was very likely to have been met already in 2018, and considering the impact of the pandemic even more so in 2020.

Second, regarding renewable energy targets, CESEE had, by 2019, on aggregate increased its share of energy from renewable sources in total FEC by about 6.5 percentage points compared to 2005. It thus met its aggregate target for 2020. The other EU MS raised their respective aggregate share by 10 percentage points, hence falling slightly short of their 2020 target. Four (of the eleven) CESEE countries had not yet reached their 2020 target by 2019, compared to ten (of the sixteen) other EU MS.

Third, as to the FEC reduction at the EU level, the CESEE countries had by 2019 on aggregate increased FEC by 6% compared to 2005 levels, hence needing to reduce it by 1.5% in 2020. The other EU MS decreased FEC by 8% compared to 2005 and needed to reduce it by another 3% in 2020. Performance at the country level

differed considerably relative to the indicative national targets. In 2020, the EU-level target was very likely to have been achieved on the back of the COVID-19 pandemic.

2.2 Climate policy targets for 2030 and beyond

Developing climate policy targets for 2030 and beyond, the European Council in October 2009 supported the more ambitious objective of reducing EU-wide GHG emission by 80% to 95% compared to 1990 levels by 2050. Starting in October 2014, it repeatedly endorsed a binding target of reducing said emissions by at least 40% by 2030 compared to 1990. Both this overall target and consistent subtargets in line with the three-pronged approach were formally set in 2018 (EU, 2018a to 2018d).

Binding GHG emission subtargets were set again relative to 2005 levels. In the ETS sectors, this translated to an EU-wide reduction of allowances by 43%. The aggregate reductions envisaged for the other sectors amounted to 7% in CESEE and to at least 34% in the rest of the EU (excluding the UK).

The renewable energy share was to meet a binding target of 32% for the EU-28. In addition, member states were obliged to set national targets for their contributions to the EU-wide increase, possibly considering an agreed formula (EU, 2018c). The latter was meant to yield aggregate targets of 27.3% for CESEE, 33.2% for the other EU MS and 32.1% for the EU-27. However, the objectives defined by member states in their national energy and climate plans (NECPs) implied targets of only 25.4% for CESEE but 34.7% for the other EU MS (excluding the UK), yielding 33% for the EU-27.

The indicative FEC targets set by member states in their NECPs imply aggregate reductions of 3% for CESEE and of 12% in the other EU MS (excluding the UK), compared to 2019 levels.

The Paris Agreement did not immediately raise the Union's 2030 energy and climate targets (EU, 2018e). However, it helped raise awareness about both the need for achieving net-zero greenhouse gas emissions in the Union by 2050 (EC, 2018) and the concept of climate neutrality as the cornerstone of the European Green Deal (EC, 2019). As a result, the new European Climate Law, which, after having been endorsed by the European Parliament and the Council, entered into force on July 29, 2021, also raised the level of intermediate commitment: "the binding Union 2030 climate target shall be a domestic reduction of net greenhouse gas emissions (after deduction of removals) by at least 55% compared to 1990 levels by 2030" (EU, 2021, Art. 4 (1)). As the amount of net removals to be deducted is determined by law (Art. 4 (3)), this target corresponds to a gross reduction of GHG emissions of about 52.5%, up from the previous 40% target. Based on this new overall target, the European Commission on July 14, 2021 proposed its "Fit for 55" package of legislative proposals, in which the subtargets under the three-pronged approach were consistently revised (EC, 2021a to 2021d).

The proposed GHG emission subtargets, set again relative to 2005 levels, include a reduction by 61% for ETS sectors. In non-ETS sectors, the implied aggregate reductions were revised to 18% (CESEE) and 45% (other EU MS). Table 1 provides an overview of overall commitments, corresponding subtargets and actual achievements with respect to GHG emissions. The proposed EU-wide target share of renewables equals 40%, up 7 to 8 percentage points from the current target. The proposed EU-wide FEC target is 11% lower than the current total of indicative national targets, which implies a 20% reduction against the 2019 level.

Table 1

EU GHG emissions: targeted changes compared with actual changes

	CESEE EU			Other EU			EU-27		
	Total	ETS	Other	Total	ETS	Other	Total	ETS	Other
Change in %									
Actual:									
1990 to 2005	-26	-27	-25	2	5	-1	-6	-6	-7
2005 to 2018	-8	-21	5	-20	-28	-13	-17	-26	-10

2020 target agreed in 2007–09 to reduce EU-28 emissions by 20% versus 1990:

Thus, agreed subtargets for sectoral changes versus 2005: (a) current ETS sectors: -21%, and (b) other sectors: specific minimum reductions or maximum increases for individual MS ranging from -20% to +20%, which imply the following aggregate targeted changes for the EU-27 and the two subgroups:

2005 to 2020	-4	-21	14	-17	-21	-13	-14	-21	-8
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2030 target agreed in 2014–18 to reduce EU-28 emissions by 40% versus 1990:

Thus, agreed subtargets for sectoral changes versus 2005: (a) current ETS sectors: -43%, and (b) other sectors: -30% for the EU-28, with specific minimum reductions for individual MS ranging from -40% to 0%, which imply the following aggregate targeted changes for the EU-27 and the two subgroups:

2005 to 2030	-26	-43	-7	-38	-43	-34	-35	-43	-29
2018 to 2030	-19	-28	-12	-23	-21	-24	-22	-23	-21

2030 target agreed in 2021 to reduce EU-27 net emissions by 55% versus 1990:

Thus, subtargets for sectoral changes versus 2005, as proposed by the European Commission: (a) current ETS sectors: -61%, and (b) other sectors: -40% for the EU-27, with specific minimum reductions for individual MS ranging from -50% to -10%, which imply the following aggregate targeted changes for the EU-27 and the two subgroups:

2005 to 2030	-41	-61	-18	-52	-61	-45	-49	-61	-40
2018 to 2030	-35	-51	-22	-40	-46	-37	-39	-47	-33

Source: European Commission (2021a, 2021b), EEA (2021), EU (2018a, 2018b, 2021b), UNFCCC (2021).

Note: For implied targeted changes, uniform ETS application across member states is assumed for simplicity. ETS covers most energy industries (electricity and heat plants, petroleum refining) and the major part of manufacturing with respect to both fuel combustion and industrial processes and product use. Thus, other (i.e. non-ETS) covers inter alia the remaining energy industries, transport, residential and commercial buildings, other industrial processes and product use, agriculture, and waste (outside heat plants).

3 Summary and conclusions

In this study, we analyzed the state of play of the green transition in the EU, comparing the progress made in the eleven CESEE EU MS from 1990 to 2018 with that of the 16 other EU MS. The physical risks of climate change are broadly the same in both country groups. In contrast, transition risks that occur on the bumpy road to a low-carbon economy are still more of an issue in CESEE, given this region's higher carbon intensity.

CESEE EU MS achieved sizable cuts in greenhouse gas emissions in the first decade of their transition to market economies. Then, their priority was to fundamentally restructure the economy to raise both competitiveness and income. Apart from a shift to services, this process meant overhauling manufacturing and energy industries by investing in state-of-the-art technology. As the CESEE countries succeeded in reducing energy intensity (substantially) and emission intensity (moderately), GHG emissions per capita (and in total) decreased while income per capita increased. CESEE's transition to market economies thus already implied a kind of green transition – even if this was not the result of a targeted climate policy

but an unintended side effect of painful structural change that largely resulted from policies meant to restore competitiveness and address consumer preferences.

After EU accession, CESEE countries' GHG emissions rose during the boom until the great financial crisis but declined again thereafter while (and even though) their catching-up process to average EU income levels continued. However, their pace of reducing emissions decelerated substantially, trailing that of the other EU MS so that CESEE economies to some degree still lag behind the rest of the EU in terms of emission and energy intensities. To a considerable extent, this may be ascribed to the fact that the 2020 climate policy targets the EU had agreed for the CESEE EU MS in 2009 (concerning GHG emission reductions and shares of renewables) and in 2013 (concerning energy efficiency) were less demanding than the targets for the other EU MS. Granted, the targets for the CESEE countries were meant to acknowledge the remarkable achievements in reducing GHG emissions against the international reference year of 1990. Also, more ambitious targets were considered a potential threat to faster growth for catching-up in per capita income levels. For similar reasons, binding targets for reducing national GHG emissions that were jointly agreed in 2018 for 2030 were again modest for CESEE EU countries. The national targets set by the member states summed up to disappointingly low target levels for the CESEE region as a whole. One may doubt that the lack of more challenging targets and greater ambition has been beneficial overall for the CESEE EU countries themselves. Going forward, the CESEE countries can certainly do better. When negotiating the Commission's July 2021 proposals for achieving the jointly agreed climate policy targets, all EU MS, and particularly the CESEE EU MS, should carefully weigh the benefits of doubling ambition and effort.

Both the CESEE and the other EU MS must step up their efforts in the coming years if they want to have a realistic chance of reaching the intermediate target to reduce net emissions by 55% up to 2030 and net-zero emissions and a climate-neutral economy by 2050, as jointly agreed in the European Climate Law. This implies doing away with fossil fuel subsidies and introducing a price for carbon that covers its external costs. It also requires substantially scaling up green investment, as envisaged for instance in the current national recovery and resilience plans, and cushioning vulnerable households, workers and partly also businesses to avoid adverse distributional and allocative effects. While expensive, this would offer long-term economic opportunities in terms of energy-efficient production and consumption, low-cost renewables, enhanced energy independence and modernized infrastructure. In this context, new nuclear power plants are unlikely to be an appropriate alternative to fossil fuels given high economic (opportunity) costs, long and uncertain construction time (delaying emission cuts), dependence on uranium as well as safety concerns regarding plant operation and nuclear waste disposal (Schneider and Froggatt, 2020). CESEE countries would benefit from participating in innovative greening industries at the competitive edge, as this would help reconcile economic convergence with environmental progress. Lagging behind in innovation and technology development, however, CESEE EU countries tend to be assemblers and importers of green technologies from other EU member states. Nonetheless, there are encouraging examples of green product market leaders from the region, e.g. Solaris buses from Poland.

Our findings may contribute to future work on measuring and assessing climate-related risks in the CESEE region's financial sectors. Regarding cross-

border banking, it is important for parent banks and their subsidiaries as well as supervisors to consistently quantify exposures to these financial risks. Increasingly aligning their portfolios to net-zero targets, markets seem to be prepared for transition but they still need political guidance. While central banks can play a role in this (Magyar Nemzeti Bank, 2021), sound carbon pricing – by addressing the initial market failure – would be most effective in mobilizing private capital for public goods.

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