The Green Transformation in Poland –

Opportunities and Challenges for Economic Growth

Country Economic Memorandum

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Abbreviations and Acronyms

ALMP	Active Labor Market Policies
ARE	Energy Market Agency
BAU	Business as usual
BGK	State Development Bank of Poland (Bank Gospodarstwa Krajowego)
CAKE	Center of Climate and Energy Analysis
CAPEX	Capital Expenditures
CBAM	Carbon Border Adjustment Mechanism
CC	Climate Change
CCC	Climate Change Committee
CCGT	Combined-cycle Gas Turbine
CCIA	Climate Change Institutional Assessment
CEC	Citizen Energy Community
CEM	Country Economic Memorandum
CfD	Contract for Difference
CHP	Combined Heat and Power
CICC	Inter-Sectorial Commission on Climate Change
CO2	Carbon Dioxide
COM	Communication
COVID-19	Coronavirus Disease
DSO	Distribution System Operator
DSR	Demand side response
EC	European Commission
EGD	European Green Deal
EIA	Environmental Impact Assessment
EPM	Electricity Planning Model
ESCO	Energy Service Company
ESD	Effort Sharing Decision
ETS	Emissions Trading System
EU	European Union
EV	Electric Vehicle
FIP	Feed-in Premium
FIT	Feed-in Tariff
GCF	Green Climate Fund
GDEP	General Directorate for Environmental Protection
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
GUS	Central Statistical Office

GW	Gigawatt
H&T	Heating and Transport
IEA	International Association for the Evaluation of Educational Achievement
IEO	Renewable Energy Institute (Instytut Energetyki Odnawialnej)
IMF	International Monetary Fund
IMGW	Institute of Meteorology and Water Management
INECC	National Institute of Ecology and Climate Change
IOS	Institute of Environmental Protection
ISCO	International Standard Classification of Occupations
KOBIZE	National Centre for Emissions Management
kW	Kilowatt
LCOE	Levelized Cost of Electricity
LFS	Labour Force Survey
LNG	Liquefied Natural Gas
LTS	Long-term strategy
MDB	Multilateral Development Bank
MFRP	Ministry of Funds and Regional Policy
MoCE	Ministry of Climate and Environment
MOF	Ministry of Finance
MRV	Monitoring, Reporting and Verification
Mt	Million tons
MW	Megawatt
MWh	Megawatt-hour
NCRD	National Center for Research and Development
NDC	Nationally Determined Contributions
NECP	National Energy and Climate Plan
NFEPWM	National Fund for Environmental Protection Water Management
NGO	Non-governmental organization
NIK	Supreme Audit Office
NREAP	National Renewable Energy Action Plans
NRIW	National Research Institute in Warsaw
NRP	National Reform Program
NRRP	National Recovery and Resilience Plan
NUTS	Nomenclature of Territorial Units for Statistics
O&M	Operation and Maintenance
O*NET	Occupational Information Network
OECD	Organization for Economic Cooperation and Development
OP	Operational Program
OPM	The Office of the Prime Minister
PA	Partnership Agreement

PEP	Polish Energy Policy
PFR	Polish Development Fund
PGE	Polska Grupa Energetyczna
PGG	Polska Grupa Górnicza
PIAAC	Programme for the International Assessment of Adult Competencies
PIM	Public Investment Management
PIMA	Public Investment Management Assessment
PIRLS	Progress in International Reading Literacy Study
PISA	Programme for International Student Assessment
PKN	Polski Koncern Naftowy
PLN	Polish zloty
PM	Prime Minister
PPA	Power Purchase Agreement
PPEJ	Polish Nuclear Energy Program
PRSP	Transmission Network Planning Document
PSE	Polskie Sieci Elektroenergetyczne
PSW	Polish Hydrogen Strategy
PV	Photovoltaic
PZPPOM	Development Plan for Polish Marine Areas
R&D	Research and Development
R&D&I	Research, Development and Innovation
RE	Renewable Energy
REC	Renewable Energy Community
RED	Renewable Energy Directive
REDD+	Reducing emissions from deforestation and forest degradation
RE-E	Renewable Sources in Electricity Generation
RE-H&C	Renewable Sources in Heating and Cooling
RES	Renewable Energy Sources
RE-T	Renewable Sources in Transport
RIA	Regulatory Impact Assessment
ROP	Regional Operational Programs
RRF	Recovery and Resilience Facility
SEA	Strategic Environmental Assessment
SISCLIMA	National Climate Change System
SME	Small and Medium Enterprise
SNG	Subnational government
SOC	Standard Occupational Classification
SOE	State-Owned Enterprises
SPA	Polish National Strategy for Adaptation to Climate Change by 2020 with the perspective by 2030
SPPMC	Strategic Project Portfolio Monitoring Council

SRD	Strategy for Responsible Development
STEM	Science, Technology, Engineering, Mathematics
TIMSS	Trends in International Mathematics and Science Study
TSO	Transmission System Operator
TWh	Terawatt-hour
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework on Climate Change
URE	Energy Regulatory Office
VET	Vocational Education and Training
VRE	Variable Renewable Energy
WB	World Bank
zł	Polish zloty

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Executive Summary

1. Poland's economic development story is one of success: since the early 1990s, the country has transitioned to a market economy, integrated into the European Union economy and global supply chains, and sustained robust growth—avoiding the middle-income trap and increasing the resilience of its economy. Poland has sustained strong growth over the past three decades, making substantial advances in converging toward the European Union (EU-27) average per capita income, although there is still a considerable gap in both productivity and income convergence when compared with aspirational peers. Poland successfully transitioned to an EU-integrated market economy, moving from upper-middle-income to high-income status in less than a decade and a half. Its economy underwent a deep structural transformation, supported by cost-competitiveness, and is now well-diversified and more resilient to shocks. Long-term growth has been supported by increased total factor productivity (TFP) and grounded in efficiency gains, although capital accumulation has remained the main contributor to growth. While capital deepening did occur, investments in Information Communication and Technology (ICT) and in intangible assets that have high growth potential lagged those of peers. A skilled labor force has contributed more to growth in the case of Poland than it did in peer countries. However, the COVID-19 pandemic has resulted in important learning losses, as observed throughout the world, and together with reversals in education reforms in recent years, could weigh down on labor quality and productivity in the future.

2. The challenge going forward will be to ensure inclusive and environmentally sustainable growth through increased productivity, competitiveness, and resilience, in the context of multiple and overlapping external shocks. This Country Economic Memorandum (CEM) strives to assess how Poland can sustain growth in the context of a transition to a lower-emission economy, surmounting structural constraints through an effective policy mix that addresses market failures, institutional challenges, and technological needs. Poland is one of the most energy and greenhouse gas (GHG)-intensive economies in the EU, with emission intensity second only to Bulgaria. High and rising energy prices, including due to rising prices of CO2 allowances and more recently due to the war in Ukraine, coupled with the high energy and emission intensity of the economy could pose competitiveness challenges in the future. To achieve sustainable growth, Poland, similar to other countries in the EU, needs to decouple growth from energy consumption and reduce the GHG intensity of its energy sources. Importantly, reducing EU and Poland's dependence on fossil fuel imports from Russia has become a top energy security priority. Addressing energy security concerns could slow the green transition in the short term but could accelerate it over the medium term by highlighting the urgency of developing renewable energy and enhancing energy efficiency. Poland's economy would need to undergo a significant transformation without sacrificing growth, which is critical for closing the income gap with EU-15 and making advances in narrowing regional income disparities within the country. Indeed, while in purchasing power standards Poland's per capita GDP reached 73.8 percent of the euro area average by 2021, its real per capita GDP is less than a third that of the EU-19 average. This report analyzes some of the key transitions that would need to take place and their implications for the factors of growth: physical capital, human capital, and TFP.

3. Economic and institutional reforms would boost growth in the medium to long term. A moderate reform package could raise Poland's GDP per capita above that of the EU-15 by 2050. In a business-as-usual scenario, with no major reforms or major economic shocks, the observed trends in the drivers of long-term growth would persist but Poland would still not catch-up with EU-15 average even by 2050. The impact of unfavorable demographic trends will intensify over the long term due to declining

population and aging. Loss of efficiency of new investments as the capital-output ratio rises over the long term and a worsening of the age structure will weigh on long-term growth, with per capita GDP growth decelerating to about a third of current levels by 2050. To boost growth, a package of complementary reforms is needed. Reforms to accelerate TFP growth, and in particular to boost technical efficiency, could boost growth to above 2 percent in the long term if they are accompanied by complementary reforms. Poland needs to continue its structural transformation and strengthen labor productivity, which remains well below that of aspirational peers across sectors, but especially in manufacturing and construction. Reforms to foster private investment and labor force participation can also lead to substantial growth in the medium term, but without complementary reforms their effect would taper off over time. Reforms to education would lead to modest but sustained contributions in the long term. A moderate reform package could help bring Poland's GDP per capita to 109 percent of the average income in the EU-15 by 2050, while a more ambitious one would see income rise to 118 percent over the same period.

4. First, a higher investment rate, and in particular the rate of private investment, could boost Poland's long-term growth and facilitate the shift toward a greener growth model. Poland's capital-to-output ratio remains below that of aspirational peers, while its private investment ratio to GDP places it close to the bottom 25th percentile of the EU. This underscores the need to reverse the downward trend observed in the private investment-to-GDP ratio in the wake of the global financial crisis through structural reforms and effective absorption of additional EU funds. To improve the investment climate and facilitate an increase in private investment ratio, issues related to policy uncertainty, a burdensome regulatory environment, deterioration in the legislative process that increases uncertainty for investors, as well as skill mismatches and labor shortages that result in rising labor unit costs need to be addressed. Such reforms could help to boost the private investment ratio; if this ratio were to increase to the median level observed in the EU, this would raise GDP per capita growth by about half a percentage point on average until 2050. Investment in high-productivity sectors such as ICT and in intangible assets (R&D and intellectual property) could unleash the potential to move up the value chains. Poland's current productive capabilities and export competitiveness also place it in a strong position to capitalize on the transition to the green economy—in the transport sector, for example—and to participate in green global value chains. Significant investment in new infrastructure, including in renewable energy (RE), is needed for making significant progress in lowering emissions, including through lowering the emission intensity of power generation. Such investment requires addressing barriers to RE investment and deployment such as inadequate policy support, inconducive regulatory provisions, overly complex or lengthy administrative procedures, limited availability of financing, and disincentivizing market structure and conditions. When conditions are right, development of RE sources can be rapid, as Poland's own experience shows. Poland has one of the highest levels of revenues from EU ETS (euro 5.6 billion in 2021), which could help finance climate and energy projects, including much-needed investments in the grid and storage, although only less than 20 percent has been used for energy-related investments. For RE sources to reach close to 70 percent of the total supply in the decade 2030–40, investments needs are estimated at US$131 billion in undiscounted terms, twice as large as in a business-as-usual scenario. Climate mitigation policy is likely to result in an accelerated depreciation of existing carbon-based capital stock that will weigh on growth.

5. Second, continued human capital accumulation is critical for long-term growth, especially in the context of a declining and sharply ageing population, placing a premium on reversing learning losses resulting from distant teaching during COVID-19 and shorter general compulsory education. While Poland has achieved important advances in human capital accumulation, the recent shortening of general compulsory education and learning loss caused by the distant teaching during the COVID-19 pandemic might result in lower skills among the

youngest cohorts. The estimated learning loss is equivalent to at least one year of education, with larger losses for younger students and in science subjects. If the learning loss is not reversed, this could have a cumulative negative impact of at least 0.68 percentage points on GDP growth, with the cumulative life-long loss of income that results from the pandemic-related learning losses exceeding 7 percent of 2021 GDP. Even in the context of a tight labor market, with rising labor unit costs, reported labor shortages, and increasing skill mismatches, Poland is underutilizing human capital, with female labor force participation lower than the EU average by close to 4 percentage points, and with labor force participation among older cohorts close to 8 percentage points lower than the EU average. Reforms that increase labor force participation would provide a strong boost to growth, amounting to an additional 0.3 percentage points on average in the 2030s under a moderate reform scenario, especially given the tight labor market and rising labor unit costs that have competitiveness implications. Poland has, for example, one of the lowest childcare enrolment rates in the EU, with only 10.2 percent of children under the age of 3 in formal childcare. Beyond the short-term impacts, the war in Ukraine could result in an increase in the labor force in Poland over the medium to long term, if some of the forcibly displaced people remain in Poland, contributing positively to growth. Simulations show that if 1 million Ukrainians join the labor force, GDP could be 3 percent higher by 2030, with the magnitude of the impact depending on the skill distribution.

6. Policies need to be put in place to facilitate an upskilling and/or reskilling and, thus, a smoother and just transition to a greener economy in Poland. That said, the pathways to achieving this are not always straightforward. Additionally, the challenges posed by the green transition require the use of active labor market policies that can help workers adapt to new labor market demands by providing upskilling and retraining toward greener jobs. While green jobs entail a wage premium, wage differentials in favor of greener jobs are the result of a more intensive use of higher skills. People in brown and green jobs in Poland, for example, tend to have different skills sets, with workers in green jobs having stronger foundational skills (numeracy, literacy, problem solving) while also using these skills more intensely. The more intensive use of higher skills also results in greener occupations benefiting from a wage premium. Given that both foundational and soft skills are more intensively used in greener jobs, there is a role for the educational system to rethink the provision of skills that will make it easier for future workers to adapt to a green economy. The scale of job changes necessary in the labor market as a whole is small relative to normal job turnover but will pose challenges for workers with outmoded skills. For these workers, more attention will need to be paid to adult education and retraining. Coal-related jobs are at the forefront of the disruption brought about by the transition toward a low-carbon economy and, although at the national level the impact may seem limited with less than 2 percent of total employment in the coal-value added chain, there is significant spatial and market concentration in the context of an already sluggish regional labor market. For a just transition, the key challenges will be to provide adequate opportunities for affected workers, especially non-mine workers in affected municipalities. Mining workers in Eastern Wielkopolska, for example, have strong preferences for job stability, and they care about commuting time, with the required compensation for an additional hour of commute time estimated at nearly 20 percent of monthly salary.

7. Third, boosting productivity is a necessary ingredient for ensuring sustained growth and for raising incomes above the EU-15 average. Reforms to support innovation, education, market efficiency, infrastructure, and institutions, which are all key determinants of TFP, would result in stronger TFP growth. The impact of these reforms is growing more significant over time given that higher TFP leads to more investment and more productive investments, as TFP increases the marginal product of capital. Narrowing productivity gaps in Poland's service sector relative to other high-income countries suggests this sector could contribute to achieving a more advanced structural transformation, one that also facilitates lower GHG emissions.

Furthermore, technological advancement and the expanding role of services as enabling sectors provide opportunities for development through achieving scale, innovation, and spillovers. Expanded access to digital technologies and training and skills development for workers and managers is needed to fully realize the innovation potential that ICTs and the associated intangible capital bring.

8. Institutions are not only critical for TFP and long-term growth but also for enabling a successful transition to a greener economic growth model. Collective action, mediated through appropriately designed institutions, is necessary to correct a wide range of market failures, including adverse climate externalities caused by GHG emissions. As an EU member, Poland has a sophisticated climate governance system, which combines EU solutions and local governance mechanisms. However, in practice the green transformation is limited by cross-cutting shortcomings of the overall governance performance. In recent years, there has been a deterioration in governance quality indicators, including government effectiveness and regulatory quality, that has the potential to impact growth. Challenges related to the complex green transformation have been exacerbated by uncertainty over the pace of decarbonization policy that impedes effective engagement on climate change by government bodies and private sector investments (renewable energy sources and so on). Some key aspects for green planning (for example, long-term vision, monitoring, reporting and verification, and financing strategy) are either missing or fragmented.

9. The financial sector has an important enabling role in the green transition. Public and blended finance play a vital part in the shift to a greener and more resilient economy, but ultimately private capital is needed to help all companies realign their business models to net zero targets and fund the initiatives and innovations of the private sector. Mobilization of capital toward environmentally friendly activities and technologies is supported by disclosure and reporting initiatives, improved risk management practices, and increased demand for green assets. Although green bond and loan markets are still relatively small, these instruments can play a transformative role by raising awareness, boosting accountability, and increasing transparency.

10. The macroeconomic effects of different decarbonization paths, focusing on the power system, are considered in terms of output, employment, and change in real wages. The macroeconomic effects of the decarbonization scenario considered in this report are relatively modest, with a real GDP level change of around -0.25 percentage points in 2050 in the main scenario where the additional energy investments required to meet emission targets are financed through public debt. This is because a certain degree of decarbonization is already factored into the business-as-usual scenario, with fossil fuel electricity generation around half of total generation by 2050, compared to the current share of 85 percent.

11. The type of financing considered for the green transition matters for the overall macroeconomic impact. For instance, even if all the investments are financed using a budget-neutral direct tax increase, thus increasing distortions in the economy, the real GDP reductions are still relatively modest, with a 0.5 percentage point GDP level reduction in 2050 compared with the baseline scenario. On the other hand, if these energy investments were fully financed using EU funds, then the effects will be positive, with GDP 1 percent higher by 2050. If the energy transition involves an increase in total electricity generation that can satisfy higher demand in the future for housing and electrical vehicles, then the real GDP effects are expected to be positive. The EU Green Deal Investment Plan presents an opportunity to make advances on the green transition and climate action—earmarking resources for climate action under the EU budget and providing member states with EUR 1 trillion in investment support, while also exempting green support from state aid rules. Furthermore, the EU has also earmarked at least 37 percent under the NextGenerationEU Fund to contribute to the green transition.

12. The choices of decarbonization paths for the power sector considered in this report are likely to also affect labor markets. As services decline at a relatively lower rate than manufacturing sectors, compared with the business-as-usual baseline, the share of total employment in services sectors is expected to increase in each labor category—a shift ranging from between 0 percentage points for skilled, male, urban workers to 14.4 percentage points for unskilled, female, urban workers. Furthermore, the overall decrease in manufacturing output is also reflected by shifts in the sectoral composition of employment—that is, across each labor category we expect a drop in the share of manufacturing employment, and particularly so for unskilled labor. Patterns in real wage changes follow the changes in labor demand, with the effects more pronounced for skilled labor. It is likely that unskilled labor groups are better able to benefit from a relatively bigger services sector demanding more labor. The relatively large decline of real wages for skilled, male workers vis-à-vis skilled, female workers is likely caused by their relatively high share in manufacturing and energy sectors, which would be declining.

13. Poland could, without sacrificing output, markedly lower the emission intensity of its manufacturing firms. Energy efficiency is also critical for the decoupling of growth from energy demand. Without sacrificing any output Poland could increase Scope 1 emission efficiency of firms reporting to the EU-ETS to levels closer to the EU average, allowing the country to more than halve its emissions from these sectors, thus contributing to the Nationally Determined Contribution (NDC). This would require firms to catch up with the efficiency levels typical of firms in their sector. Poland's gap in emission efficiency compared to firms in other EU countries is particularly pronounced in the energy and manufacturing sectors, which emit over twice as many GHGs per unit of output as the EU average. On the other hand, Poland has one of the lowest adoptions of eco-innovative solutions among the EU countries and a low number of green patents per capita, which could slow the transition to a greener economy. Improving overall firm capabilities, including managerial and innovative practices, increases the probability of firms adopting practices that raise energy efficiency and steers firms toward greener technology, while also boosting productivity. Similarly, there is substantial scope to improve the emissions efficiency of housing and district heating and transport, although this report does not delve into these areas.

14. An effective policy mix will be needed to ensure sustained growth while achieving decarbonization, and this will entail significant trade-offs and tough policy choices. These policies will potentially include taxes, subsidies, compensatory transfers, public investment, regulations, energy efficiency standards, emission standards, and border adjustment measures. One of the fundamental trade-offs faced by policy makers is the pace of the transition to be adopted. While a quick pace could result in accelerated obsolescence of the existing capital stock and offshoring of carbon-intensive industries, a delayed pace could result in continued investment into carbon-intensive assets that will inevitably turn into stranded assets (and a higher cost later). The impact on public finances is also likely to be substantial, with increased spending on compensatory measures, green public investment, green incentives, and adaptation measures, although a part of it can be financed from carbon taxes. Policy makers could also face a choice between prioritizing green spending, spending on other priorities like health and education, or accepting higher debt levels.

15. An inclusive transition would require public support and a careful consideration of distributional aspects and labor market adjustments. A lack of consideration for the impacts on poorer households of decarbonization policies and for ensuring broader public support can prevent the implementation of effective climate policies, as documented extensively in the literature. In the absence of revenue recycling through personal income tax and social assistance, carbon taxes would be regressive. Redistributive transfers and support to encourage labor market adjustments through active labor market policies can mitigate the risks of groups being left behind or to those that are

disproportionately impacted, but these efforts would need to be complemented by a host of behavioral and fiscal measures that encourage technology and behavioral change in the household sector to reduce household carbon footprints more broadly. Appropriately identifying and targeting the groups in need of support, including the energy poor, to manage the distributional aspects and labor market adjustments will involve political sensitivities and choices to be made. Finally, Poland's households will need to play their part in the transition through shifting toward greener technologies for household heating and transport and by investing in thermal modernization to reduce the carbon footprint of the housing stock.

16. What would it then take for Poland to boost growth and achieve full-income convergence with the EU-15? Overall, Poland can sustain growth at relatively high rates over the long term, including in the context of decarbonization, and converge faster to EU-15 GDP per capita levels if it implements reform packages that bolster productivity, increase labor force participation and private investment, support efforts to reverse learning losses, and increase compulsory education. Although reforms to individual growth fundamentals have a moderate impact on growth and convergence, an ambitious reform package that strengthens the various drivers of growth could boost long-term growth by 1.7 percentage points, bringing GDP per capita to close to 120 percent of the EU-15. The impact of reforms to support investment loses momentum and only TFP-enhancing reforms can yield sustainable incremental growth in the long term. Investments in the decarbonization of the power sector, if financed in a smart way leveraging EU funds, could also contribute to raising GDP.

Chapter 1
Poland—Growth and EU Income Convergence

1.1. Introduction

17. Poland enjoyed robust growth over the past three decades, making advances in converging toward the EU average per capita income. Sustained growth, though, is needed to complete the convergence. While Poland moved from an upper-middle-income economy to high income in less than a decade and a half, the income convergence process with the EU has not been completed, with advances in regional convergence in Poland lagging. Furthermore, while energy intensity of GDP has declined by nearly 40 percent since 2000, and the carbon intensity of Poland's energy has also declined, CO2 emissions have remained above their 2000 level on average, and Poland remains one of the most carbon-intensive economies in the region, with the social cost of carbon at the current level of emissions for Poland higher than 7 percent of 2019 GDP per year. Sustained growth that is inclusive and environmentally sustainable is critical for this convergence. Unfavorable demographic trends coupled with the rollback in the statutory retirement age contribute to a shrinking labor force and make sustained productivity gains even more critical for the growth process. In addition, there are indications of emerging skill mismatches that signal labor misallocation, a development that adversely affects productivity and which could become more acute because of the rapid pace of global technological change. Increased competitiveness will require productivity driven by innovation, upgrading processes and products, and using fully the human capital potential by closing existing gaps. Enhanced institutional effectiveness will be needed to address these challenges, ensure that regions grow together and that there are no communities left behind, and to mitigate the risks of increasing inequality.

18. Frequent and overlapping shocks underscore the importance of strong economic fundamentals and effective counter-cyclical policies to increase resilience to shocks. Poland outperformed other economies in the region through several external shocks, including most recently the COVID-19 pandemic. The Polish economy is now facing another external shock linked to the war in Ukraine. The spillover from the war in Ukraine to the Polish economy is expected to be significant in the near term through key transmission channels, including forced displacement, commodity prices, energy markets, and trade and confidence effects.

1.2. A growth success story but Poland's income convergence is not complete

19. Poland sustained strong growth over the past three decades, transitioning to a market economy and then successfully integrating into the European Union economy, moving from upper middle income to high income in less than a decade and a half. Poland has been one of the fastest-growing economies in Europe, recording nearly 30 years of uninterrupted growth prior to the COVID-19 pandemic. Poland has been one of the most successful post-communist countries in its economic development and sustained robust growth through the transition to the market economy, the 2004 EU accession, and EU integration. Its successful transition to a market economy was initiated with a radical and comprehensive economic liberalization program that included macroeconomic stabilization, deregulation, privatization, and a reinforcement of the social safety net (Balcerowicz plan). Poland then became a high-income country in a relatively short period of time, avoiding the middle-income trap, a feat achieved by only few countries. Strong and inclusive institutions, including economic and political ones, and a consensus at both the societal level and the political level about the country's long-term objectives that did not change fundamentally through successive

governments helped sustain growth (World Bank 2017). Strong institutions, including the rule of law, property rights, and democratic accountability at different levels of government; basic market institutions, including product regulations, corporate governance, and market regulations; and foreign trade and investment have played a crucial role. They allowed, among other things, for continued improvements in allocative efficiency—including the allocation between sectors of the economy, as well as between and within enterprises. There has been a strong social consensus that the country should aspire to become like Western Europe and meet the necessary conditions to accede to the European Union (Piatkowski 2018).

20. Sustained economic growth allowed Poland to make advances in converging toward the per capita income of EU-15 economies.

Economic convergence was a key objective for the EU accession and a key catalyzer for socio-economic cohesion (CEPS 2018). Poland's per capita GDP expanded at 3.6 percent per year on average over the past two decades, similar to the economic growth rate over the 2000–21 period, despite the global financial crisis, the euro debt crisis, and most recently the COVID-19 crisis. Income convergence continued (β convergence[1]) through the pre-accession period and then EU integration, reaching 77 percent of the average EU-27 GDP per capita by 2021 (at purchasing power standards or PPS), up from 48.3 percent of EU-27 GDP per capita in 2000.[2] Even when comparing the GDP per capita at PPS in the euro area,[3] Poland closed some of the gap, increasing its per capita GDP as a share of euro area per capita GDP by close to 31 percentage points, reaching 73.6 percent of euro area GDP per capita (PPS) (Figure 1.1).

Figure 1.1: EU β-convergence

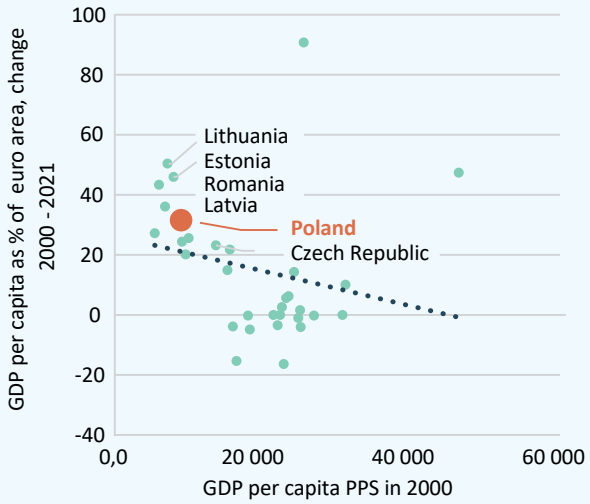
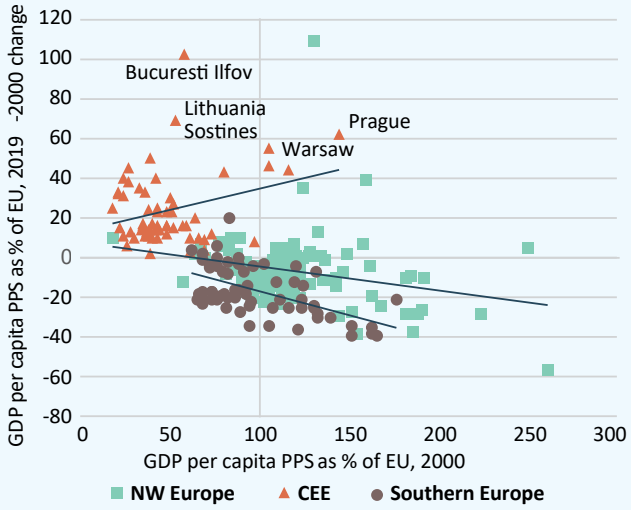


Figure 1.2: EU β-convergence NUTS2 EU Regions



Notes: CEE: Bulgaria, Czech Republic, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia and Slovakia. NW Europe: Austria, Denmark, Germany, Finland, France, Luxembourg, The Netherlands, Sweden, and the UK. Southern Europe: Cyprus, Greece, Italy, Malta, Portugal, and Spain.

Source: Eurostat, World Bank.

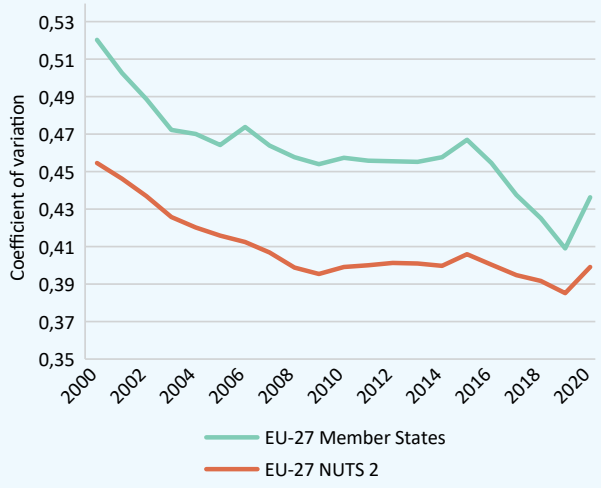
1. *The β-convergence postulates that poorer countries record more dynamic growth and converge to the level of richer countries. It is a corollary of the neoclassical theory of economic growth that hypothesizes that capital can move freely and is allocated based on returns.*
2. *The metric used is share of EU27 (from 2020) total per capita, based on million purchasing power standards (PPS), current prices.*
3. *Euro area 19 includes Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain.*

21. However, advances in regional convergence in Poland are less clear, in line with developments in other new EU member states. Poland, like other Central and Eastern European EU member states (CEE) that have joined the EU during the Eastern enlargement over the period 2004–07, has mixed experiences in convergence at regional levels (NUTS2). Even though the regions in the CEE have experienced a positive change without exception, the trend line for the β-convergence is upward sloping, suggesting limited convergence in terms of GDP per capita at PPS, with some diverging regional dynamics, notwithstanding the use of Structural Funds and the cohesion policy (Figure 1.2). Meanwhile, the slope for the North-Western countries cluster is negative, suggesting these countries have seen some degree of regional convergence, although there remain regional disparities and, in some cases, divergent regional dynamics, with the presence of champion regions. The dispersion of GDP per capita in PPS among EU-27 countries and among NUTS2 regions (σ-convergence, using the coefficient of variation) has declined during the 2000–09 period,[4] but it then started to increase in the wake of the global financial crisis. Convergence resumed at both the national and regional levels in 2016—until the COVID-19 pandemic—but is less pronounced at regional the NUTS2 level (Figure 1.3).

22. Poland's sustained growth has not translated into faster convergence in per capita incomes across regions (voivodships). There has been almost no convergence in GDP per capita (PPS) across the different voivodships, with most voivodships remaining below 60 percent of the average EU–27 GDP per capita (Figure 1.4). Five out of 17 voivodships have a per capita income level of 50 percent or less that of the EU–27 average, with little or almost no convergence taking place between 2010–14 and 2015–19. Western regions generally have a higher per capita GDP than eastern regions. The gap between the richest and the poorest voivodship is significant, with the Warsaw region at 154 percent of the EU–27 average compared with 48 percent for Lubelskie voivodship. Box 1.1 presents policy frameworks proposed by the World Bank for area, territorial or regional development policies.

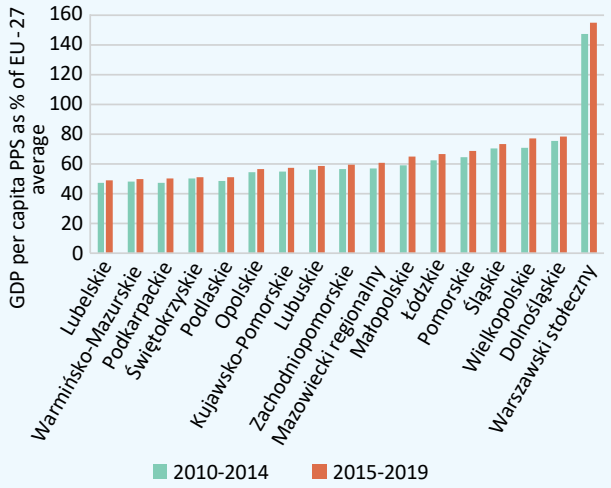
23. The strong economic performance and advances in income convergence with the EU were supported by prudent macroeconomic and fiscal policies, as well as by the EU structural fund and the EU cohesion policy. The macro framework is anchored by inflation targeting, a flexible exchange rate, and a sound fiscal framework that has supported robust and resilient growth. A sound financial sector and better access to long-term credit have also supported sustained growth.

Figure 1.3: EU σ-convergence, NUTS2 EU Regions



Source: Eurostat, World Bank.

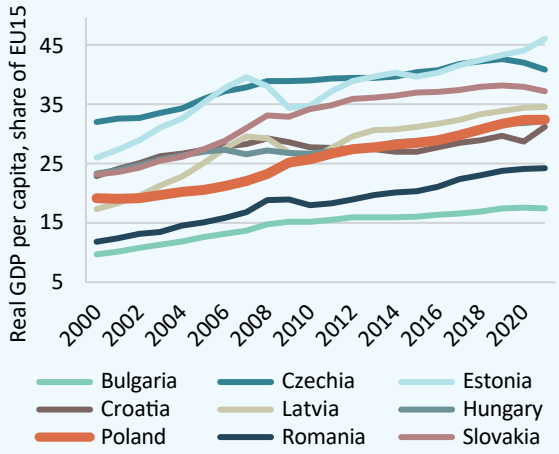
Figure 1.4: Poland regional GDP at purchasing power standard, per inhabitant



Source: Eurostat, World Bank.

4. *The uptick in 2006 is related to the increases in per capita GDP in pre-2007 accession countries, including Romania and Bulgaria.*

Figure 1.5: EU-15 convergence process is lagging



Source: World Bank.

24. Completing the convergence process requires that the country sustains growth that is inclusive and environmentally sustainable, in a context of multiple global shocks. While real per capita GDP more than doubled between 2000 and 2021, it remains slightly below a third that of the average EU-15 country (Figure 1.5). Going forward, unfavorable demographic trends coupled with the rollback in the statutory retirement age contribute to a shrinking labor force and make sustained productivity gains even more critical for the growth process. In addition, there are indications of labor shortages and emerging skill mismatches that signal labor misallocation, which adversely affects productivity and which could become more acute because of the rapid pace of global technological change. Increased competitiveness will require that productivity is driven by innovation, the upgrading of processes and products, and by closing existing gaps to achieve full human capital potential. Enhanced institutional effectiveness will be needed to address these challenges and ensure that regions grow together, that there are no communities left behind, and that the risks of increasing inequality are contained.

Box 1.1. Policy frameworks for area, territorial, or regional development policies

The 2009 World Development Report: *Reshaping Economic Geography* argued that agglomeration, migration, and trade have been the main catalysts of progress for economic development globally over the past two centuries. The report highlighted three types of disparities: spatial disparities in economic production, spatial disparities in living standards, and social inequality and argued in favor of the benefits from geographic concentration of economic production, recognizing that in the early stages of development, increased concentration is associated with spatial divergence in living standards such as income. It argued that some places were doing well because they have promoted transformations along the three dimensions of economic geography: higher densities, as seen in the growth of cities; shorter distances, as workers and businesses migrate closer to density; fewer divisions, as countries enter global markets, taking advantage of scale and specialization. The report showed that in developed countries, per capita incomes initially diverged between subnational areas, and convergence began to set in as GDPs per capita approached US$10,000, following an inverted-U relationship.

The report proposed a general policy framework for integrating lagging and leading areas, consisting of a calibrated combination of institutions, infrastructure, and incentives to address the domestic challenges posed by density, distance, and division differentiated by type of country. *Institutions* – consisting of spatially blind policies – refer to policies that are not explicitly designed with spatial considerations, but that have effects and outcomes that may vary across locations. *Infrastructure* – consisting of spatially connective policies- include all investments that connect places and provide basic business services, such as public transportation and utilities. *Incentives* – that are spatially focused policies - refer to spatially targeted measures to stimulate economic growth in lagging areas, including investment subsidies, tax rebates, location regulations, local infrastructure development, and targeted investment climate reforms. The proposed country taxonomy consists of three country types: countries with sparsely populated lagging regions, densely populated lagging areas in united countries, and densely populated

lagging areas in divided countries. The report generally recommended spatially blind institutional development and spatially connective policies that could be complemented selectively with spatially focused policies, primarily in cases of densely populated lagging areas in divided countries.

In an updated analysis, the 2021 World Bank report *Place, Productivity, and Prosperity - Revisiting Spatially Targeted Policies for Regional Development* documents how spatial landscape inequalities tend to persist and how, on the other hand, in some regions and localities underlying fundamentals are being undermined by shocks such as automation, trade, or climate change, leading to contraction, joblessness, and in some cases, political instability. The report finds that while migration is a great equalizer of internal disparities, there is less mobility than has historically been the case, with populations stranded in areas with no jobs and arguably little future. Furthermore, the report highlights that how distance affects the location of growth poles is changing drastically, with globalization and the dramatic fall in transport costs reducing the need for local cities and resulting in growth being increasingly concentrated in a few megacities, serving the international market. Based on extensive empirical evidenced and informed theory the report argues that "spatial transformations can be effective in tandem with economic transformation—but without it, they can achieve little."

The 2021 World Bank report then proposes a framework to inform policy makers' initial assessments of place-based policy proposals that would also allow them to identify complementary policy packages. The framework consists of four basic steps. The first step is a clear assessment of the key challenges, grounded in economic geography and in the facts about productivity, mobility, and connectivity. The second step consists of choosing the instruments to meet these challenges, considering both direct and indirect effects, and bearing in mind that some seemingly spatially blind policies, such as income taxation, minimum wages, or carbon taxes, which address other social objectives, can generate spatially biased distortions. Thirdly, policy makers need to ensure that any spatially targeted policy package includes all needed complementary factors and that its implementation is supported by coordination among all critical actors. Lastly, policy makers need to assess the feasibility of implementing place-based policies given existing government capabilities to identify market failures, design a policy package to correct them, as well as to implement a multidimensional package.

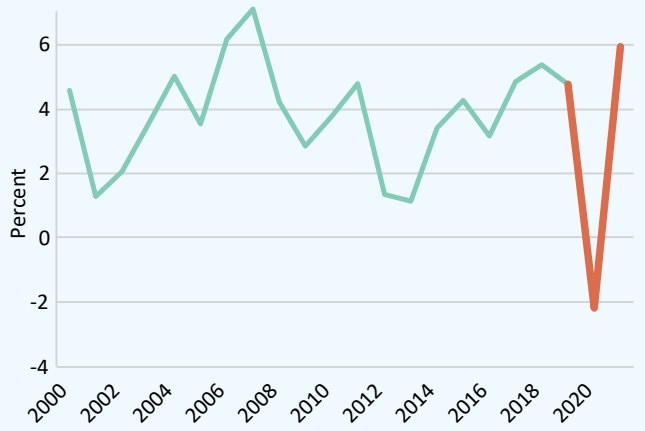
Source: Adapted from the 2009 World Development Report: Reshaping Economic Geography and the 2021 World Bank report: Place, Productivity, and Prosperity- Revisiting Spatially Targeted Policies for Regional Development.

1.3. Macro foundations have supported strong growth dynamics

25. Poland's diversified economy sustained economic growth of 3.8 percent on average prior to the COVID-19 crisis. The Polish economy grew by 3.8 percent a year, on average, over the 2000–19 period, with per capita GDP rising at a similar pace (Figure 1.6). During 2000–07 period Poland's growth averaged 4.1 percent, supported by the process of accession to the EU in 2004, which meant free access to the larger EU market as well as substantial EU subsidies and higher foreign investment (Figure 1.7). During this period Poland still had the lowest per capita GDP in Central Europe, and the convergence toward euro area GDP per capita was slower than in the Baltic countries and Slovakia (Figure 1.1). This is linked to a slower pace of second-generation reforms; a weaker fiscal stance[5] on account of higher public expenditure, including social transfers; and a tight monetary policy stance by the National Bank of Poland in the context of inflation targeting, with positive real interest rates that managed to bring inflation below 3 percent by 2007 and contain asset bubbles (Aslund 2013). The hawkish monetary policy stance prevented build-up in asset bubbles and had no significant amount of toxic assets nor banking problems. A steep increase in nominal effective exchange rates hindered capital inflows.

5. *General government deficit averaged 4.2 percent of GDP over the 2000-07 period, with a peak of 6 percent of GDP in 2003.*

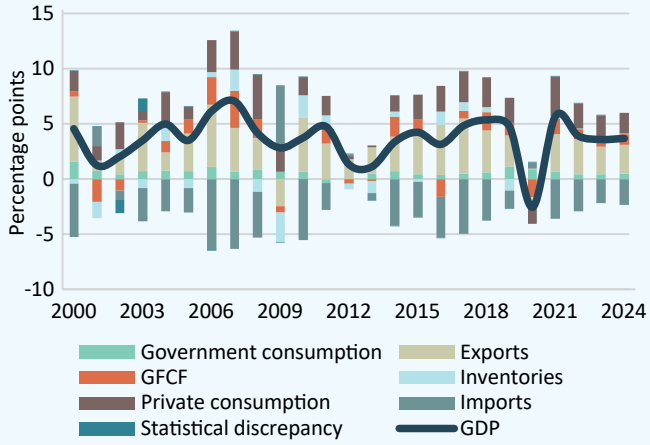
Figure 1.6: Poland real GDP growth



Source: GUS.

Note: Orangeline denotes the COVID-19 crisis.

Figure 1.7: Poland real GDP growth composition



Source: GUS.

26. Strong economic fundamentals and effective counter-cyclical policies increased resilience to shocks and helped Poland outperform other economies in the region. Poland avoided booms and busts and reached high-income status in 2010, after being an upper-middle-income country for only 13 years. It was the only EU country to expand in 2009 (2.8 percent) despite the global financial crisis, and its growth performance compares very favorably with that of the euro area and the EU-15, which contracted more than 4 percent that year. Poland also outperformed other CEE economies, which contracted on average by more than 8 percent in 2009. Poland continued to outperform most EU countries through the 2010–12 period, including during the eurozone debt crisis, growing on average 2.7 percentage points faster over this period. It also outperformed other CEE countries by 3.4 percentage points in 2010 and 1.3 percentage points in 2011. A sound macroeconomic framework, including a floating exchange rate, effective absorption of EU investment funds, a sound financial sector, and better access to long-term credit and foreign direct investment (FDI), supported inclusive growth. Falling real unit labor costs and the marked depreciation of the złoty in the last quarter of 2008 contributed to increasing competitiveness and fostered deep integration with German supply chains.

27. Poland's economic resilience was also evident during the global COVID-19 pandemic. Poland recorded one of the shallowest recessions in the region (-2.2 percent), its first output contraction since 1991 (Box 1.2.). Its economic resilience also stems from the fact that the economy is well-diversified and well-integrated in regional supply chains, and its markets function relatively well in allocating resources efficiently. Unprecedented fiscal support and accommodative monetary policy also helped mitigate the impacts and supported the recovery, with Poland growing 5.9 percent in 2021. However, the pandemic as had an uneven impact across regions, sectors, and worker groups, deepening inequalities in some cases.

28. Now the Polish economy is facing another external shock linked to the war in Ukraine. The spillover from the war in Ukraine to the Polish economy is expected to be significant in the near term through key transmission channels, including forced displacement, commodity prices, energy markets, trade, and confidence effects. While direct economic linkages outside the energy sector are limited, higher commodity prices (including for energy), increased uncertainty, and disruptions to supplies of precious metals used in the auto industry, as well as lower external demand from key trading partners, are expected to weigh on growth. The large inflow of displaced people from Ukraine is causing a significant increase in demand for public services and housing, with consequences for public finances, but is expected to contribute positively to growth. Strong inflationary pressures will keep inflation well above the targeted range for longer and is prompting a faster than expected monetary policy stance normalization. GDP for 2022 has been revised down by 0.8 percentage points to 3.9

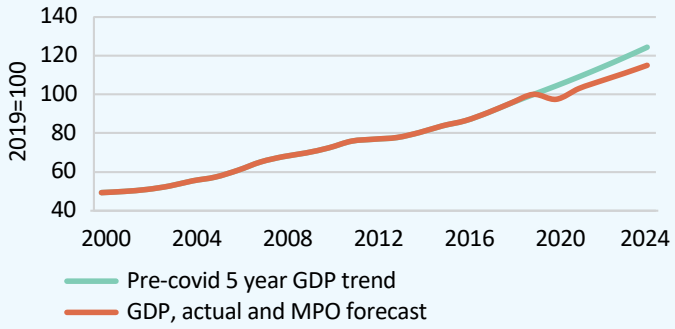
percent, reflecting lower external demand from the euro area, the impact of higher inflation on private consumption, and confidence effects on both consumption and investment. Higher energy prices and increased concerns about energy security could support a faster decarbonization pace over the medium term.

Box 1.2. The COVID-19 pandemic has affected lives, livelihoods, economic activity, and public finances markedly, but the economy rebounded strongly

The global COVID-19 pandemic caused the largest global recession since World War II and has also affected Poland. The global COVID-19 crisis hit Poland as well, triggering the first output contraction since 1991. It affected lives, livelihoods, economic activity, and public finances markedly. Economic activity in ECA is estimated to have contracted 2.1 percent in 2020 in the wake of disruptions related to the COVID-19 pandemic. The pandemic is expected to erase at least five years of per capita income gains in about a fifth of the region's economies and increase the poverty headcount. Economies with strong trade or financial links to the euro area and those heavily dependent on services and tourism have been hit the hardest in the region. Even though the well-diversified Polish economy was one of the economies least affected by the COVID-19 pandemic in the Europe and Central Asia region, its GDP declined by 2.5 percent in 2020, causing job losses (ILO 2021; World Bank 2022a), although economic scarring has been limited. Pandemic-related restrictions, heightened uncertainty, and negative confidence effects dampened Poland's household consumption and investment. Household consumption contracted by 3 percent and gross capital formation dropped 10.2 percent year-on-year in 2020. Government spending to reduce pandemic impacts contributed to a 4.9 percent increase in public consumption, while public investment also rose. Disruptions to international trade and transport and lower demand from some key EU partners caused exports growth to stagnate. Lower domestic expenditure resulted in a 1.1 percent decline in imports. As a result, net exports contributed 0.7 percentage points to GDP growth in 2020.

The economy rebounded strongly in 2021 but output has not reached its pre-pandemic path. The Polish economy rebounded from the COVID-19 recession, expanding 5.9 percent, its fastest pace since 2007, even as the important fiscal stimulus extended in 2020 was being withdrawn. Pent-up demand and a strong labor market that supported continued income growth fueled a 6.1 percent expansion in household consumption, which transla ted into double-digit import growth. Meanwhile, high-capacity utilization and strong corporate balance sheets supported investments. Robust export demand from the EU supported the recovery in the industrial sector and exports; however, the contribution of net exports to growth was negative. Easing of COVID-related restrictions, robust investment, and favorable labor market conditions supported the recovery. Inflation has, however, accelerated markedly, fueled by sharp increases in commodity prices and supply chain disruptions, feeding into rising poverty (World Bank Group 2022a). The war in Ukraine is impacting the economy, through commodity prices and trade channels, confidence effects, and the large influx of displaced Ukrainians.

Figure B1.2: Index of real GDP in Poland



Structural and cyclical factors and drivers of growth

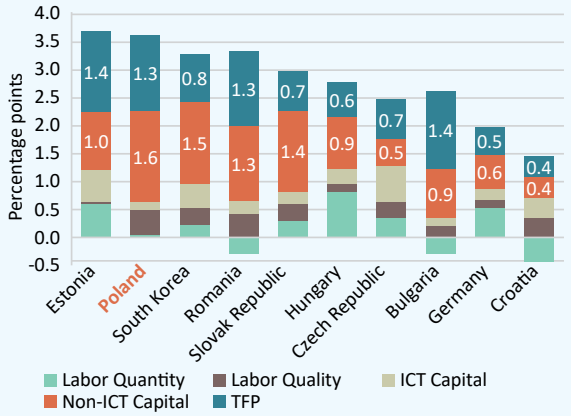
29. Growth was driven by structural factors over a sustained period, with cyclical factors and the COVID-19 shock impacting growth since 2015. Trend GDP expanded on average at 3.7 percent over the 2000–21 period, but the growth trend has decelerated following the global financial crisis (GFC). The downward trend in potential growth that started in the wake of the GFC became more pronounced during the euro area debt crisis but has improved thereafter. Capital deepening has been remarkably stable over the business cycles, while the contribution of labor has shown more cyclical variability. Prior to 2015, capital input has been found to be weakly procyclical, while the labor input was clearly procyclical and the labor composition component has been found to be countercyclical, improving during downturns (National Bank of Poland 2014). The Total Factor Productivity (TFP) also exhibits procyclicality, with less variability.

30. On the supply side, TFP has been an important contributor to growth, exceeding the typical contribution in high-income countries. Total factor productivity contributed more than a third to growth over the past two decades, grounded in efficiency gains. This compares favorably with TFP dynamics in high-income countries where TFP typically accounts for less than 15 percent (World Bank 2017). TFP growth declined to less than 1 percent in the wake of the euro area debt crisis but appears to have increased slightly since 2016. Growth in TFP has declined over time, to 1.3 percent in the 2010–19 period compared with 1.5 percent during the 2000–09 period.

31. Factor accumulation contributed significantly to growth, primarily through capital deepening. Growth over the 2010–19 period has benefitted primarily from the accumulation of non-ICT capital and from improved quality of labor. Non-ICT capital contributed the most to growth over the 2010–19 period (1.6 percentage points, or 44 percent of growth), as Poland successfully absorbed EU structural funds and attracted FDI, including for integration in Regional Value Chains (RVCs). Meanwhile, the contribution of ICT capital to growth was lower than in selected peer countries, highlighting the potential to gain from investing in this sector. ICT capital accumulation contributed only 0.2 percentage points, or 4 percent, to overall growth. This underscores the need to reverse the downward trend observed in private investment-to-GDP ratio in the wake of the GFC through structural reforms and effective absorption of additional EU funds. Improvement in labor quality was the second largest contributor to growth over the 2010–19 period, contributing 0.44 percentage points to growth, higher than in all peer countries (Figure 1.8). This was offset by the almost nil contribution from the quantity of labor.

32. Improved labor quality has contributed to growth more than in peer countries. Important reforms in education, such as restructuring schools, deferring tracking in secondary education, curricula reform, and boosting school autonomy, contributed to the increase in school attainment, with PISA reading scores rising between 2000 and 2009 from below to above the OECD average, and Poland reaped the benefits in the subsequent decade. In addition, as a result of demographic and migration trends, the working age population (15+) has declined slightly over the 2010–19 period, compared with a 0.4 percent increase in the previous decade.

Figure 1.8: Growth contributions of TFP, Non-IT, IT capital, labor and skills, 2010-2019

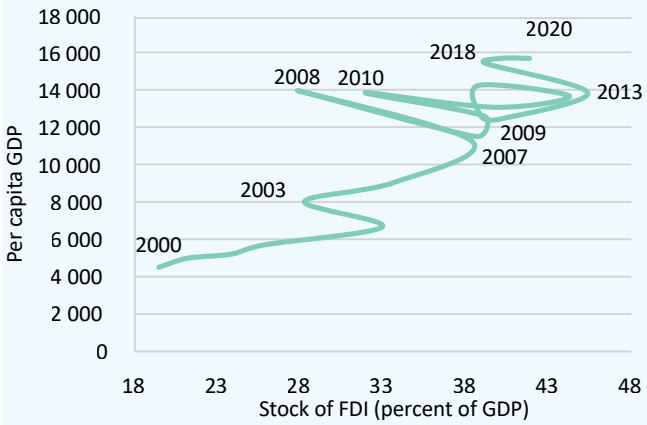


Note: Growth decomposition adjusted for labor and capital quality.

Source: World Bank staff based on Conference Board data 2010-2019.

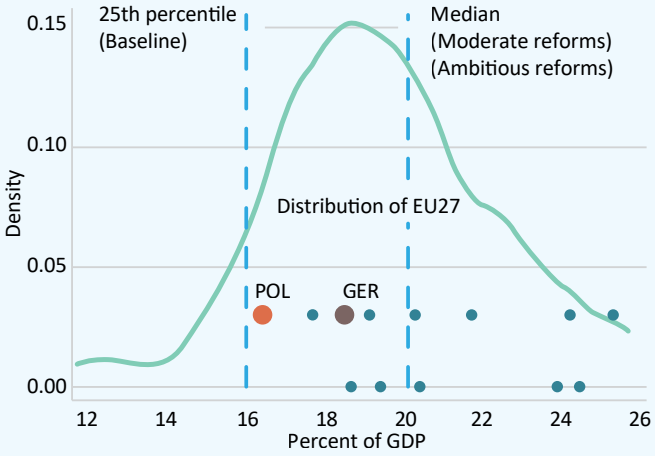
33. Integration in the global markets and the EU attracted FDI, but private investment remains below that of peers. The stock of FDI increased from less than 20 percent of GDP in 2000 to 36 percent of GDP by 2020 (Figure 1.9) (UNCTAD 2021). Following the accession to the EU, FDI inflows averaged 3.4 percent of GDP, which is slightly below the FDI-to-GDP share recorded by other new high-income countries but much lower than FDI inflows share in GDP in high-income countries. Furthermore, large EU capital transfers have been used for upgrading Poland's infrastructure. There is, however, a deficit of private investment, with Poland close to the bottom 25th percentile of the EU-27 distribution (Figure 1.10). To improve the investment climate and facilitate an increase in private investment ratio, issues related to policy uncertainty, burdensome regulatory environment, deterioration in the legislative process that increases uncertainty for investors, as well as skill mismatches and labor shortages that result in rising labor unit costs need to be addressed.

Figure 1.9: FDI and GDP per capita



Source: UNCTAD and World Bank.

Figure 1.10: Private investment rate – Distribution of EU-27



Note: Average private investment over 2000-2017

Source: World Bank.

1.4. Structural transformation and sectoral productivity

34. Poland has undergone structural transformation through input reallocation across sectors. At the start of the 2000s agriculture had lower labor productivity than other sectors, and its share in employment declined to 8.3 percent by 2021, from more than 20 percent in 2000. While the share of employment in industry remained relatively constant, the share of employment in services in total employment rose to 61.3 percent by 2021 from 50.8 percent in 2000. The reallocation of capital and labor to more productive sectors such as trade, transport, hotels and restaurants, professional services, and construction contributed to economic growth (Figure 1.12). If the number of hours worked is considered the decline in employment, the share in agriculture is close to 9 percentage points. The share of employment in manufacturing has also declined. Conversely the shares of employment in public administration and professional services have increased by close to 2.5 percentage points each, and construction by 1.8 percentage points.

35. The structural change continued over the past decade. Poland has seen one of the larger declines in share of employment in agriculture (4 percentage points, hours worked) compared with peer countries over this period, in part due to a later start in the structural transformation (Figure 1.11). Romania has seen a similar decline. Meanwhile, employment shares in both manufacturing and services have increased by 0.3 percentage points and 4.4 percentage points,

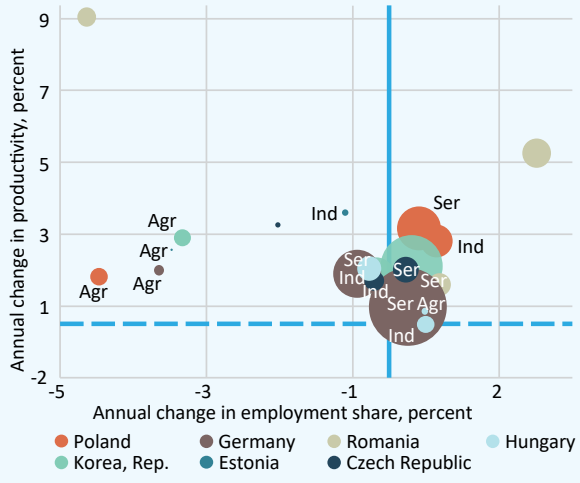
respectively. These sectors had a higher labor productivity over this period of 2.3 and 2.7 percent, respectively. The sectors that saw the largest increase in employment shares between 2010 and 2021 were higher productivity professional services (1.3 percentage points), ICT, and arts and entertainment (1.1 percentage points each), while public administration employment share also increased (1.5 percentage points). Conversely, both construction and wholesale and retail trade recorded declines.

36. Labor productivity varies across sectors and remains below that of aspirational peers. Labor productivity in Poland remains well below that of Germany, with gross value added by a person employed in manufacturing representing only 35 percent of that achieved in Germany, and lower than in comparators such as Czech Republic (World Bank 2021b). Labor productivity growth in the manufacturing sector declined by almost 1 percentage point in the wake of the euro area debt crisis, compared with the 2000–11 period, to slightly less than 3 percent. Labor productivity exceeded TFP growth by a large margin over this period, suggesting that growth in the manufacturing sector was achieved primarily through capital intensity rather than improvements in technical efficiency. In construction, gross value added per worker represents only 37 percent of that of Germany. Even in the service sector the gross value added per person employed in the sector represents slightly less than 50 percent that of Germany.

TFP in manufacturing stagnated over the past decade

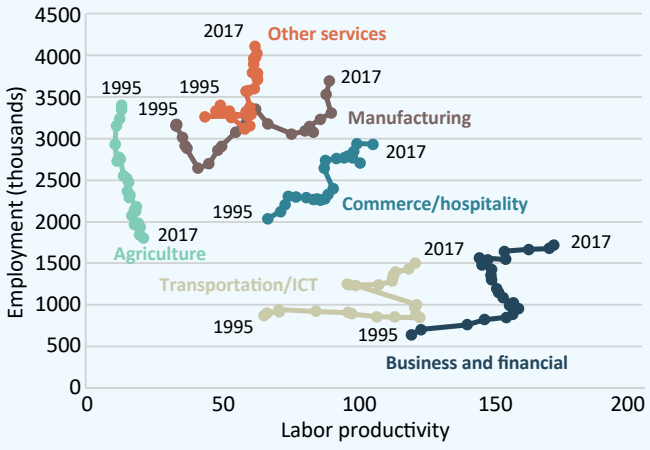
37. There has been a structural break in the "between effect" in manufacturing, with TFP stagnating over the past decade before accelerating slightly over the period 2017–19. TFP levels increased 22 percent over the period 2009–19, but most of this increase occurred between 2009 and 2011, with TFP levels rising only 1 percent between 2012 and 2019. Indeed, despite Poland's remarkable economic growth, TFP growth has stagnated in the manufacturing sector since 2012, resuming growth beginning in 2017. The stagnation can be attributed to a decline in allocative efficiency in manufacturing industries such as metal, food, and beverages, with large low-productivity firms expanding their market share and reversing the long-term trend of allocative efficiency that drove overall productivity in Poland (World Bank 2017). In the services sector TFP increased at an annual average of 4

Figure 1.11: Sectoral productivity growth and changes in employment shares – Poland and comparator countries, 2010-2019



Source: Eurostat.

Figure 1.12: Sectoral labor productivity and change in employment, 1995-2017



Note: "Other services" includes personal services. Sectoral classifications are based on UN ISIC Rev 3.1.

Source: World Bank Global Economic Prospects Productivity Dataset, based on GGDC data.

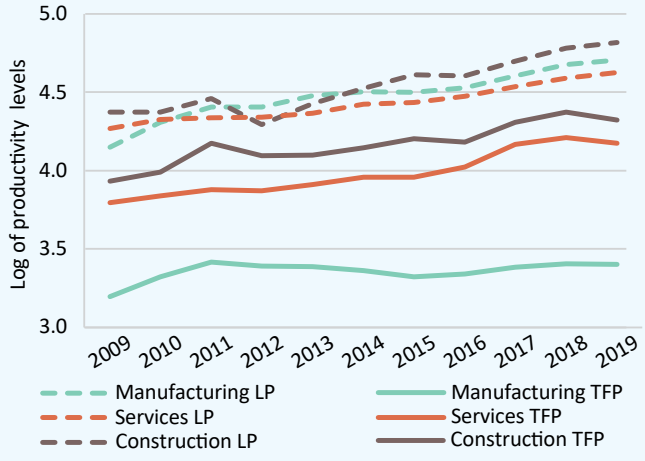
percent over the 2009–19 period, while in the construction sector TFP increased at a similar pace, reflecting allocative efficiency gains (World Bank 2021b).

38. The within-firm effect (firm capabilities) drove productivity growth after 2017. Productivity growth accelerated since 2017 in all sectors, mainly driven by within-firm productivity improvements. Resource allocation efficiency across manufacturing firms has represented a drag on productivity, while there is no significant contribution from the combined upscaling and downscaling components. The "between component" that measures productivity growth stemming from the reallocation of factors of production across manufacturing firms within the industry contributed negatively to TFP growth for most years, especially between 2013–19 (Figure 1.13 and Figure 1.14). Manufacturing industries with the fastest TFP growth increased productivity through the "within component," reflecting these firms' own productivity improvements—for instance, through innovation, better managerial practices, or adoption of new technologies. Improvements in firms' capabilities are a key driver of the TFP acceleration. There are, however, sectors that recorded a worsening of within-firm productivity (civil engineering, construction of buildings, paper, chemicals, and machinery manufacturing). Meanwhile, in the case of services, the within component contributed markedly to aggregate productivity growth, especially for the period 2016–19. However, unlike in manufacturing and construction firms, there was sustained improvement in resource allocation efficiency in service firms.

Service sector has played a crucial role in structural transformation[6]

39. Service sector labor productivity growth exceeded that of high-income countries, yet Poland's share of employment in this sector is one of the lowest in the EU. Since many high-income countries in the EU, such as those in Western Europe, are at more advanced stages of structural transformation, their share of the services in total employment is large. The growth in the services sector has been accompanied by robust labor productivity growth. Labor productivity growth in the services sector

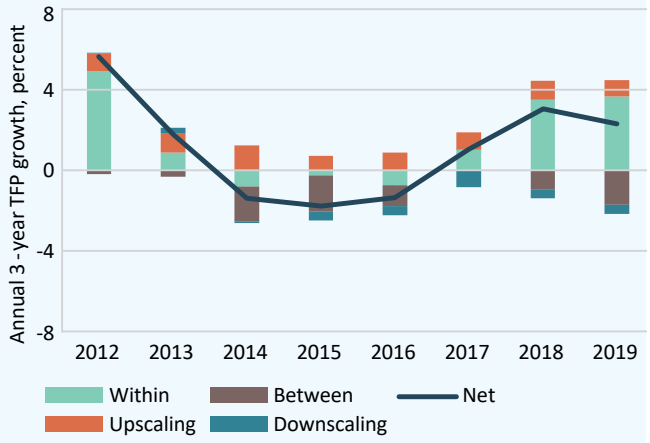
Figure 1.13: Productivity levels – TFP and labor



Notes: TFP represented by solid lines, Labor Productivity by dashed lines.

Source: Paths of Productivity Growth in Poland 2021. Marc, L. et. al.

Figure 1.14: Manufacturing TFP growth decomposition



Notes: The figure shows the results of decomposing 3-year productivity growth rates using the Melitz-Polanec method (Melitz and Polanec (2015), smoothed to represent an annual change.

Source: Paths of Productivity Growth in Poland 2021. Marc, L. et. al.

6. *This section is drawing on the background note prepared by Elwyn Davies and Gaurav Nayyar – The Promise of Services-Led Development Country Note Poland.*

in Poland was positive over the 1995–2018 period, averaging 2.6 percent per year, exceeding that of higher-income countries in the EU. Productivity growth in industry also averaged 2.6 percent per year, while in other countries in the region this was higher than that in services. The narrowing productivity gaps provide encouraging evidence that growth in the services sector contributed to closing the income gap with higher-income countries.

40. In Poland the employment share in global innovator services is among the lowest in the European Union. Poland global innovator services account for 16 percent of services employment. Most services employment is in low-skilled tradable or low-skilled domestic services. Global innovator services (including ICT, finance, and professional services) are relatively highly traded (internationally and offshorable), R&D intensive, share linkages with other sectors, and are typically skill intensive. Global innovator services are, on average across countries, more productive than manufacturing. (Figure 1.15). In Poland low-skill domestic services represent about a third of services employment, which is slightly higher than the high-income EU average (30 percent).

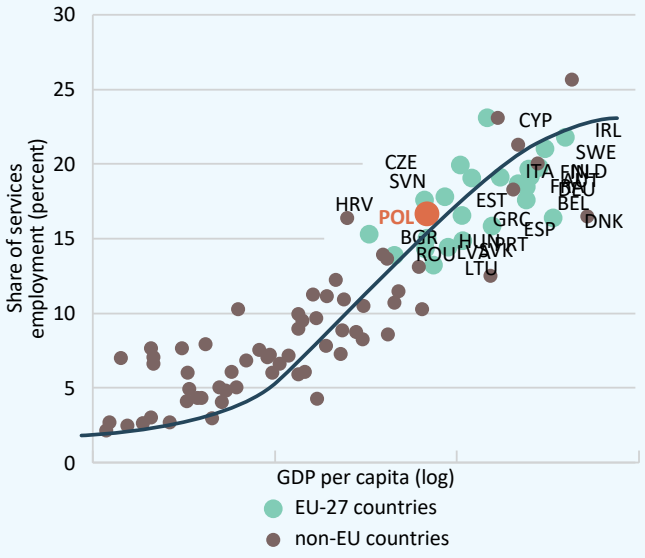
One in four jobs is in retail, among the highest in the EU, and only 7 percent of jobs are in professional, scientific, and technical services, among the lowest in the EU.

41. Poland's share of global innovators services exports in total services exports is in line with the expected value given its per capita income. Global innovator services accounted for 38 percent of all services exports in Poland, in line with the average for its level of per capita income and lower than many higher-income EU countries such as Ireland, Germany, Spain, Italy, and the Netherlands (Figure 1.16). Its share is, however, notably higher than that in several EU countries, including in some with higher levels of per capita income (Denmark, Slovenia, Latvia, Portugal, Lithuania).

Scale, innovation and spillovers

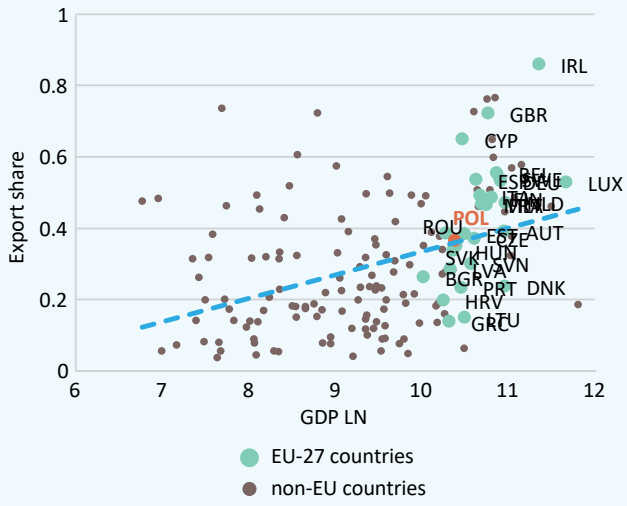
42. For the services sector, scale, innovation, and spillovers play a smaller role in contributing to productivity growth. Services firms in Poland operate at a smaller scale compared to countries at similar income levels, with the average size of a firm smaller than what is to be expected based on Poland's level of income.

Figure 1.15: Poland's employment share in global innovator services



Source: Elaboration based on Nayyar, Hallward-Driemeier & Davies (2021).

Figure 1.16: Share of global innovator services in total services exports.



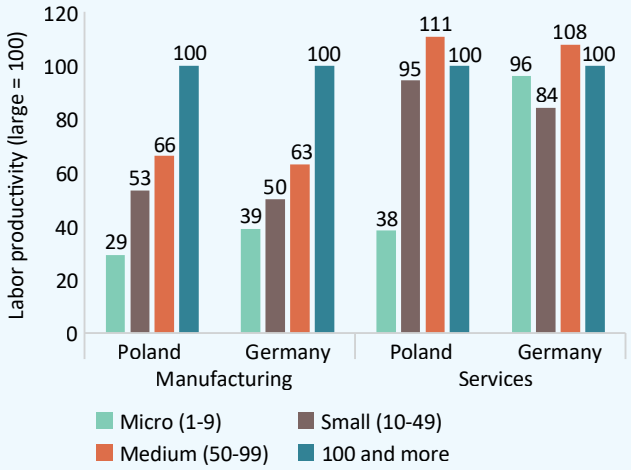
Source: Elaboration based on Nayyar, Hallward-Driemeier & Davies (2021).

However, digital technologies allow for new opportunities for scale, innovation, and spillovers to boost productivity.

43. Furthermore, the productivity of small services firms is relatively low. A small services firm can be as productive as a large services firm, based on evidence from Germany and other high-income countries. Services firms with fewer than 10 employees are relatively unproductive in Poland, however, compared to firms of similar size in Germany. In Poland, firms with fewer than 10 employees see labor productivity levels that are only a third of that of firms with more than 10 employees (Figure 1.17). Thus, a relatively large segment of small firms is not particularly productive. In the services sector, scale can manifest itself in different ways than in manufacturing. While in manufacturing, both in high-income countries and lower-middle-income countries, it generally holds that the larger the firms, the more productive it is—for services this is not necessarily the case. Scale can also be achieved through different ways than just increasing the size of the establishment, such as by operating at multiple locations through branching or franchising or increasing revenue by offering higher quality.

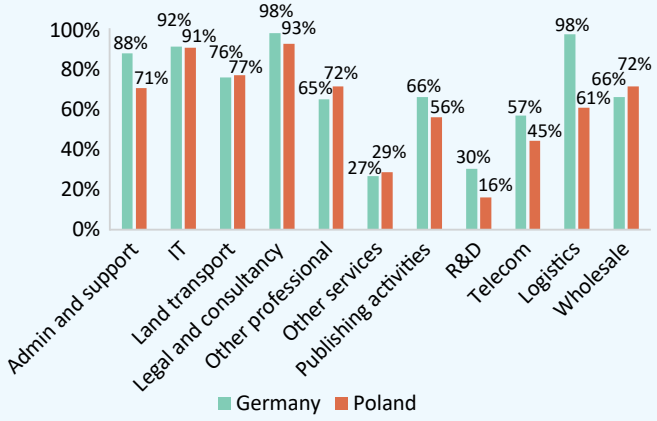
44. The second channel—innovation—also operates differently for many services sectors, while linkages and spillovers are particularly important for services, as many services are inputs to other firms. Unlike in manufacturing, for many services sectors, with the notable exceptions of telecommunications, warehousing and transportation, physical capital plays a limited role. More intangible forms of capital, such as software, intellectual property, brand value, and organizational know-how, are more important. Therefore, innovation efforts should be focused more on these intangible forms of capital. Services sectors that sell to other firms rather than to final consumers (most of the global innovator services) tend to be more productive. As discussed earlier, the share of global innovator services, which mostly supply to other firms, is lower than in other EU countries. Input-output table data also suggests that within these sectors, the linkages to other firms might be less strong than, for example, in Germany (Figure 1.18).

Figure 1.17: Labor productivity (VA/worker), relative to large firms



Source: Calculations using data collected by Bento & Restuccia (2021).

Figure 1.18: Share of services used as inputs for other production



Source: World Bank.

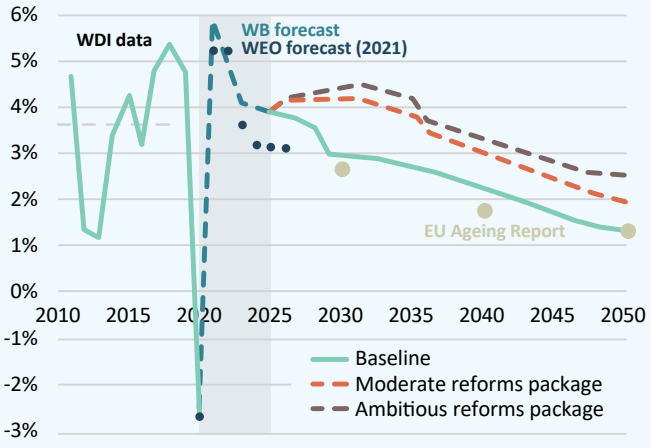
1.5. Sustaining long-term growth[7]

45. This report is organized following the World Bank's Long-Term Growth Model (LTGM),[8] which allows for an assessment of Poland's economic prospects over the next 30 years. It allows the assessment of long-term economic performance should current trends in key drivers of growth continue and to simulate reform scenarios.

A "Business-as-usual" growth path would bring convergence only in 2035

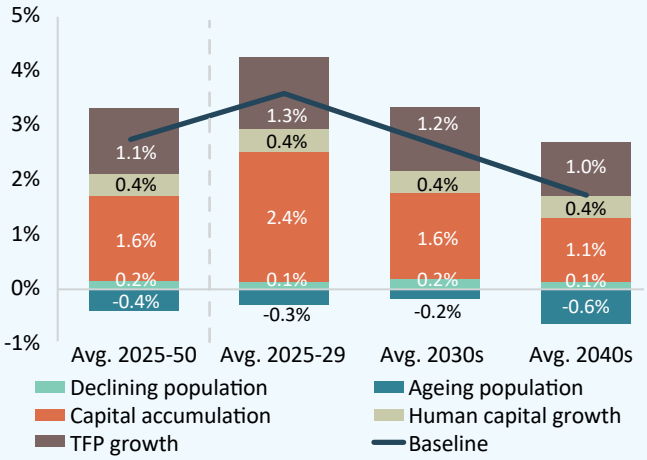
46. In a business-as-usual scenario, Poland grows at a fast but declining growth rate and catches up with the EU-27 by 2035. With no strong reforms or major economic shocks, recent trends of the drivers of growth would continue until 2050. Poland's GDP per capita growth would average 2.5 percent over 2025–50 (Figure 1.19) in line with long-term growth rates observed in countries with a similar level of development as Poland has today. Poland would not catch up with the euro area average even by 2050, however.[9] Capital deepening and TFP growth are the main drivers of growth. Investment and TFP are the key drivers of the Polish economy (Chapter 4), and they contribute 1.6 and 1.1 percentage points, respectively, on average, to growth over 2025–50 (Figure 1.21).[10] TFP growth is projected to slow down from 1.5 percent in 2020 to 0.5 percent by 2050, averaging 1 percent over the entire simulation period. The slowdown of the growth trend is explained by a loss of efficiency of new investments (as the capital-output ratio increases over time) and a worsening of the age structure.

Figure 1.19: GDP per capita scenarios



Source: World Bank.

Figure 1.20: Baseline scenario - contributions to GDP PC growth



Source: World Bank.

7. *This section is based on the background note "Poland's Long-term Growth Prospects" prepared by Arthur Mendes, Federico Fiuratti, and Steven Pennings.*

8. *Based on the WB's LTGM, www.worldbank.org/LTGM.*

9. *The Euro area consists of 19 countries: Euro area 19 includes Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, Spain. EU-15 includes Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Greece, Slovenia, Cyprus, Malta, Slovakia, Estonia, Latvia, Lithuania, and Sweden. The EU-27 includes all countries from the Euro area plus Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Hungary, Poland, Romania.*

10. *Human capital and the decline in population contribute to a much smaller share of growth.*

Economic reforms to boost long-term growth are needed

47. Poland can, however, boost its growth potential with reforms that strengthen each growth driver to levels observed in peer countries. Economic reforms to boost (1) investment, (2) pre-tertiary education, (3) tertiary education, (4) TFP growth, and (5) labor force participation are considered. The target for each growth driver is based on regional or income peers—EU-27 or Central and Eastern Europe (CEE). For each growth driver a moderate reform package and an ambitious reform package are considered (Table 1.1).[11]

Reforms to individual growth drivers could boost growth modestly

48. Poland could consider reforms that foster private investment and that could boost GDP per capita growth by about half a percentage point on average until 2050. To foster private investment, rate reforms could expand access to finance and infrastructure, reduce burdensome regulations, and promote entrepreneurship and skills development. Meanwhile, fiscal reforms could improve revenue mobilization and prioritize capital spending over consumption (Table 1.1). The simulated increase in private investment has a strong impact on growth in the early years (+0.7 percentage points in the 2030s), but the effect tapers off over the longer term (only an extra +0.4 in the 2040s). In the absence of complementary reforms to enhance productivity, the effectiveness of investment falls sharply in the latter years of the assessment period—driven by declining marginal product of capital due to the rising capital-output ratio. The extra percentage point of public investment under the ambitious reform package scenario has a small impact on growth.

49. TFP growth can be supported through reforms whose impact can strengthen over time. Reforms that could sustain productivity growth through the 2030s and 2040s could include policy changes in the five key determinants of productivity—innovation, education, market efficiency, infrastructure, and institutions (Kim and Loayza 2019). The impact on growth increases over time as higher TFP leads to (1) more investment; and (2) more productive investments, as TFP increases the marginal product of capital. As a result, in the 2040s, the incremental growth generated by the moderate and ambitious reform reaches +0.25 and +0.4 percentage points on average, respectively.

50. Reforms to increase the labor force participation (LFP) rate would have a large impact on median-term growth. Under a moderate labor market reform scenario, the increase in LFP to the median of the EU-27 would expand the workforce, providing a strong boost to growth, with an additional +0.3 percentage points on average in the 2030s.

Table 1.1: Overview of growth drivers under baseline and reform scenarios

(1) Growth driver	(2) Baseline	(3) Moderate reforms	(3) Ambitious reforms
1. Private Investment	16% of GDP	20% (median of EU27)	=Moderate reforms
Public Investment	4% of GDP	=baseline	5% of GDP (90th pct. Of EU27)
2. Quality of pre-tertiary	0.85	=baseline	0.87 (Top CEECs, Estonia)
Quantity of pre-tertiary	13.4 years	=baseline	13.9 years (Top CEECs, Lithuania)
3. Tertiary attainment	42%	=baseline	56% (Top CEECs, Latvia)
4. TFP growth	1.1→0.5%	1.1→0.7% (75th pct. EU27)	1.1→0.9% (90th pct. Of EU27)
5. Labor force participation	70%	75% (median of EU27)	=Moderate reforms

Source: World Bank's staff estimates based on the LTGM.

[11] *This section focuses on GDP per capita*

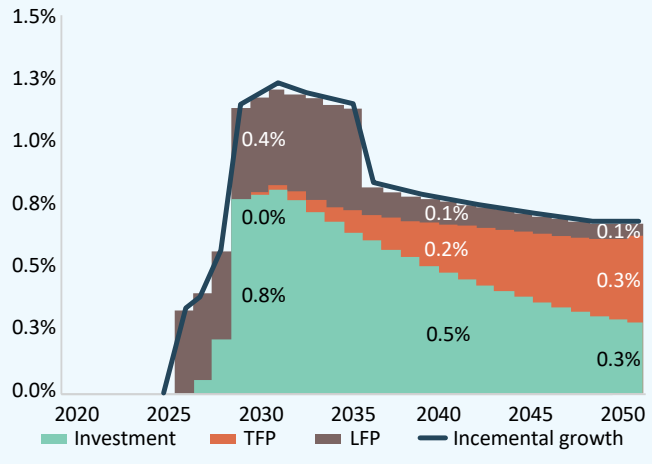
Reform packages are much more effective in achieving faster convergence

51. A combination of reforms would benefit from complementarity and result in the strongest growth trajectory when productivity-enhancing reforms are part of the package.[12] Packages of reforms that simultaneously increase (1) investment, (2) pre-tertiary education, (3) tertiary education, (4) TFP, and (5) LFP are considered (Table 1.1). A package of moderate reforms would boost GDP per capita growth by 0.8 percentage points on average until 2050. When all reforms become fully effective in 2030, GDP per capita growth would reach 4.2 percent, an increment of 1.2 percentage points vis-à-vis baseline. A decomposition of incremental growth shows that reforms that foster private investment and support LFP generate significant extra growth in the medium term (see Panel A of Figure 1.21). In the long run, productivity reforms are quantitatively the most important and the only ones with an increasing impact over time.

52. A package of ambitious reform would result in a stronger growth trajectory. They could boost GDP per capita growth by 1.1 percentage points on average until 2050 as complementary reforms reinforce each other, resulting in stronger incremental growth. When all reforms become fully effective in 2030, GDP per capita growth would reach 4.4 percent, an increment of 1.4 percentage points vis-à-vis baseline (see Panel A of Figure 1. 21). Growth decomposition shows that the impact of reforms to support investment loses momentum, and only TFP-enhancing reforms can yield sustainable incremental growth in the long term (see Panel A of Figure 1. 21). The reforms to pre-tertiary education yield results starting in the 2040s, generating a modest but sustained boost to growth.

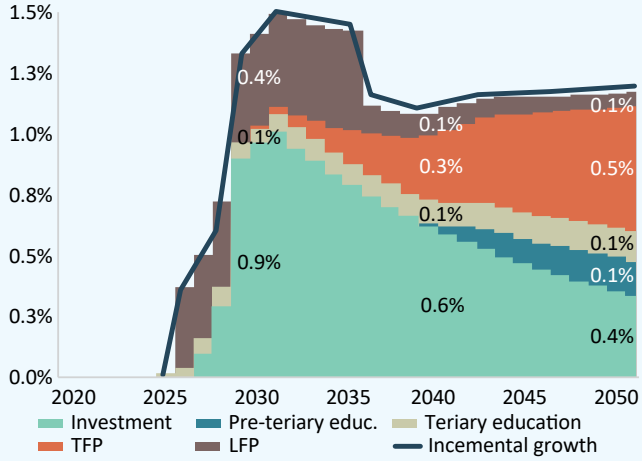
Figure 1.21: Decomposition of incremental GDP per capita growth
Percentage points of extra growth due to each reform

A. Moderate Reforms



Source: World Bank's staff estimates (LTGM).

B. Ambitious Reforms



Source: World Bank's staff estimates (LTGM).

[12] *An example is a complementarity between TFP and investment. Reforms to investment benefit greatly from higher TFP growth, as it increases the marginal product of capital, preventing the efficiency of investment from declining too sharply over time. Conversely, reforms to TFP also benefit from higher investment, as the higher productivity applies to a larger base (stock of capital).*

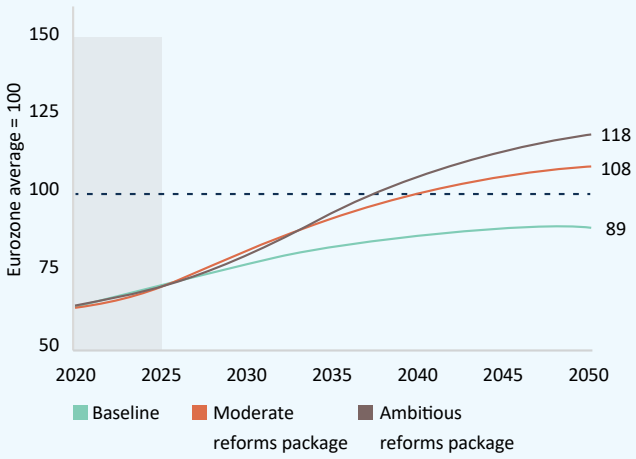
1.6. Poland's income convergence

53. Income in Poland would quickly converge to European levels by 2035. In 2020, Poland's per capita income accounted for 75 percent of the average in the EU-27 and 64 percent of the euro area (which includes only 19 countries, who are richer on average). Under the baseline, income would quickly converge to the EU-27 average by 2034 but then slow down, reaching 110 percent by 2050 (see Panel A of Figure 1. 22). Relative to the euro area, the baseline does not catch up during the simulation period, remaining 10 percent below by 2050. As a result, baseline GDP per capita would more than double from 2020 to €47,600 by 2050 (Panel B).[13]

54. A package of reforms would accelerate convergence markedly, while individual reforms would have a modest impact on convergence. Poland can sustain growth at relatively high rates over the long term, including in the context of decarbonization, and converge faster to EU-15 GDP per capita levels if it implements reform packages that bolster productivity, increase labor force participation, and boost private investment, as well as put in place education reforms to reverse learning losses and increase compulsory education. Although reforms to individual growth fundamentals have a moderate impact on growth and convergence, an ambitious reform package that would strengthen the various drivers of growth could boost long-term growth by 1.7 percentage points, bringing GDP per capita to close to 120 percent of the EU-15. Indeed, under the moderate and ambitious reforms package scenarios, GDP per capita would reach €58,100 and €63,000 by 2050.

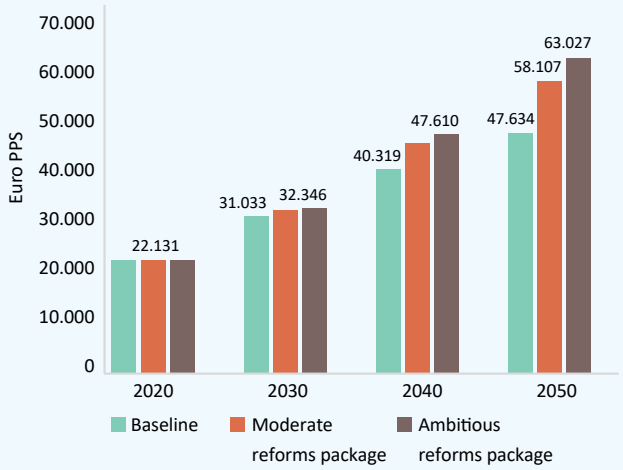
Figure 1.22: GDP per capita: baseline versus reform packages

Panel A. GDP per capita Index



Source: World Bank's staff estimates based on the LTGM.

Panel B. GDP per capita



Source: World Bank's staff estimates based on the LTGM.

[13] *The GDP per capita PPS we are assuming does not account for convergence in prices. The reason for that is based on empirical results that suggest that for the 2000-19 period, price adjustment had no role in convergence. This is concluded by looking at the relationship between PPS convergence rates (difference in PPS GDP PC growth rates between Poland and the EU-27, using Eurostat data) and the real growth differential rates (difference in real GDP PC growth rates between Poland and the EU-27, using WDI data). Doing a regression of PPS convergence rates on real growth differential rates without constant, we get a coefficient nearing 1, which suggests a zero inflation elasticity (as the inflation elasticity is equal to the estimated coefficient minus 1). Hence, it is reasonable to assume no price adjustment during convergence (contrary to what a Balassa-Samuelson effect might suggest). This has also been done to Croatia and Bulgaria and similar results are obtained.*

Chapter 2
Physical Capital—Growth in the Context of Transitioning Out of Coal in Power Generation

2.1. Introduction[14]

55. To achieve sustainable growth Poland, like other countries in EU, needs to decouple growth from energy consumption and ensure energy security. The country needs to see a continued reduction in the energy intensity of GDP (Chapter 1 and Chapter 4) and of the emission intensity of energy to comply with its international commitments. For example, to achieve carbon neutrality, the EU-27 needs to achieve a 7.4 percent annual reduction in CO_2/energy demand, given current assumptions of population and GDP growth. For Poland, compliance with the "Fit for 55" package requires the share of RE in the electricity sector to reach 42 percent in 2030 up from 16.9 percent in 2021. But reaching net zero emissions by 2050 would require far more ambitious emission reduction plans and investments than considered under a business-as-usual scenario. It would also require addressing barriers such as inadequate policy support, inconducive regulatory provisions, overly complex or lengthy administrative procedures, limited availability of financing, and disincentivizing market structure and conditions.

56. Poland is undergoing a fundamental power sector transformation, but it remains one of the most coal-dependent countries in the world. Poland and the other EU member states agreed on a joint NDC, including a commitment to reduce greenhouse gas (GHG) emissions by 55 percent by 2030 from 1990 levels. Poland's GHG emissions have already dropped significantly due to structural shifts and efficiency improvements over the last 30 years,[15] but despite this progress power sector emissions remain high, with a limited downward trend over the previous two decades. The country has the second-highest CO_2 emissions intensity in electricity generation in the EU, more than three times the European average (EEA 2021). Power sector emissions contribute 40 percent to the total annual emissions as domestic electricity supply continues to be dominated by thermal generation and the power sector emissions are increasing (Ember 2022a). Higher demand and very high gas wholesale prices across Europe have led to coal becoming cost-competitive compared to gas power plants, making Poland a temporary exporter of coal energy, and resulted in a slight increase in the share of coal in power generation.

57. The aging coal fleet represents a critical challenge for the Polish power system, and significant investments are needed to upgrade it. The aging infrastructure, in many cases past its economic life, means that significant investments are needed and that the risk of stranded assets for the current infrastructure is limited. The average age of Polish hard coal-fired power plants is over 40 years,[16] while the average age of lignite-fired power plants is more than three decades. Plants commissioned over 50 years ago account for around a third of installed capacity, and the majority of these will need to be soon retired for technical (age and inefficiency), economic (negative commercial margins), or environmental (reaching decarbonization targets) reasons. Polish power infrastructure (generation, transmission, and distribution) is also aging and will require far-reaching retrofits and new installations, translating into substantial investment needs over the next three decades.

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[14] *This chapter draws on the background paper prepared by Mateos-Merino and Nicolas.*

[15] *This drop in emissions happened mainly between 1990-2000, having stabilized without significant reductions since 2000.*

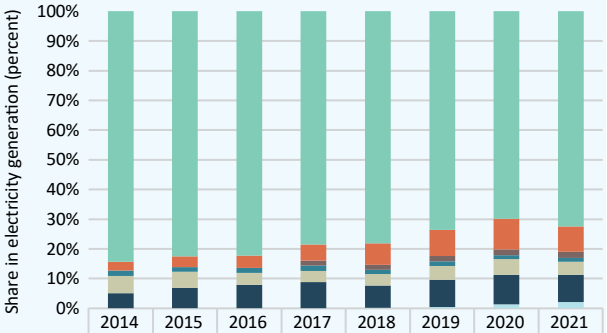
[16] *Tygodnik Gospodarczy PIE – 2021 – Polish Economic Institute, https://pie.net.pl/wp-content/uploads/2021/03/Tygodnik-Gospodarczy-PIE_11-2021.pdf*

58. The increase in installed capacity in the power sector in recent years is due mainly to renewable sources, but coal-fired power plants still play a key role in the energy system. In 2021, 42 percent of the total installed capacity was hard coal and 16 percent lignite power plants. Poland also has an extensive combined heat and power (CHP) fleet. The high-efficiency co-generation share in electricity supply has been relatively stable over recent years (12.8 percent in 2020) without significant new installations and developments. The installed capacity of variable renewable sources (VRE—wind and solar) has increased considerably in recent years, reaching a total of 14.8 Gigawatts (GW) at the end of 2021. The development of the onshore wind sector has slowed down markedly due to unfavorable regulatory changes. Only prosumer energy, from household rooftop solar photovoltaic (PV) installations, has increased over the last two years (Figure 2.1).

59. Large investments are needed to achieve the different decarbonization paths for the power sector considered in this report. One of the decarbonization path would ensure RE sources reach nearly 67 percent of the total supply in the decade 2030–40, with an accelerated retirement of coal plants. The investments needs are estimated at US$131 billion in undiscounted terms, twice as large as in a business-as-usual scenario. Furthermore, if the electrification of heating and transport is considered, the impact on investment needs would also be significant. Given the availability of mature technologies that can be deployed at scale, and its potential to participate to the decarbonization of other sectors, the power sector is central to decarbonization strategies. However, these other sectors (in particular, transport, heating, and industry) should not lag in their efforts to reduce their use of fossil fuels if an economy-wide decarbonization is to be attained.

60. The fossil fuel-dependent energy system in the context of high and rising CO2 allowance prices and increasing coal and gas costs result in higher electricity prices, affecting the competitiveness of Polish businesses as well as consumer welfare. Poland, like other European countries, has implemented various measures to reduce the impact of these rising energy costs, especially for the most vulnerable segments of the population—most notably, special allowances to compensate for higher energy and food prices—and is already planning medium- and long-term measures to reduce its dependency on fossil fuels.

Figure 2.1: Electricity generation by technology (2014-2021)



	2014	2015	2016	2017	2018	2019	2020	2021
Coal	84.3%	82.5%	82.3%	78.5%	78.2%	73.6%	69.8%	72.5%
Natural gas	3.0%	3.7%	4.1%	5.4%	7.2%	8.8%	10.3%	8.5%
Other	0.0%	0.0%	0.0%	1.7%	1.7%	1.8%	1.9%	2.1%
Hydro	1.8%	1.5%	1.7%	1.8%	1.4%	1.6%	1.3%	1.3%
Biomass/biogas	5.8%	5.5%	4.0%	3.7%	3.8%	4.6%	5.2%	4.3%
Wind	5.1%	6.8%	7.8%	8.7%	7.6%	9.2%	10.1%	9.2%
Solar	0.0%	0.0%	0.1%	0.1%	0.2%	0.4%	1.3%	2.1%

Source: energy.instrat.pl based on ARE.

61. Poland could follow different decarbonization strategies. Decarbonization pathways for the Polish power sector are assessed using the Electricity Planning Model (EPM), a power system planning tool developed by the World Bank. This chapter considers the implications of ambitious decarbonization pathways in terms of scale and timing of new capacity additions, mainly low carbon/carbon-free generation deployment, investment needs, and the potential impact on generation costs. It also provides for scenario analysis (for example, with and without nuclear) and considers the potential impact of the decarbonization of the rest of the economy (that is, through the electrification of the transport and heating sectors).

Box 2.1. Poland's energy security in the context of Russian invasion of Ukraine

The energy crisis linked to the war in Ukraine and sanctions imposed on Russia could potentially delay or even reverse the energy transition process. However, early reports suggest that the crisis could accelerate the sustainable transformation in Europe, as independence from Russian fossil fuel imports becomes a political priority. This includes refraining from signing new contracts with Russia, diversifying fuel suppliers, and accelerating the deployment of renewable and alternative energy technologies. The current situation may also induce a need to build new gas storage facilities as well as Liquefied Natural Gas (LNG) terminals to facilitate diversification and provide energy security. Nevertheless, in the longer term, the extensive development of zero-carbon power technologies (primarily renewable and nuclear) should be the most viable option to gradually reduce the EU's dependence on imported fossil fuels and its share of fossil fuel in the power mix.

Poland remains dependent on Russia for its energy supply, despite efforts to diversify away in recent years. Its overall energy dependency on imports stood at 45 percent in 2020. This dependency is much higher for crude oil at 97 percent, 78 percent for natural gas, and 97 percent for oil and petroleum products, while it is lower for coal at 20 percent. Imports from Russia represent 55 percent of the total imports for natural gas, 66 percent for crude oil, and 73 percent for coal. On April 27 Russia stopped gas supplies to Poland over its refusal to pay for the gas in rubles.

As part of its energy security strategy, Poland has already banned coal imports from Russia and was planning to stop importing natural gas by early 2023. Poland remains dependent on Russia for its energy supply (oil, natural gas), despite efforts to diversify away in recent years. Efforts to diversify gas supply include increased imports of LNG from Qatar and the United States through the LNG terminal in Swinoujscie and the Baltic Pipe, expected to be operational in October and reach full capacity by the end of the year, which will bring Norwegian gas to Poland via Denmark. Furthermore, the new gas pipeline connection with Lithuania is expected to open in early May, giving Poland access to gas from Lithuania's LNG terminal. Poland has also increased gas storage to more than 96 percent of its capacity, and storage is expected to be full in July 2022 compared with 38 percent in March 2021. With the Baltic pipe coming online in October, Poland will be the first European country to entirely break its dependance on Russian gas. In addition, Poland has also announced plans to stop imports of oil from Russia by the end of 2022, in line with the recent EU-wide ban to pipeline imports. Plans are also under discussion to accelerate the deployment of RE beyond current targets.

2.2. More ambitious strategies for the greening of the power sector are needed

62. Several crucial strategies outline the direction of changes in the Polish power system at the national level (Mateos-Merino and Nicolas, forthcoming). The key ones are the National Energy and Climate Plan (NECP) for the years 2021–30; the Energy Policy of Poland until 2040 (PEP2040); Polish Nuclear Power Program (PPEJ); and the Polish Hydrogen Strategy until 2030 with an outlook until 2040. Although PEP and NECP call for significant structural changes within the power sector over the long-term horizon, more ambitious plans are needed. They assume that supply from coal-fired units will be gradually diminishing and the percentage of RE sources (primarily from wind and solar power plants) in electricity generation would increase significantly, with targets of 32 percent by 2030 and 40 percent by 2040. A significant increase in the share of gas units is also expected. Both documents are consistent about the starting date of the nuclear power program, with the first block to be commissioned in 2033 and additional ones coming online in subsequent years.

63. Investment needs will likely exceed those estimated in key national strategies, and the "Fit for 55" package has raised the level of EU climate policy ambition and, thus, represents an additional challenge for Poland. The Polish System Operator (PSE)'s draft Power Transmission Network Development Plan for 2023–32[17] calls for investments that significantly exceeded PEP and NECP strategies. It assumes that gas will be the largest, dispatchable source of electricity in 10 years, while also projecting additional 13.8 (GW of PV and 10.9 GW of offshore wind farms). The main objective of this package is to reduce the emissions of the EU economy by 55 percent by 2030 compared to 1990 levels and subsequently reach full climate neutrality by 2050. For Poland, compliance with the "Fit for 55" package requires that the share of RE in the electricity sector reaches 42 percent in 2030.

2.3. Power sector decarbonization pathways and investment needs

64. Poland's power mix would likely be heavily dependent on natural gas, with solar PV the most prominent RE source, as coal plants are being retired. The timing of the retirement of existing coal plants is one of the critical drivers of the transformation in the power sector and of carbon abatement. Nearly 75 percent of the total electricity supply currently comes from coal-fired generators (27 percent from lignite and 48 percent from hard coal). Projected growth in electricity consumption and the long-term forecasts of the cost parameters for technologies and fuels are the other key drivers. Cumulative capital expenditures under a no-RE-reform scenario are estimated at US$49 billion by 2050 (in undiscounted terms) as retirements start accelerating between 2029 and 2038 for the hard coal plants and between 2029 and 2044 for lignite plants.

65. Reaching the net-zero target, however, will require far more ambitious emission reduction and investment trajectories, resulting in significantly more RE by 2050. Emissions would drop by 57 percent under the business-as-usual scenario compared with the 2020 level as a result of forced retirement of the coal units and their replacement with gas. Even without a constraint limiting or penalizing GHG emissions, emissions decrease with new investments in PV, gas, and offshore wind. Nevertheless, the power system continues to rely heavily on fossil fuel-based generation with constrained deployment of RE sources. The power sector should decarbonize at a much higher pace than other segments of the economy, such as transport or industry, given that it is the key contributor to overall emissions and is also, at the same time, one of the easiest to decarbonize. Yet, sustained efforts are needed to also decarbonize harder-to-decarbonize sectors, which is going to be a lengthy and costly endeavor.

Decarbonization of power generation

66. Ensuring the power sector is at the forefront of emission cuts requires a more ambitious decarbonization path with large, front-loaded, and diversified investments in RE sources. This scenario assumes a 50 percent power sector emission reduction by 2030 compared to 2015 levels, followed by a 90 percent reduction by 2040 and net zero by 2050. By 2030, the capacity of PV as well as onshore and offshore wind would account for over 45 percent of electricity supply, with RE sources reaching nearly 67 percent of the total supply in 2030–40. There is a diminishing role for the remaining thermal generation as well as the deployment of alternative zero-carbon energy technologies, including battery storage and green hydrogen (due to costs in the latter case). Natural gas serves the role of transition fuel if nuclear power is not an option and if there is not another low-carbon alternative. Yet, in 2050, gas represents less than 10 percent of capacity. After 2037, commissioned gas units are not retiring; instead, their overall utilization rate decreases, but they serve a key role in balancing and as reserve supply for the RE-based system.

[17] *PSE – 2022 - Plan rozwoju w zakresie zaspokojenia obecnego i przyszłego zapotrzebowania na energię elektryczną na lata 2023-2032, https://www.pse.pl/documents/20182/3129193627/Dokument_glowny_PRSP_2023-2032_do_konsultacji.pdf/. The draft was posted along with this on the TSO's website on March 14, 2022, and submitted for consultation with interested parties.*

67. "Sector coupling" is expected to be one of the critical drivers of electricity consumption by 2050, contributing an additional 28 percent to electricity demand. Electrification of buildings (heating and cooling), transport, and industry through electric furnaces, boilers, and heat pumps and electric vehicles (EVs) could play a key role in the decarbonization of the economy if the electricity is produced from non-emitting sources. To accommodate advances in electrification in other sectors without significantly increasing emissions and compromising the system's security, additional low-carbon electricity supply is needed, combined with far-reaching grid reinforcements. Consequently, the Decarbonization scenario assumes the gradual electrification of transport and residential heating, resulting in additional demand compared with the base case scenario.

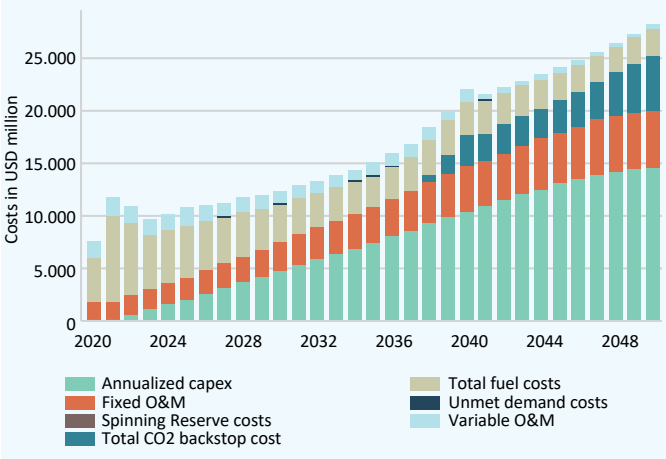
68. An ambitious decarbonization scenario implies an acceleration of coal plant retirement compared to the current plan and that annual operation and expansion costs grow gradually over the entire horizon (Figure 2. 2). By 2050, the decarbonization scenario leads to investment needs of around US$130 billion (in undiscounted terms), more than twice the amount in the business-as-usual scenario (Figure 2. 3). Segments of annualized CAPEX and fixed O&M increase substantially, accounting for over 70 percent of the total annual costs in 2050. The share of variable and fuel costs decreases due to less thermal generation. The transition to clean energy results in higher upfront capital expenditure and lower fuel costs. Appropriate risk allocation and a conducive regulatory framework is essential to maintaining a low cost of capital for RE.

69. Acceleration in decarbonization leads to massive additions in onshore and offshore wind and of PV. In the Decarbonization scenario, VRE sources, with zero carbon emissions and negligible marginal costs, represent most of the supply of the new power system, while conventional and dispatchable sources (coal and gas) operate exclusively during peak demand or amid shortages. Furthermore, while gas units are currently the leading providers of reserve capacity and flexibility, they could be replaced with demand-side management, storage, hydrogen- or biogas-fired gas turbines, or cross-border transmission capacities.

The impact of electrification of heating and transport

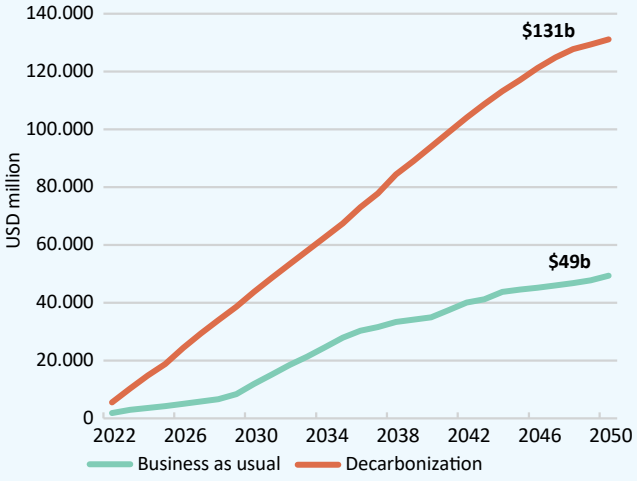
70. Electrification of heating and transport has a significant impact on the results. The electricity demand for heating and transport profoundly affects the system's peak demand. Without the additional heating and transport demand, annual costs in 2050 experience a 27 percent decrease, predominantly due to the reduction in the annualized CAPEX (-19 percent) and savings in the penalty on excessive power sector emissions (-57 percent). Cumulative investments by 2050 decrease from around US$130 billion to around US$105 billion under this scenario. The present

Figure 2.2: Annual cost breakdown under the Decarbonization scenario



Source: World Bank.

Figure 2.3: Cumulative CAPEX under BAU and Decarbonization scenario



Source: World Bank.

value of total system costs over the horizon for this scenario decreases by 17 percent compared to the main Decarbonization case when the H&T electrification considered.

Nuclear deployment

71. Nuclear deployment in the power sector may substantially ease the transition of the power sector, facilitating a simultaneous achievement of climate targets, provision of a stable supply, and reduction of the dependence on imported fossil fuels. Cumulative investments would increase from US$129 billion to US$160 billion. The Polish Nuclear Power Program assumes multiple nuclear units commissioned between 2033 and 2043, reducing the capacity requirements from other sources. Nuclear plants may substantially ease the transition of the power sector, facilitating a simultaneous achievement of climate targets, provision of a stable supply, and reduction of the dependence on imported fossil fuels. Annual cost in 2050 decreases by 6 percent, primarily due to a significant reduction in fuel costs (-43 percent) and emission penalty (-72 percent). Finally, the nuclear program has a positive impact on the net present value and emissions, with a decrease of 2 percent and 7 percent.

2.4. Renewables for a low-carbon energy transition

72. Poland's RE generation plans could be more ambitious for all sectors, but it will require addressing barriers to investments in the RE deployment. Those barriers are already a challenge for the implementation of the current, less ambitious targets. Poland's goal for the share of RE in total final energy consumption by 2020 was among the lowest in the EU, and a comparison of the 2030 RE targets declared in NECP's shows that Poland's ambition is low (Table 2. 1).

Table 2.1: Comparison of Polish and EU-27 renewable energy and climate targets

	Poland 2020 actual values	EU27 2020 actual average	Poland PEP2040/ NECP target (2030)	EU27 average target (2030)
Share of renewable energy in final energy consumption	16.1%[18] (target: 15%)	22.1% (target: 20%)	23%	45%
Share of renewable sources in electricity generation (RE-E)	17.9%	37.5%	32%	69%
Share of renewable sources in heating and cooling (RE-H&C)	22.1%	23.1%	28.4%	46%
Share of renewable sources in transport (RE-T)	6.58% (target: 10%)	10.2%	14%	32%
Reduction of GHG emissions compared to 1990	22%	31%	30%	55%
Reduction of GHG emissions in power sector compared to 2015	12%	24%	25%	70%

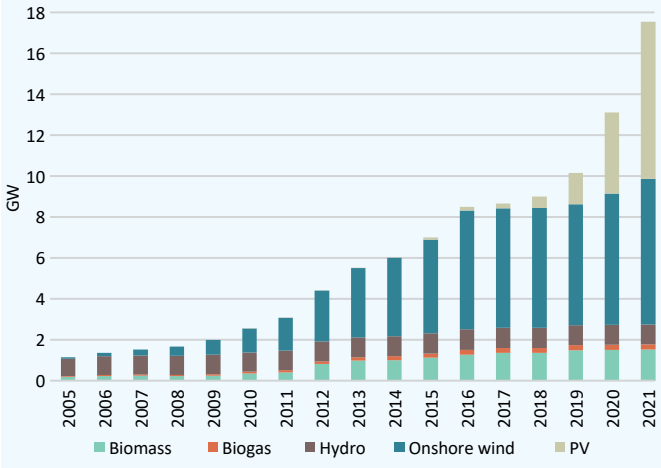
Sources: KOBiZE, Eurostat, NECP, PEP2040, EEA (proxy for 2020), Ember (proxy for EU 2020 power sector emissions), Renewable Energy Directive (RED), Draft RED amendment, GHG55 percent Impact Assessment, EC Fit for 55, RepowerEU Action Plan.

[18] *Poland adjusted the methodology of calculating biomass consumption that resulted in an increase by 3 percentage points in the RE share. Using the pre-2020 methodology, Poland would have missed the RE goal by around 2 percentage points.*

Renewables in the power sector

73. Poland's development of RE has seen periods of accelerated growth that were cut short by the introduction of unfavorable regulations. The country has used hydro energy for electricity generation since the early 20th century, but due to low hydro potential, the installed capacity of around 1 GW has remained at that level for many years. The first onshore wind turbines were deployed in 1998, and onshore wind developed rapidly until 2016, with yearly capacity increases exceeding 1 GW (Figure 2. 4). However, in 2016, the introduction of the so-called 10H rule[19] brought wind investments to a standstill at a capacity of around 6 GW. Since then, the capacity has increased only slightly, reaching 7.1 GW in 2021. The first notable growth in solar capacity was achieved in 2017–18, followed by a boom that started in 2020 with the introduction of the "My Electricity" program that provides subsidies to households for rooftop PV installations. In 2021, the country saw a record increase in solar PV of 3.7 GW, with total capacity reaching 7.7 GW.[20] Bioenergy is developing slowly, with an installed capacity of 1.5 GW in biomass and 0.2 GW in biogas power plants.

Figure 2.4: Installed capacity of RE generation technologies (2005-2021)



Sources: URE (2005-2019), ARE (2020-2021).

74. Almost no energy storage has been deployed in Poland. Around 1.7 GW of pumped storage plants exist, most of which were built in the 1970s and 1980s. Battery storage is almost nonexistent, with under 5 megawatts (MW) of large-scale units and limited home batteries as well, due to a lack of support schemes. As for other flexibility tools, 1 GW of demand-side response (DSR) is provided by industrial players who are willing to reduce demand for a certain price. The latest capacity auction contracted 1.5 GW of DSR for the year 2026 (Forum Energii 2022), but this is still only 6 percent of the current peak power demand.

Outlook and targets for RE development in the power sector

75. Poland could set more ambitious targets and increase its alignment with the EU's climate policy. Poland's target for the share of RE in final energy consumption has been set at the level of 21-23 percent by 2030, almost 20 percentage points below the proposed EU average (45 percent, up from the original 40 percent, as per the proposed revision of targets under the Fit for 55 package in the RepowerEU plan announced in May 2022). Under the NECPs, only Hungary (20 percent), Cyprus (19 percent), Belgium (18.3 percent), Slovakia (18 percent), and Malta (10.6-13.3 percent) proposed lower RE targets.

76. The PEP2040 assumes a 32 percent share of RE in electricity generation in 2030, while the EU average is expected to be 69 percent (Figure 2. 5).[21] The plan also assumes a reduction of GHG emissions by approximately 30 percent by 2030 compared to 1990, and as much as 37-56 percent of coal share in electricity generation. By contrast, the EU targets a reduction of at least 55 percent in emissions and only a 2 percent share of coal in electricity generation in 2030 (Climact & Ecologic, 2020).

19. *Act of May 20, 2016, on investment in wind turbines, Journal of Laws of 2016, item 961.*

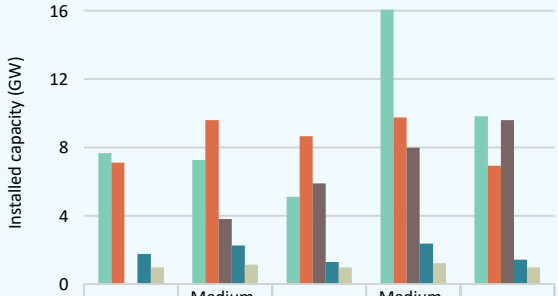
20. *76 percent of this 7.7 GW is from prosumers—households or businesses with micro-PV (<50 kW) installations.*

21. *Proposal for a directive of the European parliament and of the council amending directive (eu) 2018/2001 of the European parliament and of the council, regulation (EU) 2018/1999 of the European parliament and of the council and directive 98/70/ec of the European parliament and of the council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, 2021/0218, 14.7.2021.*

The European Commission (EC) estimates that the average reduction of CO_2 emissions in the power sector should amount to approximately 70 percent,[22] whereas in the PEP2040 it is only 25 percent. Following Russia's invasion on Ukraine and the announcement of the Repower EU program (Mateos-Merino and Nicolas, forthcoming) that increases the target for RE capacity in electricity generation by 15 percent by 2030, the PEP2040 is being updated, but it is expected to remain conservative in terms of RE adoption plans. The update is focusing mostly on energy security, and assumptions remain conservative in terms of RE adoption, as the RE share target for 2040 was increased from 40 percent to 50 percent.[23]

77. The core strategic RE project in the NECP and PEP2040 is the offshore wind expansion plan. This plan assumes up to 5.9 GW of capacity added by 2030 and up to 9.6 GW by 2040, together with a dedicated support scheme and legislation and related infrastructure such as the installation terminal or transmission network expansion. Several other actions are proposed in the NECP and PEP2040 to increase the adoption of RE: an increase in solar PV capacity (5-fold increase in the number of prosumers by 2030), with an active role of consumers in the electricity market and incentives for local power balancing (300 energy clusters by 2030); incentives toward low/zero-emissions individual heating; an expansion of smart electricity grids; R&D activities related to hydrogen and energy storage (with dedicated legislation for energy storage devices); the large-scale deployment of smart energy meters; modernization of distribution grids; and an increase in biomass, biogas, and geothermal energy use in large-scale heating.

Figure 2.5: Government plans for RE development by 2040



	2021	2030 Medium CO2 prices / NECP	2030 High CO2 prices	2040 Medium CO2 prices / NECP	2040 High CO2 prices
PV	7.7	7.3	5.1	16.1	9.8
Onshore wind	7.1	9.6	8.7	9.8	6.9
Offshore wind	0.0	3.8	5.9	8.0	9.6
Biomass and biogas	1.8	2.3	1.3	2.4	1.4
Hydro	1.0	1.2	1.0	1.2	1.0

Source: PEP2040, NECP, ARE.

Table 2.2: Resource potential for RE technologies

Technology	European Commission [GW]	Instrat [GW]
Wind – offshore	12	31
Wind – onshore	105	44
PV – ground-mounted	802	47
PV – rooftop	91	32
Biomass	31	5.2
Biogas	N/A	3.6

Sources: Instrat (2021), Ruiz Castello (2019); for wind and biomass the reference scenario, for PV the 170 MW/km2 scenario with 3 percent land availability.

[22] *Commission staff working on document on impact assessment accompanying the document communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions Stepping up Europe's 2030 climate ambition, investing in a climate-neutral future for the benefit of our people, part 1/2, 17.9.2020.*

[23] *At a press conference on March 30, 2022, the Minister of Climate and Environment suggested that the combined RE capacity in 2030 could reach 50 GW, which would align with existing market pipelines (PAP 2022).*

Barriers and gaps in the regulatory environment for renewable energy in Poland

78. Various barriers are hindering investments and thus slowing down the scale-up of RE in Poland. A comprehensive review of the regulatory framework, including a stakeholder consultation and a comparative analysis with European best practices—that is, the EC policy framework for climate and energy—aimed to identify regulatory gaps and to prioritize fields of action for the promotion of RE deployment and the acceleration of Poland's transition toward the implementation of market-based support mechanisms. Mateos-Merino and Nicolas, forthcoming, provides a comprehensive overview of the regulation and framework conditions with relevance to RE in the electricity sector in Poland and identifies gaps compared to EU best practices.

79. The main challenges for the scaling up of RE, especially wind and solar, are the spatial planning restrictions. For onshore wind projects, the 10H distancing rule introduced in 2016 completely halted new investments, making more than 99 percent of Polish land unavailable for wind turbines (Instrat 2021). As a result, installed capacity has increased only slightly and is expected to level at around 10 GW, or half of the capacity required to comply with the EU's 2030 climate targets indicated by the European Green Deal/Fit for 55 package (Ember 2022b). The spatial planning processes also affect large-scale solar farms, which can only be built on land of medium and low agricultural value.[24] An even more restrictive approach was proposed by the Ministry of Development in 2022 and is currently under discussion (Ministry of Development 2022). The new rules could, if approved, ban solar farms above 500 kilowatts (kW) of capacity from areas without local spatial plans (MPZP), which exist only for around 30 percent of Polish land as flagged by the Supreme Audit Office - NIK (Supreme Audit Office 2017). The process for creating spatial plans is time consuming and expensive, and the proposed change would almost completely stop solar investments above 500 kW. Additionally, land use criteria for solar farms below 500 kW would be tightened as well, excluding up to 75 percent of agricultural land from these investments (West-Pomerania, 2022). This could have a severe impact on the development of solar energy, comparable to the restrictions placed upon onshore wind projects. Finally, spatial planning is a core component of offshore wind investments, with project location strictly determined within the Offshore Act and the Spatial Development Plan for Polish Marine Areas (PZPPOM).[25] The areas available for offshore wind projects are scarce: currently, a total of 21 areas are defined in the Offshore Act, with 10 areas already allocated to projects in planning/development phases. The remaining 11 locations (Biznes Alert 2022) will be assigned to selected developers later in 2022, with a preference given to state-owned companies, making this sector almost completely inaccessible to foreign RE-sector players.[26]

80. The quality of grid planning, as well as the lead time and predictability of the grid connection process, are also key barriers to RE deployment. The grid infrastructure is under-funded and aging quickly. The aged distribution grids represent a particular challenge, with almost half of the high-voltage (110 kV) and medium-voltage (10-20 kV) overhead lines being more than 40 years old (Energia Elektryczna 2021). The investments carried out in recent years were insufficient to change the age structure of the distribution network and lead to its expansion. The transmission network

[24] *Agricultural land is categorized by soil classes I-VI, with I having the best soil quality. PV farms can currently be placed on low-quality land - categories IV, V and VI. This excludes 24 percent of the land from PV investments.*

[25] *Regulation of the Council of Ministers of April 14, 2021, on the adoption of a spatial development plan for internal sea waters, territorial sea and the exclusive economic zone on a scale of 1: 200,000, Journal of Laws of 2021, Item 935.*

[26] *The location granting criteria include a so-called "transition requirement," giving priority to companies with historically high fossil fuel shares that have green transition plans, like Polish utilities. This discriminates against RE sector players with no fossil share in their portfolio (which should be preferred but is treated negatively) (Dziennik Gazeta Prawna 2022). This means that, even if the auction support scheme will be competitive, access to auctions is limited by the planning procedures.*

also requires significant investments,[27] given that it is only half as dense compared to Western European countries—Germany, for example (Instrat, 2021a). While grid losses are assessed as medium (at 6 percent) (PTPiREE 2021), the system lacks RE connection capacity (Business Insider 2022a). Obtaining grid connection permits is highly unpredictable, with long lead times and certain Distribution System Operators (DSOs) reducing up to 60 percent of grid connection permits and blocking an estimated 20 GW of solar farms from being deployed. Low grid density also means that RE developers face significant infrastructure costs to connect to the nearest suitable substation. Grid bottlenecks are also becoming visible to prosumers (users of small-scale PV installations). Access to information about the Polish grid is also very limited, with the predictability of future grid development perceived as low and DSO grid expansion plans unavailable to the public. Finally, grid balancing is also becoming a real concern with the increased adoption of RE in Poland. Historically, the topic was overlooked, and balancing costs were assumed to be covered by DSOs and the Transmission System Operator (TSO), but this is now quickly changing.

81. Grid challenges could be tackled to some extent using energy storage or other flexibility options (for example, demand-side response, variable tariffs, self-balanced energy clusters of communities, on site or near-site PPAs) but these are not yet supported well enough for them to have a significant contribution. Alternatively, some grid connection capacity could be opened by introducing cable-polling (PSEW 2021a)—that is, sharing the grid connection between wind and solar installations.[28]

82. The duration and complexity of other administrative procedures also constitute important barriers. The administrative process for a new RE project is managed by multiple institutions, reducing transparency and predictability. The local spatial planning processes, environmental impact assessments, and public consultations take a minimum of three years for onshore wind projects, and even longer for offshore wind. Poland has yet to implement "single-contact-points" suggested in the EU's Renewable Energy Directive (RED), which could solve some of these challenges and significantly decrease project lead times.

83. Finally, the general instability of the policy environment, the limited reliability of support schemes, and the market concentration also negatively influence RE investment decisions. Delays in implementing EU directives, frequent changes in the national energy regulations and support schemes, short adjustment periods, as well as fluctuating currency exchange rates and high inflation affect the investment environment, increasing risks and cost of capital. Furthermore, a highly concentrated market dominated by coal-dependent state-owned utilities can disincentivize international investors from entering Poland's RE sector. Also, a lack of clear vision and outdated strategic documents with low RE ambition add to the uncertainty faced by foreign financial institutions.

Main gaps in implementation of EU legislation

84. Gaps in the regulatory framework are a key driver of the barriers for RE deployment, in particular with respect to the EU Directives and policy packages. These are described below (Mateos-Merino and Nicolas, forthcoming, presents a detailed analysis of the European and Polish legal framework and strategic plans for RE).

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[27] *Estimating the exact size and scope of grid-related investments is very complex. The draft 10-year development plan of the Polish TSO for the years 2023-32 assumes 32.3 billion PLN of investments for the transmission grid alone (PSE 2022). This is comparable to a recent modelling study by Instrat - 29.7 billion PLN in the years 2021-40 (Instrat 2021a). In terms of distribution grids, the DSOs proposed 45 billion PLN worth of investments between 2021 and 2025, or 9 billion per year, up from the historical yearly average of around 6 billion PLN (Energy Regulatory Office, 2020). According to Instrat and Eurelectric/Deloitte these distribution grid investments are still underestimated, with forecasts suggesting up to 12 billion PLN DSO investments per year needed to accommodate the accelerated RE growth (Instrat, 2021a).*

[28] *Cable-pooling can greatly increase the utilization of the grid connection infrastructure and limit connection capacity requirements, with minimal losses for the RE producers themselves estimated at around 10 percent of the production.*

85. Poland's 2030 RE deployment plans, included in the EU-facing NECP and national PEP2040 documents, are far less ambitious than the EU averages. The only RE-related strategic project included in the PEP2040/NECP documents, which is the deployment of offshore wind farms, is already at risk. The key legislation, the Offshore Wind Act, took over a year between publication of the draft and its acceptance by the Parliament. Similarly, the Spatial Development Plan for Polish Marine Areas (PZPPOM),[29] due to be implemented by March 31, 2021, according to the EU's Maritime Spatial Planning Directive,[30] entered into force only in May 22, 2021, which made it more difficult to comply with the very tight timeline for applying for offshore support to the Energy Regulatory Office (URE) and the EC (the deadline was June 30, 2021).

86. There are also delays and gaps in the implementation of RE-related directives relating to prosumers and energy communities. These are described in the RED II and the Internal Electricity Market Directive.[31] Two energy community schemes are proposed: the Citizen Energy Community (CEC)[32] and the Renewable Energy Community (REC),[33] but these are still not fully implemented in Polish law. Instead, two other schemes are provided (RE Act and Cooperative Law[34])—energy cooperatives and energy clusters, which are not compliant with CEC and REC. Given the design of energy cooperatives under Polish legislation, excluding them from cities, they have not been widely adopted, with only two registered so far (KOWR 2021). Around 50 energy clusters have been registered, but due to a lack of detailed regulations few are active. Energy clusters are also not limited to RE sources and often include gas plants, making them incompatible with the REC scheme from RED II. Arrangements for "peer-to-peer trading" in the sense of Article 2 (18) Directive 2018/2001 are also non-existent in Polish law,[35] and several measures for implementing "renewables self-consumers," as per Article 2 (14) Directive 2018/2001, are still being introduced. A solution to implement some of these RED II components was introduced in December 2021[36] with the definition of "collective prosumers" and "virtual prosumers," The latter scheme will enter into force in 2024, while the specific regulations, best practices, and administrative tools for the former are not yet in place.

87. Persistent gaps in the PPA legal framework make it impossible to use direct lines between the producer and the consumer. This means that the consumer must always pay distribution and transmission charges, which constitute close to 50 percent of the electricity bill. In this scenario, the benefits of a PPA are limited only to the reduction of the power cost itself; so even if that is reduced by 50 percent, the overall savings will not exceed 25 percent. If direct lines or on-site generation are implemented, the minimization of grid charges will further decrease the bill, making the scheme much more attractive for PPA consumers, who could reduce total electricity costs by 50 percent or more. Further gaps in the implementation of the Clean Energy for All Europeans package relate to the complexity and

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29. *Regulation of the Council of Ministers of April 14, 2021, on the adoption of a spatial development plan for internal sea waters, territorial sea and the exclusive economic zone on a scale of 1: 200,000, Journal of Laws of 2021, Item 935.*

30. *Directive 2014/89/EU of the European Parliament and of the Council of July 23, 2014, establishing a framework for maritime spatial planning.*

31. *Directive (EU) 2019/944 of the European Parliament and of the Council of June 5, 2019, on common rules for the internal market for electricity and amending Directive 2012/27/EU.*

32. *Art 16 of Directive 2019/944.*

33. *Art 22 of Directive 2018/2001.*

34. *Art. 1 §1 of Act from September 16, 1982, Cooperative Law.*

35. *Definitions will likely be introduced in a new amendment to the RE Act and Energy Law that is currently under public consultations (Draft Amendment to RE Act from February 25, 2022, UC99). However, the specific regulations needed for the implementation are yet to be presented.*

36. *Act of October 29, 2021, amending the Act on Renewable Energy Sources and certain other acts, Journal of Laws of 2021, item 2376.*

duration of administrative procedures, as well as the lack of transparency and predictability. These challenges were identified in RED II, and a proposal was included to introduce so-called single contact points for applicants for permits to build and operate RE installations and infrastructure.[37] These have not been created in Poland, and the development process for RE investments involves multiple steps managed by several institutions, constituting an important barrier to RE adoption. RED II also specifies that the permit-granting process should not exceed two years, and in exceptional circumstances three years.[38]

88. The integration of RE in spatial planning is also an area in which Poland falls short of European best practices. Poland's onshore wind distancing law is among the most restrictive in Europe (Ember 2022a), comparable only to regional regulations in individual states/counties in Germany, Austria, Estonia, parts of the United Kingdom, and a policy introduced in 2016 in Hungary that effectively banned onshore wind through several legal measures. On a national level, most countries assume a 500–1,000m minimum distance between wind turbines and houses, while in Poland this exceeds 2,000m. The 10H rule also applies to national parks and reserves, and bans repowering of existing turbines. An amendment to the 10H rule was proposed in 2021, lowering the distance to 500m if confirmed through local spatial planning processes.[39] Public consultations were completed in 2021, but the bill has not yet been approved. The increased spatial planning restrictions currently under discussion for large-scale solar plants go against the EU's goal of tackling barriers to RE, which was set in the REpowerEU program. The lack of integration of RE in spatial planning compares unfavorably with Germany's recent commitments to open up land for RE investments, speed up permitting, and increase the attractiveness of RE investments for municipalities (S&P 2021).

89. The share of EU Emission Trading Scheme (ETS) income spent on green investments is below EU requirements. Data on the amount of support and the sources of funding for RE in Poland has been limited, and Poland is among only a handful of countries that did not provide data to the Council of European Energy Regulators for their 2021 report (CEER 2021). Even though 50 percent of ETS income should be spent on green investments, only around 16 percent of the 2021 ETS money could be directly tracked to energy-related investments (Business Insider 2022b), with a major part of the funding spent on shielding consumers from increasing gas prices or COVID-19 recovery programs. In the future, around 40 percent of ETS income is supposed to be spent on a dedicated Energy Transformation Fund (Ministry of Climate and Environment 2022), but the legislation is still pending.[40]

90. Finally, while the design of Poland's RE support schemes is considered mostly consistent with European best practices, some challenges still exist. These are especially related to the perception that Poland's general policy stability is below EU standards by national and foreign financial institutions.

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[37] *RED II states: The single contact points should guide the applicant and facilitate through the entire administrative process so that the applicant is not obliged to contact other administrative bodies in order to complete the permit-granting process (paragraph 50 of the recital). The draft RED II proposed January 1st 2021 as the due date for the creation of these contact points, but this date was not included in the final text.*

[38] *RED II, Art. 16, p. 4.*

[39] *Draft Amendment to Act on Wind Energy Investments from May 4, 2021, UD207.*

[40] *Draft Act of October 14, 2021, amending the Act on the Greenhouse Gas Emission Allowance Trading system and Certain Other Acts, UA7.*

Barriers related to market-based support mechanisms for RE in Poland

91. Poland has in the past and is still supporting RE development through several schemes. The current ones include competitive auctions for large RE producers, Contract for Difference (CfD) support program for offshore wind farms (to be replaced by auctions), and feed-in tariff (FiT) and feed-in-premium (FiP) for biogas and hydroelectric plants below 1 MW.[41] In addition, small-scale RE prosumers (below 50 kW) are supported through direct subsidies via the "My Electricity" program, and they also benefit from reduced transmission and distribution tariffs. It is also worth mentioning that large-scale energy storage plants can take part in the capacity market, which can be considered a form of subsidy financed through consumer tariffs. Except for some minor exceptions, the existing support mechanisms are all market-based (see Mateos-Merino and Nicolas, forthcoming). The most important issues identified relate to their stability and predictability, as explained below.

92. RE auctions, the core RE support mechanism in Poland, has historically been quite effective, and its design is aligned with the EU's State Aid Guidelines. The auctions are based on competitive bidding and have contributed to significant RE capacity additions in previous years. Thus, the auctions should continue in the future, with adequate budget allocations that allow for the rapid expansion of RE.

93. However, the transparency of RE auctions needs to be improved. The reference (maximum) prices for auctions are determined administratively using undisclosed methods. Investors point to significant delays in publishing regulations setting auction dates and reference prices (for example, these regulations were delayed between 61 to 261 days in the years 2018–20). Given this, auction regulations should be published in advance, allowing investors to prepare their strategies. Control mechanisms should also be put in place to monitor the effectiveness of the scheme and adapt the design to current market conditions.

94. The design of auction categories, combined with the 10H onshore wind restrictions, lead to suboptimal budget distribution and hinder competition. Onshore wind and solar energy are combined under one category despite the large difference in levelized cost of electricity (LCOE). This means that the latter are treated less favorably, with settled prices possibly not covering LCOE. At the same time, the supply of wind projects is decreasing due to the 10H rule, leaving unused budget in the >1MW auction category, while in the <1MW category there is significant underfunding, with the request for funding twice as large as the budget. The total auction fund allocation remains at 50 percent of the budget, limiting the RE capacity expansion. Auction categories should consider project supply to ensure optimum fund allocation and competition.

95. Due to the very low prices, auctions are used mostly as collateral for securing funding. This, combined with the low availability of PPAs and the increasing CAPEX and cost of capital, means that financial conditions for RE in Poland are becoming less attractive. This might lead to a slower pace of RE development. Auction reference prices and budgets in underfunded categories should, thus, be increased to account for the changing market conditions.

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[41] *RE auctions and the FIT/FIP schemes are funded directly from the "RE fee," applied to all electricity consumers. The RE fee represents only 0.1 percent of the total household tariff of 852 PLN/MWh in 2022 and even less in the case of institutional consumers, who typically face higher energy costs per MWh.41 In the future, the RE fee is expected to increase together with the increasing volume of RE. However, the increased RE share in the power mix should also lead to the lowering of wholesale electricity prices, offsetting the increase in support costs.*

96. The use of BASE prices as the reference in auctions leads to discrimination against solar energy producers. PV investors sell energy below the BASE[42] price, but they are only compensated to the BASE level, which currently lowers support income by 15–30 percent (a percentage that is expected to worsen in the future). The mechanism of price calculation should be changed so that no technology is treated unfairly. Alternatively, adequate support for storage should be provided to enable balancing for PV investors.

97. Auctions can only be effective if access is open to all participants without prejudice. This is not the case due to policy barriers, such as the 10H rule for onshore wind, spatial planning and grid connection restrictions for solar farms, or unequal permitting rules for offshore wind projects. For the support schemes to achieve expected outcomes, RE barriers need to be tackled first.

98. Support for energy storage is nonexistent. The only support scheme available for large-scale storage projects is the capacity market, which prioritizes fossil fuel funding and the largest state-owned utilities. No new energy storage projects have been supported within the six that have already settled capacity market auctions. Due to the high CAPEX, without transparent, stable funding schemes, energy storage will not accelerate in Poland, hindering the expansion of RE. The capacity market should provide attractive funding opportunities for storage projects, and they should be included in RE auctions—or a new dedicated support scheme should be introduced.

99. Support for small-scale prosumer RE installations is decreasing, which might lead to a deceleration of RE expansion. The change of the settlement schemes, the reduced budget, and the decreased attractiveness of the "My Electricity" program will likely lead to lower adoption of rooftop solar energy.[43] Currently, these rooftop installations constitute over 70 percent of all solar capacity, so a collapse in this market segment will have a significant impact. The budget of the "My Electricity" program should be adapted to demand to ensure the quickest possible expansion of solar energy.

100. The stability and simplicity of support schemes is essential for their effectiveness. Stakeholders point to the overall instability of the legal framework and support schemes as one of the top barriers for realizing investments. When modifying support schemes, adjustment periods should be sufficiently long and public consultations should be carried out. In addition, to ensure simplicity, it would be preferable to use a single support scheme design for large-scale RE producers. The coexistence of Feed-in Tariff/Feed-in Premium for some technologies with RE auctions and Green Certificates increases administrative overhead, lowers transparency, and leads to suboptimal budget allocation. Support schemes should be simplified and preferably combined under the single RE auction scheme.

101. Market-based support schemes cannot be fully effective without completing the market unbundling. The combination of DSOs with SOE fossil energy producers that have a dominant position leads to the unequal treatment of private RE producers in terms of access to funding,

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[42] *The BASE prices is the arithmetic mean of the volume-weighted average hourly prices on the day-ahead market for a given delivery day (from 00:00 to 24:00), calculated on the basis of all hourly contracts. The BASE price averages the hourly price deviations that correspond with demand and supply. This means that the BASE price will be increased by high prices in the morning and evening demand peaks and will thus typically be higher than the sales prices in the middle of the day, when the solar generation peaks.*

[43] *Due to an amendment of the RE Act from December 2021, since April 1, 2022, new prosumers use a net-billing settlement scheme, selling the surplus energy generated during the day at wholesale prices and buying the energy back at standard tariffs with a 15 percent discount on selected distribution charges. This means that the profitability of the investment will vary significantly depending on highly volatile wholesale electricity prices. While the new settlement scheme is more in line with the State Aid Guidelines in terms of incentivizing market behavior, this change is expected to increase payback times by at least two years (Wysokie Napięcie 2022a).*

both directly and indirectly via permitting barriers. Market unbundling should be completed, with DSOs financially separated from energy production and sales segments of the existing utilities.

2.5. Policy considerations

102. To accelerate the green transition and prevent a significant slowdown of RE development, several actions need to be taken. Poland's RE potential is high with significant success already achieved in wind and solar deployment. However, many obstacles hinder further expansion, some of which can be overcome quickly by legislative action and with broad public support, given the very high social acceptance for RE in Poland. Key barriers to address include spatial planning restrictions, grid connection impediments, the complexity and duration of administrative procedures, and a general lack of stability and strategic planning. The proposed roadmap is aligned with these priority areas.

103. The key short-term priority for improving RE adoption in Poland is the loosening of spatial planning restrictions. This includes aligning the rules for onshore wind with European standards and lowering the setback distance to 500m. A change in spatial planning for solar farms is necessary as well to unlock PV investments on most agricultural land. Further, the area allocation procedures for offshore wind farms need to ensure competition without discriminating against certain types of market players, such as foreign RE developers.

104. To ensure widespread RE adoption, grid connection procedures need to be quick, transparent, and predictable. Short-term actions, therefore, should prioritize including more access to data and information about the status of the procedures, as well as ensuring the availability of connection capacity in different areas. Longer-term recommendations focus on strengthening the grid infrastructure through investments, as well as better planning and more public participation in the process.

105. Further unbundling of the large energy utilities would level the playing field for RE producers. Challenges related to grids are strongly tied to a fundamental condition of Poland's energy market: the lack of unbundling. The dominant role of utilities that combine distribution grid management with conventional electricity production and sales has a strong impact on energy transition. In particular, the coal-focused utilities have a strong financial interest in slowing down the development of RE, and they can do that through their ownership of distribution grids. Until these entities are separated, the position of RE producers will always be endangered.

106. Improvements in the design of RE support schemes and in grid flexibility are also recommended. The support schemes available to RE producers are mostly perceived positively and have already contributed to a strong increase in RE capacity. Still, several recommendations for improvement are proposed, including the redesign of RE auction categories with better transparency and scheduling. Among the critical actions needed in the short term is a support mechanism for energy storage that could accelerate the deployment of battery storage needed for grid balancing. Other recommended measures include the deployment of smart-meters, variable tariffs, electromobility, and demand-side response.

107. Investment risks need to be reduced by ensuring equal access to electricity markets and a stable policy environment. In the future, a shift from support schemes toward a fully market-based transition is expected. For that to happen, however, RE producers need to be treated equally and have free access to fluid electricity markets, including access to market data. A stable policy environment is also needed, with wide public participation, long adjustments periods, and high predictability. This will

increase the availability of funding, especially from foreign investors. While support schemes for large-scale RE will likely be declining in popularity, alternatives are needed—for example, a high availability of PPAs. Additionally, actions should be taken to reduce RE investment risk—for example, by national banks or Multilateral Development Banks (MDBs) providing guarantees or taking part in funding consortiums.

108. These actions, coupled with ambitious targets and Poland's high RE potential, can open up multiple investment opportunities while also contributing to Poland's green growth and the realization of the EU's climate policy. In particular, the positive effects of the green energy transition on job creation have been broadly discussed. Due to being the major component of the power mix, coal has been an important contributor to the labor market and the overall economy. Over the past three decades, however, the number of jobs in coal mining has dropped substantially, from almost 400,000 in 1990 to 87,600 at the end of 2020.[44] The PEP2040 estimates that investments in RE, electromobility, grid infrastructure, and energy efficiency could create 300,000 new jobs. A recent study on the Polish onshore wind potential (Instytut Jagielloński 2022) shows that between 51,000 and 97,000 new jobs could be created in that segment, with an added value of 70 to 133 billion PLN. Furthermore, according to government officials, offshore wind investments are expected to generate up to 77,000 new jobs (Biznes Alert 2020).[45]

[44] *Most of this reduction happened during the first decade of the transition from a centrally planned model to a market economy, that is, in 1989-2002. It is estimated that Poland's coal mining sector generates another 57,000 to 130,000 indirect jobs. The effects of mine closure are especially felt in mining municipalities where the mines and many of the companies servicing them are concentrated and where tax contributions from the mines make up a large share of local government revenues.*

[45] *International studies are even more optimistic, indicating a potential of up to 800,000 green jobs by 2030 (IRENA 2022), although these should, however, be treated with caution given that most of that potential is on short-term construction work (World Bank, 2021). Also, the local content of RE projects in Poland varies between 26 percent for PV to 55-60 percent for onshore wind (Instytut Jagielloński 2022 and IEO 2021) with many high-quality jobs related to R&D, product design, manufacturing, and so on located abroad.*

Chapter 3
Human Capital—Critical Driver of Quality Growth

3.1. Introduction: shocks, human capital, and long-run growth

109. Human capital is a key driver of growth. The macroeconomic modelling results for Poland show that human capital is one key component of economic growth in Poland. Endogenous growth theory emphasizes that growth is determined by "knowledge," which is, in turn, embodied in either physical or human capital (Romer 1986). Knowledge can, instead, be thought of as reflected in technological change, driving growth (as in Lucas 1988). The economic intuition is that knowledge can lead to ideas and innovation that are observed in the world in the form of physical capital (that is, technology). But at the core of knowledge, ideas, and innovation is the necessary condition of human capital accumulation. Moreover, human capital is linked to productivity growth.[46] Indeed, historical and cross-country evidence indicates that growth is associated with initial levels of human capital (Barro 1991).

110. Human capital is also a driver of social mobility. Human capital accumulation triggers the process of knowledge-idea-innovation-technological change that culminates in long-run growth. At the same time, human capital yields benefits for the individuals accumulating knowledge. Productivity will ensure that individuals possessing knowledge, skills, and other personal characteristics that are applied to those activities see higher returns for their labor. Social mobility will occur if individuals, regardless of their background, get the opportunity to accumulate human capital. These opportunities may come in the form of formal or informal education (with both codified and tacit knowledge implications), training, and on-the-job learning in the labor market (Mincer 1984).

111. In addition to the quantity and the quality of education, the knowledge acquired on the job is also important for growth. The quantity of education is important as a mechanism for human capital accumulation but may require achieving a certain threshold for schooling to deliver economic growth (Ahsan and Haque 2017). However, educational attainment may not guarantee economic growth. Instead, cognitive skills are strongly related to individual earnings, income distribution, and economic growth (Hanushek and Woessmann 2008). For instance, individuals scoring one standard deviation above the mean in standardized mathematics tests may experience a 12 percent premium in their earnings (see Mulligan 1999; Murnane, Willett, and Levy 1995). But just as important is the learning and knowledge acquisition that occurs while working. Technological change that delivers productivity growth and long-run growth can also be attributed to workers' experience in the production process (Arrow 1962). Thus, the type of jobs directly affects workers' experiences, their learning, technological change, and ultimately long-run growth.

112. However, non-idiosyncratic shocks can have devastating and lasting consequences on human capital. Coping strategies aside, income shocks, for instance, can lead to a reduction in human capital investments (see Dasgupta and Ajwad 2011). Similarly, natural disasters can also represent a non-idiosyncratic shock that reduces human capital (Baez, de la Fuente, and Santos 2010). Just as income or climate are exogenous (that is, non-idiosyncratic) shocks, individuals can be affected by policy-induced shocks such

[46] *Since production is a function of the stock of knowledge, the latter exhibits have an increasing marginal product (see Romer 1988).*

as an educational reform. More recently, the COVID-19 pandemic has made evident that a worldwide health threat can represent another type of idiosyncratic shock. Backtracking on educational reform and a pandemic can both be shocks that lead to a reduction in human capital accumulation.

113. This chapter analyzes human capital accumulation in Poland as a driver of growth, assesses possible shocks, and recommends policy options. The chapter first assesses Poland's human capital dynamics and gaps. However, it does so by exploring two distinct non-idiosyncratic shocks: policy-induced and world health risks. On the one hand, the chapter considers whether the 2016 educational reform in Poland led to human capital reductions. The chapter first discusses educational reforms implemented in Poland over the last 20 years. It explores learning outcomes, attainment, and skills in the adult population. The chapter then provides evidence on human capital improvements using data from international large-scale student assessments and adult skill surveys. The chapter also assesses the potential shock to human capital in the form of the 2016 educational reform while also exploring the challenges implied by COVID-19 as a second shock to human capital. In particular, the section presents evidence on learning loss caused by the pandemic and the restructure of the school system. It also provides predictions of the impact of the learning loss on economic growth and wages.

114. Finally, the current green transition implied by the European Green Deal (EGD) can be considered a second potential policy-induced shock to human capital. The EGD can be considered a set of policies that aim to induce a change in behaviors that can move society toward a green and circular economy. In doing so, firms will face the challenge of finding a new mix of factors of production that avoid emissions, very likely by relying on technological change. Similarly, workers and individuals at large will face the challenge of ensuring their skills remain relevant, given demand in the new labor market. Thus, the chapter addresses the human capital gaps limiting growth potential through green-brown skills, mismatches, and skills' returns in greener jobs. Finally, the chapter links skills and labor market data to provide an analysis of job transitions and the role that skills can play with occupation-specific examples. The paper concludes with a summary of evidence and policy options to facilitate an upskilling and smooth transition to a greener economy in Poland.

3.2. Education reforms and their impact on human capital accumulation

115. Poland's rapid transition from a centrally planned economy to a market economy in the 1990s was not accompanied by changes in the education system. Schools were still following old-style curricula, inspectorates focused on administrative tasks rather than teaching quality, national examinations were not standardized, and selection to a limited number of places in tertiary education was not fully transparent. Since the 1990s, Poland has become one of the fastest-growing economies in Europe, with a growing demand for skilled labor. But to meet that demand, a large-scale reform of the education system was necessary.

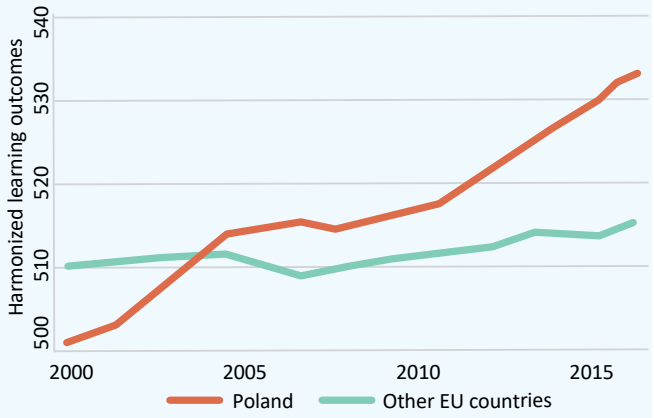
116. The 1999 educational reforms expanded general education and established key competencies from pre-K through 12th grade, while the 2008 reform modernized the curricula, gave teachers more autonomy, and improved educational quality in vocational schools. The education reforms were carried out between 1999 and 2016. The overarching goal of the reform was to expand general education and to provide learning opportunities for all students. The 1999 structural reform replaced eight years of primary school with nine years of general education in primary and lower secondary schools. The curricular reform of 2008 not only modernized the curricula and gave more autonomy to teachers,

but it also introduced a new requirement for all vocational schools to cover at least a one-year equivalent of the core subjects taught in academic schools (see Marciniak 2015). The 2008 reform introduced a consistent curriculum that emphasized key competencies from preschool up through the end of upper secondary education. The early childhood education reform also started around that time and was continued until 2015. It introduced compulsory education for 5-year-olds, lowered the starting school age to six years, and extended the right to preschool education to three-year-olds and four-year-olds. Overall, the reforms expanded the length of compulsory general education from eight to 10 years and increased opportunities for children to start education at the age of three and for youth to continue into tertiary education (Jakubowski 2021). In 2015, general education started at the age of three and continued until the age of 16.

117. During the reform period, tertiary education enrollment increased, quality improved, and skills met demand. In the meantime, tertiary education also expanded with new three-year bachelor programs that attracted an increasing number of students, with a growing number of graduates obtaining master's degrees. The expansion of tertiary education could have affected its quality as the increase in the number of students was not associated with an equal increase in the number of academic teachers and resources available at universities (Kwiek and Szadkowski 2018). Despite the rapid expansion, the market premium for a tertiary education diploma in Poland remains comparable to the average across the EU or OECD countries. The wage premium in Poland was above the average levels in the 2010s, but the rapid increase in the supply of people with tertiary degrees decreased the wage premium and increased the variability in salaries (Gajderowicz, Grotkowska, and Wincenciak 2012). Currently, the market valuation of these diplomas is similar to the average level in Europe, despite the above-average proportion of tertiary education graduates.

118. The 1999 reform coincides with a noticeable increase in learning outcomes in Poland, which, through human capital accumulation, potentially supported growth. Large-scale international student assessments like OECD's PISA and IEA's TIMSS and PIRLS offer the most precise measurement of human capital. One version, in the Harmonized Learning Outcomes database (Angrist and others 2021), allows for making comparisons of changes in learning outcomes for Poland and the EU average (across the remaining 26 EU countries). While the EU average for learning outcomes shows modest improvements (particularly since 2007), Poland's learning outcomes increased significantly throughout the period. While the comparison is not evidence of causality, it reflects a period in which he 1999 educational reform in Poland coincided with improvements in learning outcomes for the country, which were noticeably larger than the EU average experience for the same period (Figure 3.1).

Figure 3.1: Student learning outcomes in Poland and among other EU countries



Source: Angrist, N., Djankov, S., Goldberg, P. K., & Patrinos, H. A. (2021). Measuring human capital using global learning data. Nature, 592(7854), 403-408.

119. Expanding general education had a noticeable and lasting effect on learning performance and, thereby, on human capital and long-run growth. Prior to the 1999 education reforms, learning outcomes in Poland were below the EU average (Figure 3.1). The learning outcomes quickly improved after the implementation of the 1999 reform, mainly

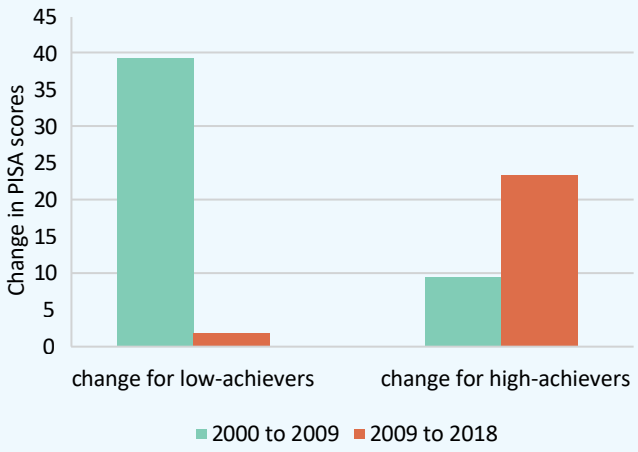
due to the extension of general education and delayed selection to academic and vocational schools. Research in Jakubowski and others (2010) presents a hypothetical comparison in students' performance trends: students who, without the reform, would likely enroll in secondary education, and students who would go to vocational education. Results show that expanded general education mainly benefited the latter. These benefits not only improved performance for vocational school students, in reading, mathematics, and science, but their effects persist over time (Jakubowski and others 2016).

120. The 1999 reform also had a progressive effect on educational outcomes. Poland experienced a significant improvement in educational outcomes. However, between 2000 and 2009 those gains were largely concentrated among the lowest-achieving students (Figure 3.2). In fact, Poland's lowest achievers experienced the largest improvement across all OECD countries during the same period.[47] At the same time, the results delivered a Pareto optimum: improvement in the lowest decile had no effect on the outcomes for decile in the highest-achieving students.

121. The curricula reforms starting in 2008 also coincide with an improvement in quality of education that might be associated with a period of human capital accumulation and growth. It is possible that the curricula reforms and other changes implemented around 2008/2009 could have led to further improvements in the quality of teaching. Although there is no evidence on the causal impact of any of these reforms on teaching quality, the improvement coincides with the moment of reform. Student outcomes improved rapidly to above EU-average levels (Figure 3.1). Improvements were larger among the higher-performing students (Figure 3.2).

122. Learning outcomes between low- and high-achieving students started to converge. Over time, both low- and high-achieving students improved their performance substantially, keeping the differences between them at similar levels. Changes in student performance translated into improved earnings and a lower chance of unemployment for the lower educated (Liwiński, 2020; Drucker, Horn, Jakubowski, forthcoming). The full impact of these reforms on the economy is yet to be realized as the oldest students who benefited from them are now into their 30s.

Figure 3.2: Reading performance changes among the low- and high-achievers



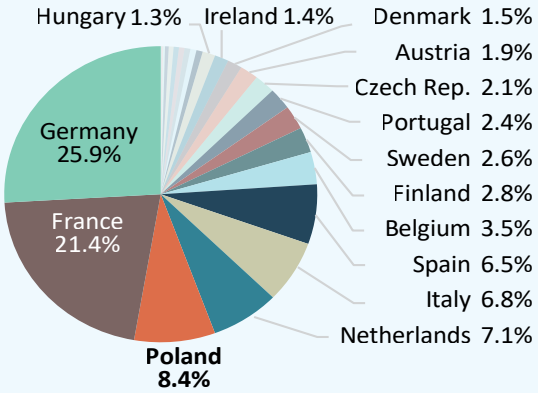
Source: Authors' analysis of PISA data.

Note: The performance change for low-achievers is the change at the 10th percentile of PISA reading scores distribution, and for the high-achievers it is the change at the 90th percentile.

123. The reforms also attracted talent in growing numbers. Successful reforms in the Polish school system resulted in a growing pool of talented students entering higher education. By 2015, the percentage of students achieving the two top proficiency levels in science in PISA was the third largest in the EU (Figure 3.3). These top students are those who are likely to go into science, technology, engineering, and mathematics (STEM) professions and who will drive future innovations and technological progress in EU countries. The percentages show the proportion of these most talented students in science coming

[47] *When comparing students at the 10th percentile of the performance distribution within each country.*

Figure 3.3: European talent pool: share of EU students who excel in science by country



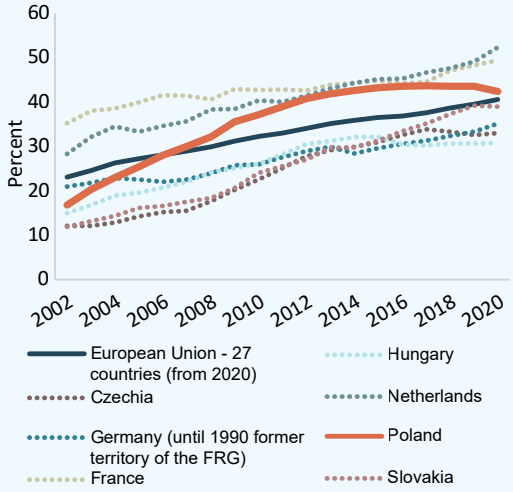
Source: Authors' calculations based on PISA 2015 data.

Note: The percentages show the proportion of the total EU population of students achieving Level 5 or 6 in PISA science assessment residing in each EU country.

from each country. Although these proportions are influenced by population size, they also reflect teaching quality. Germany and France are leading, but Poland is third, providing around 8.4 percent of the EU's 15-year-olds showing science knowledge and skills at the top levels—more than Italy or Spain.

124. The reforms resulted in faster-than-average growth in tertiary education attainment. One of the main goals of the Polish school reforms was to allow more students to enter tertiary education. Access to universities was limited during communist times, and in the 1990s, it became clear that the limited supply of a well-educated labor force was a major obstacle for the whole economy. Deregulation and privatization of the tertiary education sector allowed increasing enrolment, while school reforms improved the foundational skills of students. In the 2000s, the number of higher education graduates started to increase rapidly, soon reaching above EU-average levels (Figure 3.4). While the number of students in tertiary education increased all over Europe, Poland's growth was faster (Figure 3.4). In recent years, the share of the population graduating from higher education institutions became stable, mainly due to demographic decline.

Figure 3.4: Tertiary educational attainment, percentage of population aged 30 to 34



Source: Tertiary Educational attainment, Eurostat.

125. In 2016, these reforms were largely reversed, leading to a shorter period of general education, which limits the possibility for human capital formation and could impinge on long-run growth. The reform reversal was driven by public opinion, which held that the lower secondary schools introduced by the 1999 reform were the main cause of student misbehavior—despite research showing that discipline is not weaker in these schools. In addition, many parents opposed the idea of starting school earlier, despite evidence that in most EU countries school starts at the age of six. The argument that schools were

not prepared to accommodate younger children properly won, and the obligatory starting school age was again set at seven. As a consequence, since 2016 the age of compulsory preschool education was raised from five to six. These changes negatively affected local governments' capacity to provide preschool environments and, thus, to equip children from disadvantaged backgrounds with the skills needed to successfully begin their educations. Raising the starting school age will, in the future, also increase the age that citizens enter the labor market, which could negatively affect growth in the ageing Polish society. General education with the same curriculum is now limited to eight years of primary school, as opposed to six years of primary and three years of lower secondary. The potential impact of these recent changes on human capital development in Poland are evaluated through a human capital gaps analysis.

3.3. Skills in the adult population

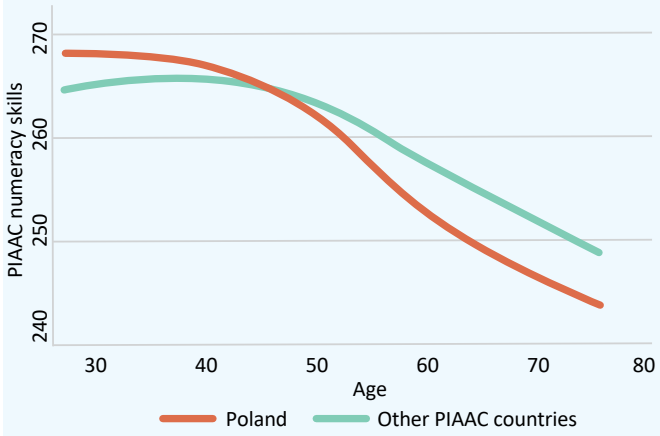
126. Young adults in Poland display higher skills than other OECD countries, but older adults' skills decline rapidly across older cohorts. Improvements in tertiary education participation and in the quality of teaching in secondary schools are well documented for Poland. The data on adult skills is more limited, and what is available suggests a less optimistic picture. The main source for comparisons of skills comes from OECD's PIAAC, which is a large-scale representative survey measuring adult numeracy, literacy, and problem-solving skills. This survey also provides data on self-reported skills, labor market participation, training, and so on.

127. Some of the critical foundational skills are lower than the EU average for older adult workers. When numeracy skills among adults of different ages, as measured by PIAAC, are compared, the results are lower than those from other PIAAC countries for adults in their late 40s or older (Figure 3.5).[48] The average skills for the youngest cohorts are higher than the average in PIAAC, but in Poland, they decline more rapidly with age. For people at around 50, numeracy skills in Poland are already lower than the PIAAC average, and the gap increases for older people (Figure 3.5). There are two possible explanations for this trend. One is that the successful education reforms significantly improved the skills of younger people when compared to the older cohorts. As discussed above, the improved outcomes in schools are well-documented, so that could at least partly explain why in Poland we observe a more negative association between skills and age. The second explanation is related to limited learning at work in the Polish economy, which we discuss below.

128. The Polish labor market offers limited opportunities for skills updating and upgrading, which limits human capital accumulation and long-run growth. Skills of the adult population do not improve in Poland after finishing formal education. However, the above analysis (Figure 3.5) does not measure age-cohort skills over time but, rather, at a moment in time. It is very likely that part of the decline in skills for older age cohorts is related to better skills of the younger adults due to the successful education reforms. It is also possible that part of this effect might be related to limited opportunities for upskilling and updating for adults in Poland. Eurostat data shows that the percentage of adults participating in formal and non-formal training and education in Poland is much lower (Figure 3.6). Only one in four Polish adults participated in training or education over the last 12 months before the Eurostat study. In contrast, on average across the EU, 44 percent of adults participated in training or education, while in the Netherlands or Sweden, two-thirds of adults updated their skills.

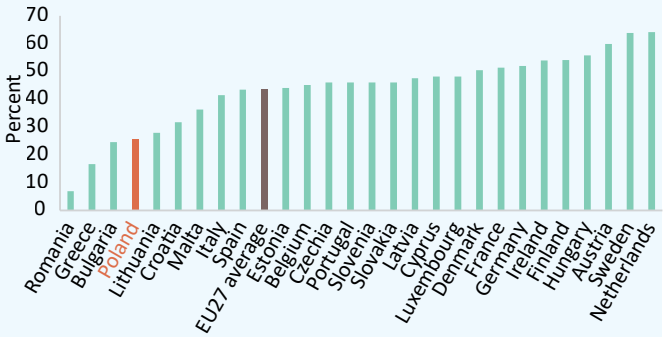
[48] *The current age of PIAAC respondents is provided, assuming their skills did not change much over the last decade (PIAAC data were collected in 2011).*

Figure 3.5: Skills-age profile for adults in Poland and other PIAAC countries



Source: Authors' calculations based on PIAAC data.

Figure 3.6: Participation in adult training or education



Source: Authors' calculations based on Eurostat, Participation rate in education and training.

3.4. An exogenous shock: the impact of COVID-19

129. The lockdowns put in place to contain the COVID-19 pandemic have affected educational attainment. The COVID-19 pandemic has caused major disruptions, and education is no exception. To contain the spread of the virus, schools have switched to remote education, which has caused substantial damage to the educational attainments of students (Donnelly and Patrinos 2021). In Poland, schools have remained closed for one of the longest periods in Europe.

130. The lockdowns and other COVID-19 policies have had an impact on economic growth, which can be estimated. To evaluate the impact of distance learning on GDP in Poland, the OECD methodology is applied, which correlates GDP growth with the educational achievements obtained in the PISA assessment to derive a growth coefficient.[49] Since human capital impacts GDP in terms of overall income, distribution, and growth rate (Hanushek and Woessman 2008), to estimate the impact of distance learning on GDP growth in Poland the chapter employs the following elements: (1) data on economic indicators and GDP growth (from the World Bank estimates), and the indexes gathered by the Penn World Tables (Feenstra, Inklaar, and Timmer 2015); and (2) to estimate the COVID-related learning loss measure, we used PISA-scaled data from the TICKS assessment (Jakubowski Gajderowicz, and Wrona 2022) and PISA historical outcomes.

131. Two approaches are used to estimate the GDP impact of the educational loss caused by distance learning. A reduction in student learning outcomes reduces long-term productivity of affected cohorts, which in turn impacts economic growth. The first approach uses the correlation of educational achievements measured by PISA with GDP growth, using control variables (OECD 2010). As a treatment, the analysis employed the learning loss estimates from the TICKS assessment (Jakubowski, Gajderowicz, and Wrona 2022). The result indicates how much output growth may be lost due to distance learning.[50] For robustness checks, the Psacharopoulos and

[49] *In OECD (2010), to estimate the impact of educational achievements (using PISA scale) on GDP growth, linear regression is used, relating the latter with the former and with other economic indicators for a given country. Once the correlation coefficient is found, it is possible to use it to estimate the impact of the COVID-related learning loss on future rates of GDP growth.*

[50] *The model in this chapter also used GDP growth as the dependent variable and as the independent variable. Average results in the PISA assessment (labeled as "cognitive skills"), the expenditure- and the output-side real GDP (in 2017 million $), the population, and the engaged persons (in millions) were used as control variables.*

others (2020) analysis of the impact on individual and aggregated income is applied.

132. The estimated learning loss—and, therefore, the loss to human capital accumulation— due to distance learning is substantial. The post-COVID standardized assessment show that the effect of distance learning induced by the pandemic is considerable. Distance learning caused an estimated loss of 30 points in the PISA domains of mathematics and science and 20 points in reading (Jakubowski and others 2022). However, these estimates can be considered as being the lower bounds of the decrease in the achievements in the whole country because the gap is greater for low-achieving students.

133. Distance learning is expected to have a negative impact on long-term GDP growth. The correlation of cognitive skills and GDP growth shows that, everything else being equal, distance learning had a considerable negative impact on economic growth. To estimate the correlation parameter, four different specifications were used. First, a model was used that relies exclusively on PISA assessment data for Poland, with control variables that include real GDP (both expenditures and production approaches). Second, a specification was employed that considers a larger sample of Eastern European countries, including Bulgaria, the Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia. However, Belarus, Moldova, and Ukraine were removed from the sample due to missing values following the specifications outlined by Hanushek and Woessman (2010).[51] The third and fourth estimates are taken directly from the 1960–2000 correlation coefficient between educational achievements and GDP growth in Hanushek and Woessman (2010).[52] The growth coefficient estimated by Hanushek and Woessman (2010) for the 23 OECD countries with relevant data is equal to 1.74, which indicates that an increase of one standard deviation in the PISA average achievement would increase long-term GDP growth rate by more than 1½ percentage points. This means that, everything else being equal, distance learning may have a negative impact on the GDP growth of Poland not lower than 0.35 percentage points on GDP growth (assuming a 20 PISA points loss in achievement), averaging 0.52 percentage points (if the loss is assumed to be equal to 30 PISA points), but likely even larger. [53]

134. Previous pandemic impact estimates can be used to guide estimations on the potential effects of COVID-19. Economic loss estimates caused by previous pandemics show that, in addition to the obvious health risks, pandemics can also affect individuals' welfare in a substantial way (Burns, Mensbrugghe, and Timmer 2006; Sidorenko and McKibbin 2006; Jonas 2014). Psacharopoulos and others (2020) estimated the loss in GDP caused by the COVID-19 pandemic for groups of countries with different income levels and argue that the individual economic loss caused by school closures can amount to US$1,300 per year in the United States, which represents up to US$2.5 trillion for the entire population.

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[51] *Data for these countries refers to the entire period in which PISA results are available for individual countries. In this specification, GDP per capita is the only control variable. Years of schooling are not considered since they have not shown significant variations over the various PISA assessments. As before, the resulting coefficient indicates the impact of the change by one point in PISA achievements on GDP growth. This specification yields a statistically non-significant result, yet the outcome is comparable to the one found in later specifications.*

[52] *The former uses 50 OECD countries, while the latter is restricted to the 23 OECD countries with full data. In both cases, the control variables are GDP per capita and years of schooling, and the resulting coefficients measure the impact of a change in achievements equal to one standard deviation.*

[53] *As an additional reference, using the correlation estimated only for the Eastern European countries would yield a loss in economic growth that amounts to between 0.34 and 0.51 points (considering a 20- or 30-points loss in achievements, respectively), which can be seen as a confirmation of the soundness of the estimation and the coefficient itself, even though without the statistical significance.*

135. Modelling results show that the loss in income that results from the pandemic exceeds 7 percent of GDP. The economic loss at the individual level is estimated to amount to PLN 2,927 each year in present value, using the approach proposed by Psacharopoulos and others (2020). Accounting for the entire 45 years of working life at present value, individual economic loss accrues to PLN 74,693 when considering each student, and more than PLN 179 billion when considering the total affected population (which is the one not "covered" efficiently by the introduction of remote learning). This aggregate sum is equal to 7.2 percent of the GDP of Poland in 2021 (Table 3.2, see Appendix A). These estimates can be considered conservative, given that the parameters have also been chosen conservatively when possible.

136. School closures in Poland since the beginning of the COVID-19 pandemic are expected to affect incomes (Equation 3.1, see Appendix B). Once the value of the loss L is calculated in absolute terms, it is also possible to compute it as a share of GDP and evaluate its impact in the long run. The parameters for the model are based on previous estimations from different sources. The rate of return of one year of schooling r is equal to 7.82 percent, following the estimation of Wincenciak, Grotkowska, and Gajderowicz. (forthcoming). Using this value, and accounting for the 25 weeks of school closures (UNESCO 2021), the value of the adjustment term to account for the period in which schools were closed α is equal to 0.52. The mean annual earnings Y are considered for 2021 and equal to PLN 72,000 (GUS). Following Psacharoupoulos and others (2020), the present value PV is calculated over a student's working life period of 45 years and assumes a 3 percent discount rate, while the number of students S is equal to 6 million (UNESCO, 2021). Finally, the efficiency of distance learning β, which indicates how many students can switch to remote learning without disruptions, was set at 0.6. In their analysis, Psacharoupoulos and others (2020) assume an "optimistic" level of 0.9, indicating that only 10 percent of students suffer educational losses due to distance learning. The actual share may be much higher (Kuhfeld and others 2020). The value 0.6 is used to maintain a balance between a conservative estimate and the impact of hybrid learning as well, since in Poland schools were closed for an additional 19 weeks since the start of the pandemic (UNESCO 2021).

137. School closures affect human capital: the losses are not only felt in the short term but have long-run growth implications. The estimated consequences of the COVID-related school closure are substantial. The analysis shows a marked impact on GDP growth rate, as well as income at the individual and macro-level.

3.5. Human capital in a green transition

138. The EGD will engender a green transition that could have profound impacts to an already diminished human capital. The EGD objectives of reducing carbon emissions and decoupling the economy from natural resource consumption represent a policy-induced shock to the economy. They effectively challenge firms to reconsider their mix of factors of production toward the use of more technology. That shift in the capital–labor ratio also affects the level and types of skills demanded in the labor market. Workers would also be confronted with the choice of upskilling or reskilling as needed in the labor market. While there is still a place for relatively lower-skilled workers in a green economy (for example, greening buildings), skills would need to be adapted. It is likely that despite adaptation and mitigation measures to reduce the impact of EGD policies in the labor market, redundant skills and job losses in the market can be part of a medium-term equilibrium (Eisfeldt, Falato and Xiaolan 2021). At the same time, new jobs filled by relatively high-skilled workers can produce not only job opportunities but also a human capital accumulation opportunity.

139. These dynamics in skills demand will lead to human capital changes and to asymmetrical impacts in the labor market. The asymmetrical jobs and human capital impacts of a green

transition can be estimated using various measures of skills. PIAAC data provide information on hourly salaries and occupations of adult workers. The basic equation explaining log wages by skills, age, and age squared (capturing decline in cognitive abilities but also a proxy of job experience), sector (public/private), and gender is expressed by Equation 3.2 (see Appendix B).

140. The regressions can use different measures of skills and skills usage. However, the model specification strategy includes an index of skills by combining information on schooling years, foundational skills measures (numeracy and literacy), use of skills at home and at work, and soft skills (for example, influencing and planning). The combined measure was estimated using a factor analysis model after imputing missing data for individual skills indices (key measures of cognitive skills have no missing data). Skills index was standardized (z-score) to be able to interpret the results as percentage change in wages related to a one standard deviation change in skills.

141. Although there is not a universally accepted definition of green jobs, this chapter adopts a strategy to assess the degree of "greenness" in a job. The model introduces skill measures to indicate how "green" or "brown" a given job is. A lack of common definition of what constitutes a green job hampers comparisons of existing research on the green economy (Valero and others 2021). Several studies used a binary approach assigning workers in a given industry or establishment to a green or brown category based on a high-level definition of environmentally friendly production (Eurostat 2009; Deschenes 2013; Yi 2014; Georgeson and Maslin 2019). A growing number of studies use an alternative occupation-based approach (Bowen, Kuralbayeva, and Tipoe 2018; Vona, Marin, and Consoli 2019; Hancké and Bowen 2020; Elliott and others 2021; Valero and others 2021). This method applies the O*NET classification system (US Department of Labor) to describe a job's "greenness." Green jobs in this classification are defined according to the number of green tasks they require from workers. The task-based classification enables a more fine-grained analysis of the green economy as it considers each occupation to be on a continuum of "greenness" (Elliott and others 2021). However, given the US origin of the classification, it is necessary to perform adjustments to the EU data and a matching exercise between the O*NET-SOC code and the corresponding ISCO codes (Hancké and Bowen 2020; Elliott and others 2021).

142. The methodology to identify job greenness employs disaggregated data. In this analysis we apply a task-based approach based on the O*NET classification to study the green job market in Poland. We have used the data on the greenness of occupations on the 4-digit levels available in the appendix of Elliott and others (2021), which directly follows Vona and others (2019) to construct a continuous measure of occupational greenness: a weighted average of the green-specific and non-green tasks based on the O*NET data. The greenness of each occupation is calculated using the equation 3.3 (see Appendix B).

143. The methodology uses both the continuous measures as well as the green/brown dummy classification. Elliott and others (2021) provide three O*NET based green indices: broad, core, and task based. They differ in the scope of occupations considered. The green core index excludes "Green increased demand" (Green ID) occupations from the analysis. Green ID occupations are those expected to experience an increase in demand because of a greening economy but do not involve changes to the content of work or the requirements of the job (Elliott and others 2021). Consequently, some authors treat them as indirectly green (Bowen et. al. 2018; Vona et. al. 2018). This chapter employs a continuous measure of job green core tasks and a dummy variable indicating jobs that are mainly brown or green. To see if green (or greener) jobs provide different returns to skills, we estimate using the equation 3.4 (Appendix B).

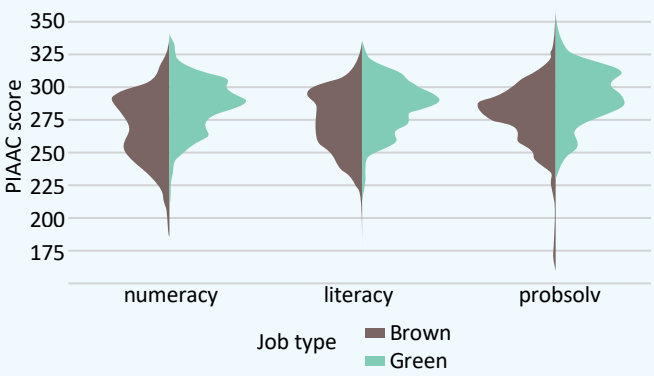
144. Regression results show that the wage premium in greener occupations is significant. The combined skills index is, as expected, positively associated with wages. This association is stronger for greener professions. Using the dummy indicator for brown vs. green jobs, the estimates suggest that returns to skills are 11.8 percent higher for greener jobs (Table 3.3, see Appendix A). Using the continuous measure, which allows for estimating results using a larger sample, the estimates show that a one standard deviation improvement in skills is related to an increase in wages of 4.1 percent.

145. Higher skills that are the basis of greener jobs also offer a wage premium. Another way of looking at the relationship between skills and wages in green and brown jobs is to separately estimate the effects of foundational skills, their usage at home or at work, and soft skills. Results for three regressions, estimated separately for numeracy, literacy, and problem-solving skills, also yield a wage premium in favor of greener jobs (Table 3.4, see Appendix A). While each regression shows that higher skills are strongly associated with better salaries, only numeracy returns to skills are higher in greener jobs. Similarly, the higher usage of skills at home or at work is related to higher salaries, even after controlling for the effect of foundational skills and education. The results suggest that the usage of skills at work could be associated with higher salaries in green jobs, but the results are statistically significant only in the case of literacy skills. Finally, the effect of formal education is consistent across specifications, but it is not stronger in greener jobs after controlling for the actual level of foundational skills.

3.6. Brown to green jobs transition

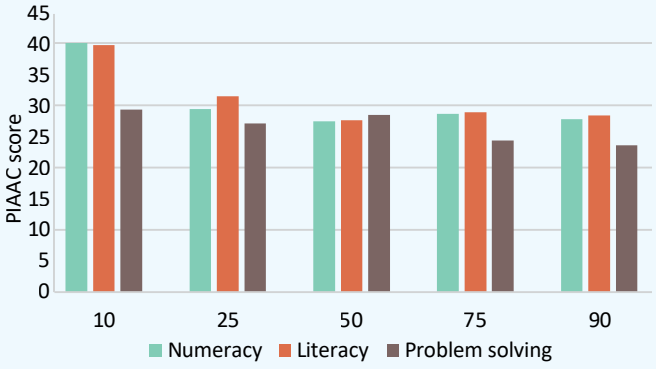
146. Wage differentials in favor of greener jobs are the result of a more intensive use of higher skills. Regressions show that after controlling for skills, greener jobs, on average, do not offer higher salaries. Thus, it is important to understand how skills are distributed in these two groups of workers when considering the transition from brown to green jobs. People in green jobs have, on average, higher foundational skills (Figures 3.7 and 3.8). Comparing foundational skills' distributions in green and brown jobs (using sharp 0/1 classification) shows that the gap tends to be larger for lower-skilled adults.

Figure 3.7: Distribution in foundational skills in brown and green jobs



Source: Author calculations using PIAAC micro data.

Figure 3.8: Differences in foundational skills between green and brown jobs, percentiles



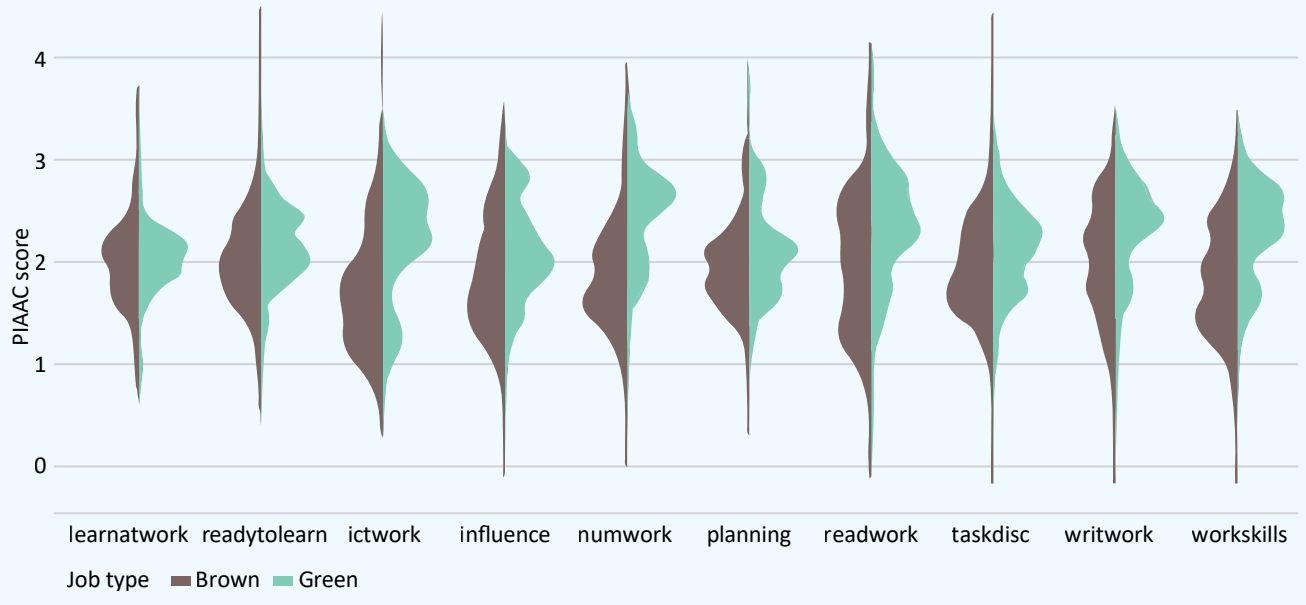
Source: Own calculations using PIAAC micro data.

147. Greener jobs intensely use hard and soft skills associated with human capital development. Greener jobs' hard and soft skill-use intensity is greater than brown jobs regardless of whether the jobs are carried out at home or at work. Comparing distributions of different measures of skills use, readiness to learn and soft skills between adults in brown and green jobs show that, in most cases, adults in greener jobs use higher skills more often (Figure 3.9). But there are interesting differences between skills use at home and at work. Combined standardized indices for skills use at home, at work, and soft skills (Figure 3.10) show that the use of higher skills at home is more intense in greener jobs, but the differences are similar across the distribution. However, more people in green jobs use skills at work intensively. Also, the share of workers using soft skills intensively is higher in green jobs.

148. However, this analysis exposes gender imbalances in the emergence of greener jobs that may bias human capital accumulation in Poland. The analysis reveals major gender differences in green employment across all major occupation groups. Women on average tend to occupy "browner" jobs. This result can be explained by the fact that many green jobs are positioned in the construction, manufacturing, and engineering sectors where women are significantly under-represented (Stevens 2009). Major occupation groups analysis reveals that greener positions can be found especially in the managerial group (number 1 in Figure 3.11), and the least green occupations are in services and sales (number 5 in Figure 3.11). A clear relationship between education level and greenness, however, is absent since the green core index varies. Thus, green positions can also be found in occupations requiring less formal education (for example, plant and machine operators and assemblers).

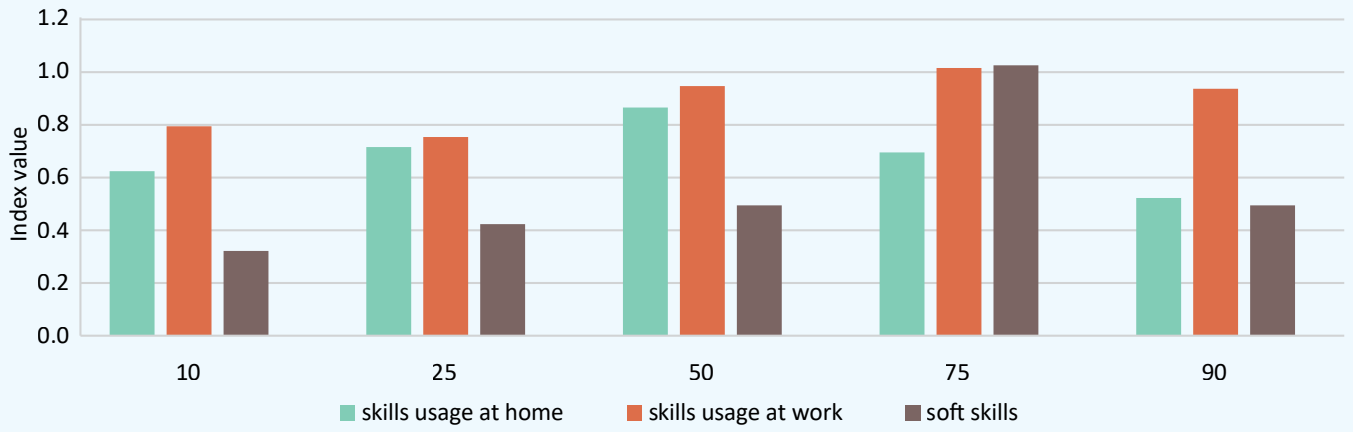
149. However, gender exclusion from the green economy in Poland needs further examination that focuses on the sectoral and occupation level. As mentioned, the classification used is just one of the range of methods that classify jobs regarding their greenness. The task-based approach (contrary to the sectorial approach) allows for investigation within industry variety. At the same time, this method often classifies types of jobs as non-green even though they involve dematerialized consumption and low emissions. Thus, one should exercise care when interpreting imbalances by personal characteristics (for example, gender) as they may result from selection bias to these specific types of misclassified occupations.

Figure 3.9: Skills usage, readiness to learn, and soft skills between green and brown jobs



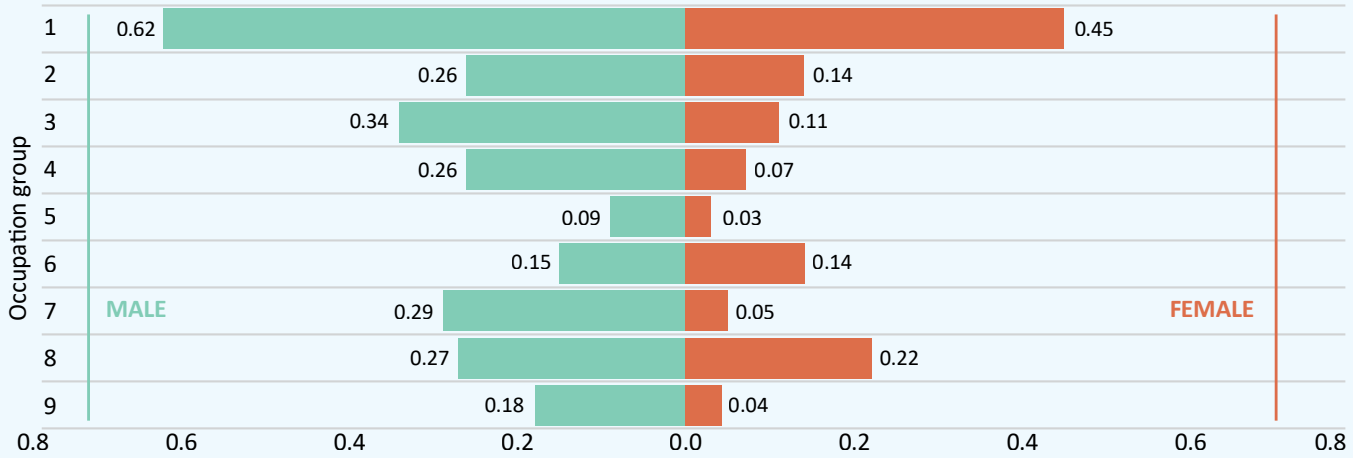
Source: Author calculations using PIAAC micro data.

Figure 3.10: Skills use, readiness to learn, and soft skills between green and brown jobs, percentile



Source: Own calculations using PIAAC micro data.

Figure 3.11: Mean green core index by gender and major occupation group



Source: Authors' calculations using BAEL (LFS) data.

Note: Occupation groups: 1 - Managers, 2 - Professionals, 3 - Technicians and Associate Professionals, 4 - Clerical Support Workers, 5 - Service and Sales Workers, 6 - Skilled Agricultural, Forestry and Fishery Workers, 7 - Craft and Related Trades Workers, 8 - Plant and Machine Operators, and Assemblers, 9 - Elementary Occupations

Box 3.1. Toward a Just Coal Transition in Poland: a Labor Perspective

Coal-related jobs are at the forefront of the disruption brought about by the transition toward a low-carbon economy. Some displaced workers may be able to easily transition to new job opportunities, but many others may not. The disruption to jobs and livelihoods may exacerbate the already challenging labor market environment in remote regions and traditional sectors that have not kept pace with broader economic modernization trends. World Bank studies deep dived into the skills and labor challenges brought about by the transition out of coal in three Polish regions: Wielkopolska, Silesia, and Lower Silesia.

The impact at the national level may be limited, as less than 2 percent of total employment is in the coal-value chain. At the end of 2020, 88,000 people are estimated to work directly in the mining conglomerates. Lignite conglomerates are vertically integrated, and less than 250 additional jobs are indirectly linked to the mining sector in Wielkopolska or Lower Silesia; on the other hand, 17,000 workers are providing goods and services to mining conglomerates in Silesia.

Yet, coal-related jobs are characterized by both spatial and market concentration, often in otherwise sluggish labor markets. Employment is concentrated geographically around the mines: in a few municipalities where coal-related employment represents over 20 percent of total employment and sometimes as much as 50 percent (Jastrzębie-Zdrój, Bieruńsko-ledziński). Spatial and market concentration is particularly high in Silesia, where 80 percent of contract value goes to companies located within a 20km radius of the mines, and where 30 percent of the indirect workforce is employed by the 10 most affected subcontractors. The dominant position of the mining conglomerates and large subcontractors is further reinforced by limited outside opportunities in sluggish local labor markets. Regionally, the economies and labor markets perform similarly to the rest of Poland, but people must move to access jobs there.

Mine workers have skills on par with other Polish workers, but non-mine workers in the nearby municipalities lag across the board. Mine workers have skills mostly similar to other Polish workers: they are even better at machine handling but score worse in advanced digital skills. This holds for both higher and lower educated workers. On the other hand, non-mine workers residing in heavily affected municipalities (Wielkopolska and Lower Silesia) and lower educated coal workers (Silesia) are less skilled.

Coal-related workers favor stability and continuity, and they are willing to give up a lot for these preferences. They want to remain in the municipalities where they live, work in similar positions/sector of activity, and value job security: an additional hour of commute is worth PLN 5,342 per month (more than the average monthly salary in the Konin subregion), as highlighted by workers from the four most-affected municipalities in Wielkopolska.

With the help of machine learning and online job descriptions, viable transition pathways for workers in the mining and power sector are identified. The job-matching tool used big data techniques to identify positions requiring skills most similar to the position held by the dismissed worker, narrowing down options to occupations with demand surplus, as identified by the Public Employment Services (PES). Viable transition pathways are available in the current local labor market for blue-collar workers (70 to 80 percent of coal-related workers), but the numbers may not be sufficient to absorb everyone; tertiary educated specialists may need more reskilling given the demand for high specialization.

Key challenges going forward will be to provide adequate opportunities for affected workers, especially non-mine workers in affected municipalities. This segment of the population deserves special attention: their numbers are non-negligible, they are less skilled, they operate in heavily affected and already lagging local economies, and they are not covered by the social agreements covering mine workers.

Source: Christiaensen and others 2022a; 2022b; 2022c.

3.7. Policy considerations

150. The Polish education system achieved major progress over the last 20 years, improving student outcomes from some of the lowest to some of the highest in the EU. However, older cohorts still have lower skills that are below EU average levels. Moreover, the recent shortening of general compulsory education and learning loss caused by distant teaching during the pandemic might result in lower skills among the youngest cohorts. The estimated learning loss is equivalent to at least one year of education, with larger losses for younger students and in science subjects. One can expect that the equivalent of an additional one year of learning can be attributed to the reversal of educational reforms (Jakubowski, Gajderowicz, and Wrona 2022). In addition, the reversal of the school starting age reform increased the age of completing education, postponing entrance into the labor market. The impact on economic growth may, thus, be much stronger; however, this issue requires further investigation. The model linking changes in PISA scores to GDP changes suggests that the learning loss will have a negative impact of at least 0.68 percentage points on GDP growth. The economic loss at the individual level equals PLN 2,927 each year. Accounting for the whole 45 years of working life at present value, the economic loss amounts to more than PLN 179 billion for the whole population, the equivalent of 7.2 percent of the 2021 GDP. These are conservative estimates and provide a lower bound of educational and economic costs.

151. People in brown and green jobs in Poland tend to have different skills sets. Workers in green jobs have higher foundational skills (numeracy, literacy, problem solving on computers) and use skills more often at home or work. These differences are partly associated with a higher level of formal education than people in green jobs have, but they also use skills more intensively at work, including soft skills. Finally, returns to skills are estimated to be higher in green jobs, which explains why skilled labor is attracted to these jobs.

152. Two sets of policy actions can help address the challenges to human capital accumulation in Poland, which is vital for long-run growth. In the short- to medium-run, the challenges posed by the EGD and the green transition require the use of Active Labor Market Policies (ALMPs) that can help workers adapt to new labor market demands by providing upskilling and retraining toward greener jobs. ALMPs, in the context of the EGD, would require some adaptation to allow for certain brown occupations to transition through Vocational Education and Training (VET) into greener jobs. However, given that both foundational/hard and soft skills are more intensively used in greener jobs, there is a role for the educational system to rethink the provision of skills that will make it easier for future workers to adapt to a green economy. Public education should strengthen the teaching of foundational skills as they provide a basis for a smooth transition with opportunities for better-paid jobs available to all workers. People who lack foundational skills will have difficulties moving from brown to green jobs, but they also cannot expect higher returns in new jobs. Green jobs tend to give higher returns to foundational skills even among workers with lower levels of education, which shows that recent reforms in school structure and vocational education that emphasize job-specific skills over general curriculum might negatively impact job opportunities and economic development.

153. The more limited skills of older cohorts and the learning loss for the youngest means that upskilling will be necessary and should include general training in foundational skills that can support long-run growth. Opportunities to broaden skills at current employment, whether in green or brown jobs, might be limited and narrowed to job-related tasks. Training provided by employers in green jobs is also focused on job-specific tasks, while workers might require more general upskilling before learning new tasks. Examples include professions with more intense usage and a better understanding of new technologies, which requires a strong foundation in numeracy and problem-solving skills in technology-rich environments. PIAAC

data show that more than 20 percent of working-age adults in Poland do not possess these skills even at the basic levels, and a large proportion of low-educated young workers also lack even basic digital skills.

154. Providing training of foundational skills for adults is a major challenge. In Poland, very few adults go back to formal schooling, and labor offices do not offer assessments that recognize actual skill levels.The specific trainings they offer (for example, digital skills) are often ineffective, as participants do not possess the required foundational skills or drop out early for the same reason. Polish labor offices should be equipped with assessment tools that can recognize prior learning and propose upskilling that fits labor market demand and individual potential. Assessments should be followed by targeted training and incentives for individuals and employees to continue upskilling despite considerable costs on both sides. For well-educated individuals, training offerings should depend on the needs to bring their specific skills in alignment with those required in green occupations. In this regard, transition patterns for different professions should be well-understood before offering training.

155. In the long run, Poland should consider a remediation strategy to recover from learning losses.[54] Human capital reduction, chiefly due to COVID-19–induced distance learning, and the potential reversals in human capital due to the 2016 educational reforms deserve policy discussion that aims to remedy the losses as much as possible and make changes to improve resiliency in the educational system to cope with these shocks. Arcia and others (2021) suggest a recovery plan based on the following: (1) identifying and treating students with low-learning performance while improving their access to quality education; (2) defining clear equity goals and allocating budgets and personnel accordingly; (3) implementing teacher support and innovations for hybrid instruction; (4) investing in internet access and in digital infrastructure and pedagogy; (5) promoting a climate of educational innovation for improving hybrid/blended methods of education delivery; and (6) continuously monitoring and evaluating impacts to ensure the delivery of quality education and the improvement of learning equity.

[54] *See for instance Arcia and others (2021).*

Chapter 4
Technology, Innovation, Entrepreneurship

4.1. Introduction

156. Innovation and technology will play a key role in achieving the transition to a net-zero world while also being a key driver for productivity and growth. Technology adoption and innovation have historically played a key role as an engine of growth through their direct impact on productivity (OECD 2007[55]; Verspagen 2006[56]). Going beyond their contribution to growth, the role of technology and innovation will be crucial in achieving agreed-upon targets to reduce emissions by 15 and 46 percent by 2030 and 2050, respectively.

157. The chapter examines the role that technology adoption and innovation can play in the context of Poland to address green transition challenges, promote a greener recovery, improve productivity, and create green jobs. The chapter assesses the potential of green innovation in Poland as well as the drivers of emissions among private businesses, with a special focus on the role of energy efficiency. We also assess the current plans for public investments as part of the NRRP and how they could contribute to promoting innovation as well as fostering technology diffusion and energy efficiency among Polish companies. Firm-level analysis of emissions is limited by the lack of availability of high-quality firm-level data, in particular with respect to Scope 2 emissions.[57]

158. Efficiency plays a key role in reducing emissions: overall, economy-wide efficiency emissions improved in Poland. This is due to a mix of sectoral changes in the economic structure and improvement in the average level of sectoral efficiency. However, market forces have played a negative role in overall emissions growth as resources have been misallocated toward less-efficient firms. Understanding the distortions responsible for this misallocation of resources is key to improving both emissions and overall productivity.

159. Improving firm-level efficiency could play a very large role in reducing emissions. The levels of firm emissions in 2020 would have been nearly halved if firms had increased their levels of efficiency to those of the "median" firms in their respective sector. To improve firm-level efficiency, firms need to improve their managerial practices, as these are associated with good green managerial practices and the adoption of energy efficient technologies.

160. Innovation and green patenting are very limited among Polish firms, but public support for innovation and integration into global markets could play an important role in spurring innovation. The analysis of patents suggests some emerging opportunities and technological comparative advantages in key technological areas such as wastewater processing, recycling, as well as solar and geothermal power. Additionally, there is evidence that firms that receive public support through programs promoting innovation are more likely to register green patents. Similarly, integration into global markets and overall levels of innovation at the sectoral level are positively correlated with higher levels of green patenting.

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55. *OECD. 2007. Innovation and Growth: Rationale for an Innovation Strategy.*

56. *Bart Verspagen. 2006. Innovation and Economic Growth, in the Oxford Handbook of Innovation, Edited by Jan Fagerberg and David C. Mowery.*

57. *Scope 2 emissions are indirect GHG emissions attributed to a given firm, related to use of externally generated energy (electricity, heat, cooling or steam), purchased from other enterprises.*

161. While future (2021–27) operational period supports for "green" objectives significantly increased on paper, this increase may not necessarily lead to an increase in funding of "green" objectives. The increase in funding for "green objectives" is only "potential," as the funding increase is mainly driven by the introduction of a new "optional" objective to instruments that 'simultaneously support many potential areas of innovation.

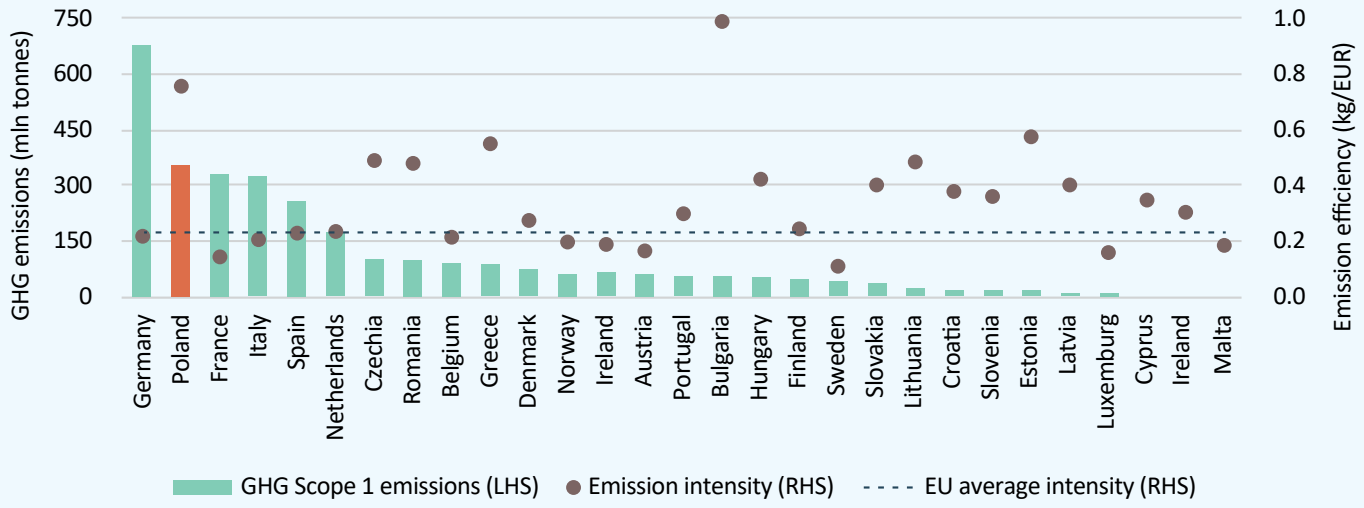
4.2. Private sector contribution to emissions in Poland

162. Poland's greenhouse gas (GHG) emissions are driven both by the scale of the economy and by its relatively low aggregate emission efficiency. As the sixth largest economy in the European Union (EU), Poland ranks second in terms of total direct Scope 1 GHG emissions from economic activities. This is a result of its low emission efficiency, ranking ahead of only Bulgaria in the EU. In fact, Poland is not only significantly worse in emission efficiency than more advanced EU economies but also of peers in Central and Eastern Europe (Figure 4.1). Emission efficiency in CEE countries is typically below the average EU level of 0.23 kg/EUR of value added. However, Poland's emission efficiency is 50–100 percent worse than that recorded in Czech Republic, Romania, Hungary, and Slovakia.

163. Energy and manufacturing sectors emit more than double the GHG per unit of output relative to the EU average, accounting for two-thirds of national emissions. Low emission efficiency of the energy sector reflects the continued dominance of coal in Poland's energy mix (Chapter 2). However, given the decrease in reliance on coal from 82 percent to 69 percent between 2010–20, the energy sector recorded the biggest sectoral improvement in emission efficiency in Europe.

164. There are big opportunities to improve emission efficiency in the manufacturing sector that are consistent with a growth-enhancing path. Poland has not yet been successful in closing the gap with other countries in improving the emission efficiency of its manufacturing sector. Czechia's manufacturing emission intensity (0.37 kg/EUR) is close to the EU average, while Poland's manufacturing sector emits more than twice as much (0.78 kg/EUR) (Figure 4.2). The Polish economy

Figure 4.1: Total GHG emissions (CO2 equivalent) from economic activities and GHG emission efficiency, EU-27 countries, 2020

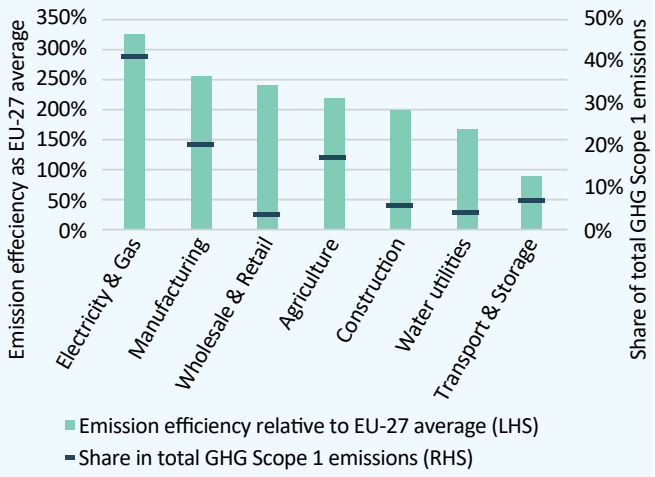


Note: Scope 1 emissions are direct GHG emissions generated by sources owned or controlled by a given firm; Emission efficiency is defined as Scope 1 GHG kg/EUR of value added.

Source: World Bank analysis based on Eurostat.

could halve its emissions from manufacturing by improving emission efficiency to levels closer to the EU average, without output loss. Additionally, increased efficiency is likely to be associated with growth as it is positively correlated with overall efficiency.

Figure 4.2: Breakdown of Scope 1 GHG emissions and emission efficiency per NACE2 division in Poland, 2020

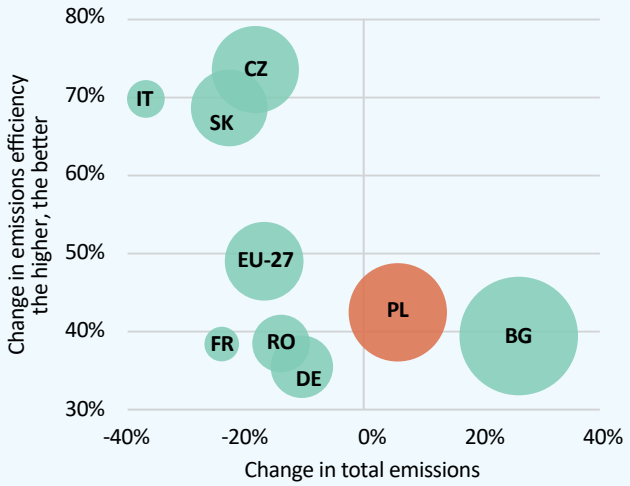


Note: Scope 1 emissions are direct GHG emission generated by sources owned or controlled by a given firm; Emission efficiency is defined as Scope 1 GHG kg/EUR of value added.

Source: World Bank staff analysis based on Eurostat.

165. Poland and Bulgaria are the only EU members that saw an increase in GHG emissions and employment in manufacturing over the past decade. In both countries, manufacturing output grew faster than improvements in emission efficiency. Despite low initial levels of efficiency, Poland recorded modest improvements compared to regional peers in manufacturing (Figure 4.3). The increase in manufacturing output was accompanied in 2010–20 by an increase in employment of 14 percent. As a result, employment in the manufacturing sector reached 2.7 million people in 2020, or one-third of people employed in the enterprise sector (Statistics Poland 2021).[58]

Figure 4.3: Manufacturing emissions, emission efficiency and output, selected EU countries, 2010-2020



Note: Scope 1 emissions are direct GHG emission from source owned or controlled by a given firm; Emission efficiency is defined as Scope 1 GHG kg/EUR of value added.

Source: World Bank analysis based on Eurostat data.

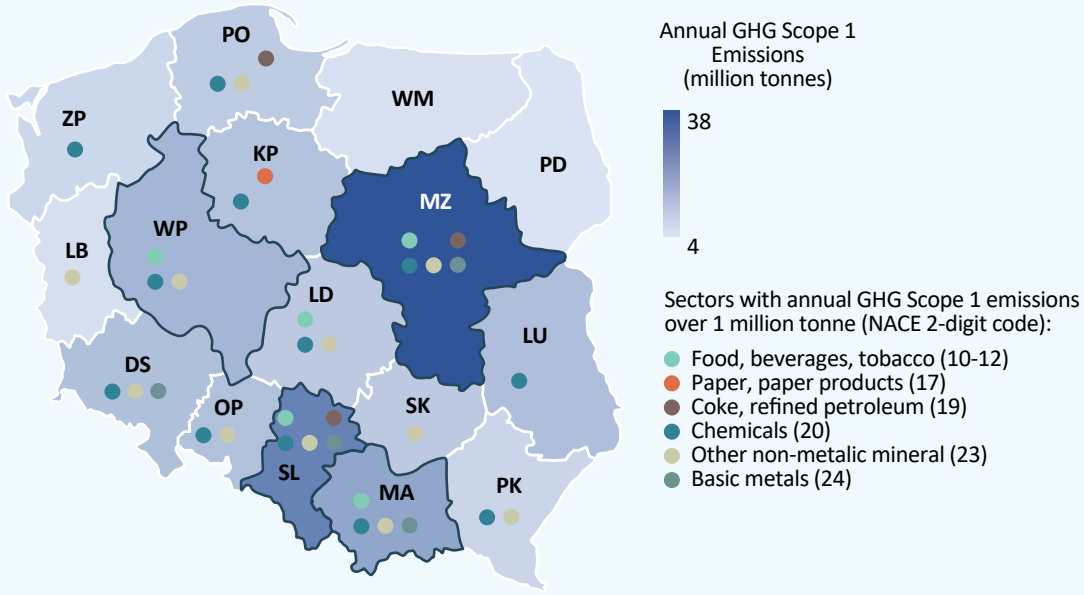
166. Manufacturing emissions are concentrated in a few regions. Up to 60 percent of manufacturing emissions in Poland are concentrated in four regions (NUTS2) and six sectors (NACE2 2-digit). These four regions house the most emitting subsectors. Mazowieckie and Śląskie Voivodeships host a large share of enterprises from four sectors: coke and refined petroleum, other non-metallic mineral products, chemicals and chemical products, and basic metals (Figure 4.4). Pomorskie Voivodeship's economic activity is concentrated in three manufacturing sub-sectors that have the highest emissions (chemicals, other non-metallic mineral and coke, refined petroleum), while Dolnośląskie Voivodeship produces non-metallic mineral products, chemicals and chemical products, and basic metals.

167. Unlike the energy sector, manufacturing is not covered by structural policies to cut GHG emissions. No policies at the EU or national level set emission reduction targets for manufacturing enterprises in Poland. At the same time, reducing the manufacturing sector's carbon footprint is essential if Poland is to achieve

[58] *Statistics Poland. 2021. Average paid employment and average gross wages and salaries in the enterprise sector in December 2020.*

its climate goals under the Paris Agreement (Kechichian and others 2016). As manufacturing products contribute to over 90 percent of the value of Polish exports, the long-run competitiveness of the Polish economy is highly dependent on the reduction of manufacturing GHG emissions. Later, this chapter identifies factors that can prepare Polish enterprises, particularly in the manufacturing sector, to compete in the low-carbon world as well as argue that improvements in energy efficiency can be an opportunity to enhance the productivity and profitability of the manufacturing sector in Poland.

Figure 4.4: Regional distribution Manufacturing of GHG Scope 1 emissions in Poland, 2019



Note: DS – dolnośląskie, KP – kujawsko-pomorskie, LU – lubelskie, LB – lubuskie, LD – łódzkie, MA – małopolskie, MZ – mazowieckie, OP – opolskie, PK – podkarpackie, PD – podlaskie, PO – pomorskie, SL – śląskie, SK – świętokrzyskie, WM – warmińsko-mazurskie, WP – wielkopolskie, ZP - zachodniopomorskie

Source: World Bank analysis based on Statistics Poland.

4.3. Decomposition of firm emissions[59]

168. This section looks at what has driven overall emissions growth in Poland based on firm-level data reported by the largest "emitters." Overall emissions growth can be decomposed into four components in a manner that can help policy makers to identify priorities for intervention. Specifically, overall growth in emissions can be decomposed into the following:

1. Scale: changes in emissions due to overall growth of output (scale).
2. Structural transformation: changes in emissions due to expansion/contraction of sectors with different levels of efficiency.

[59] *Limited completeness of firm-level data on direct GHG emissions and lack of access to information on fuels and electricity consumed by individual enterprises limited the scope of decomposition analysis to firms participating in the EU-ETS system. Since 2010, all entities emitting any greenhouse gases (including, but not limited to, enterprises), with no minimum emission threshold, are required to report emission value in the National Centre for Emissions Management (KOBiZE) database each year. Despite legal obligation, enterprises underreport information on direct emissions. Completeness of the KOBIZE dataset increased significantly in 2018-20, but gaps in previous years impede its use as a reliable analysis of the change in emissions over time. Information on firm-level electricity and fuels consumption, necessary for estimating Scope 2 indirect emissions, are inaccessible due to procedures related to statistical secrecy. For the above reasons, the decomposition analysis was based on the emissions data of companies participating in the Phase III (2013-20) EU-ETS system from the EU Transaction Log system, in which completeness id verified administratively.*

3. Within firm efficiency: changes in emissions due to evolution of average level of efficiency at firm-level within sectors.
4. Between-firms reallocation: changes in emissions due to reallocation of market shares between firms with different efficiency levels (including entry and exit) within sectors.

169. The analysis focuses on firms reporting to the EU-ETS, which account for over 80 percent of all (Scope 1) total emissions in Poland. Because of data availability limitations[60] the analysis focuses on the largest emitters, those businesses that are obliged to report to EU as participated to the EU-ETS Scheme. Despite being a relatively small number of firms, their importance is significant as they contribute to overall Scope 1 emissions in a large-scale manner.

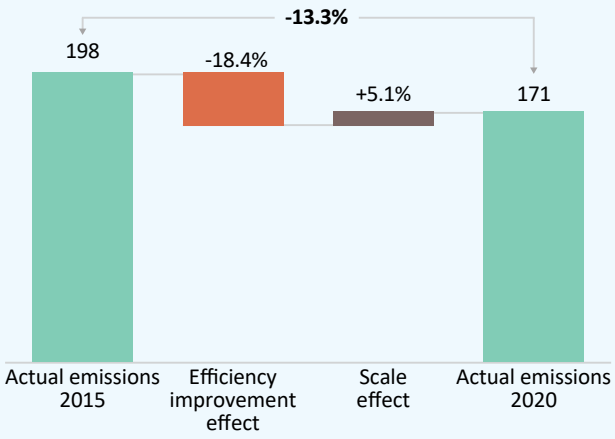
170. Overall, firm-level Scope 1 emissions decreased, and this was driven by improvements in efficiency as well as by structural transformation. Despite an expansion in scale, overall emissions, as measured in our sample of large emitters, decreased. While scale expansion led to higher emissions, structural transformation (an expansion in sectors with higher efficiency and a contraction in those with lower efficiency) drove a reduction in emissions, together with improvements in efficiency levels. Improvements in emission efficiency have been driven by the energy sector, with electricity, gas and coke, and petroleum sectors responsible for three-quarters of emissions.

171. Average firm-level efficiency improved but between-firms reallocation moved toward an expansion of emissions. Within-firm average levels of emission efficiency improved in all EU-ETS sectors. However, in manufacturing, firms with lower efficiency increased their market share relative to more efficient ones, which worked against a reduction in overall emissions. Improving the functioning of markets in a manner that is conducive to a better allocation of resources toward more efficient firms not only fosters energy efficiency but also promotes productivity and growth, as discussed in the recent World Bank report (2021).[61]

Aggregate emissions level

172. Improvement in economy-wide emission efficiency in the Polish economy helped reduce emissions between 2015 and 2020. Total emissions decreased by 13.3 percent in 2020 compared to 2015 among firms reporting to EU-ETS, driven by an 18.4 percent improvement in economy-wide emission efficiency in the Polish economy. Total emissions declined even as output increased, adding 5.1 percent to overall GHG emissions (Figure 4.5). The improvement in the economy's emission efficiency is a result of improvements in firm-level emission efficiencies across the entire group of enterprises participating in the EU-ETS system as well as changes in firms' sectoral market shares.

Figure 4.5: Change in emissions due to efficiency improvements and scale, million tones, 2015-2020



Source: World Bank analysis based on emissions data from the European Union Transaction Log (EUTL) and financial information from the ORBIS database.

[60] *The decomposition was limited to Scope 1 GHG emissions of firms participating in the EU-ETS system due to low quality data on Scope 1 emissions outside the EU-ETS system and lack of available data on Scope 2.*

[61] *Marć Ł., U. Kilinc, M. Malec, B. Skowron. 2021.. Paths of Productivity Growth in Poland: A Firm-Level Perspective. World Bank.*

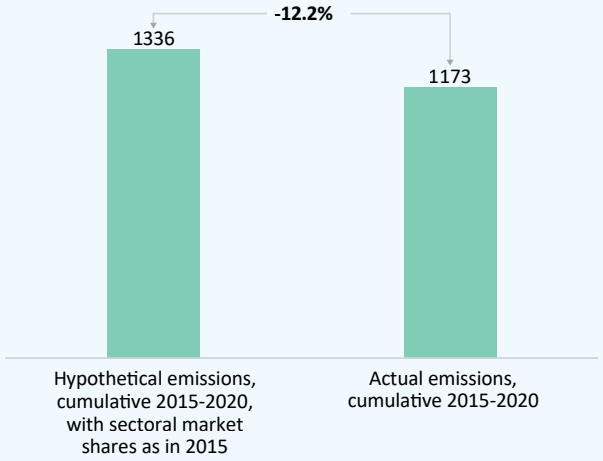
173. Changes in sectoral composition resulted in a decrease in cumulative emissions. During 2015–20 emissions declined by 12 percent compared to a scenario where the sectoral structure of the economy remained unchanged since 2015. Sectors that improved their efficiency increased market shares compared to sectors where efficiency worsened. (Figure 4.6). The reduction in total emissions due to structural changes was driven mostly by improved efficiency and increased market share of the energy sector. Some sectors, such as metals or wood, achieved greater improvements in efficiency, but their relative share remained low, thus they did not significantly impact emission levels (Figure 4.7). Emissions efficiency of non-metallic mineral and food sectors decreased, while their market share increased, contributing to higher total emissions. Changes of market share and emissions are not correlated with productivity of respective sectors, except the Coke & Petroleum sector, which had the highest value added per person employed of all EU ETS sectors in Poland, but its market share decreased significantly. The above change illustrates the challenge for the growth agenda during the transformation toward climate neutrality related to the impact of environmental regulations on highly productive sectors of the economy.

Trends in sectoral level emissions

174. Average firm-level emissions efficiency within the EU-ETS system improved, but this was partially offset by an increase in the market share of firms with lower emission efficiency. Average firm-level emissions within EU-ETS declined by 20 percent but market shares of firms with lower efficiency in the manufacturing sector increased, limiting the resulting decline in net efficiency change in emission efficiency to only 5 percent. Firm-level efficiency ("within" component) improved due to the diffusion of innovation, technology adoption, and the upgrading of managerial processes among individual firms, and was positive in all economic divisions (Figure 4.8). In air transport, firms not only improved their efficiency, but also market shares were reallocated to firms with higher efficiency, which resulted in net improvements of emission efficiency of 35 percent. In electricity and gas, the net growth of emission efficiency is equal to the within-firm improvement, as market shares remained stable across firms at various levels of efficiency.

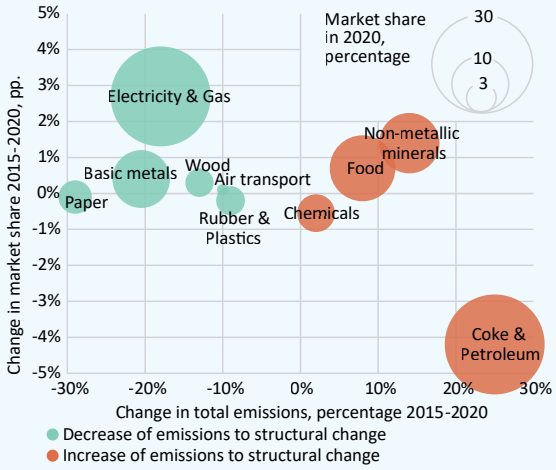
175. In manufacturing, there is a sectoral deterioration of emission efficiency driven by the increase in market share of relatively inefficient companies, which was higher than

Figure 4.6: Change in emissions due to structural change, million tones, cumulative 2015-2020



Source: World Bank analysis based on emissions data from the European Union Transaction Log (EUTL) and financial information from the ORBIS database.

Figure 4.7: Change in market share and emissions per sector, 2015-2020

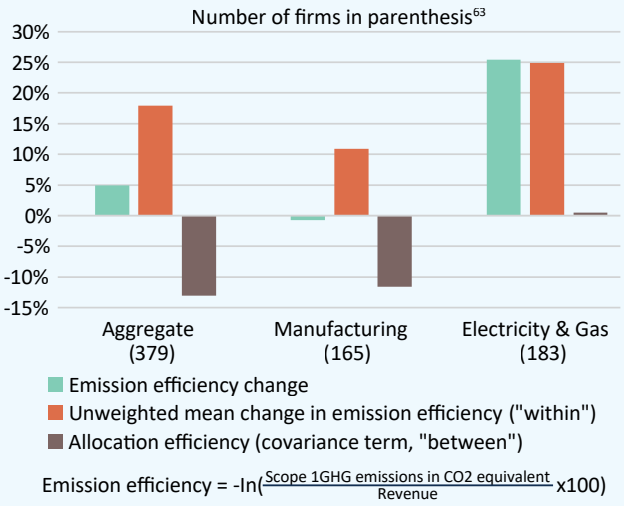


Source: World Bank analysis based on Emissions data from the European Union Transaction Log (EUTL) and financial information from the ORBIS database.

the improvement in the average efficiency levels "within" companies. Manufacturing firms improved average emission efficiency in all sectors except paper, but in most sectors more emission-efficient firms did not increase their market share relative to firms with lower efficiency. Only in basic metals, paper, and wood sectors, were market shares reallocated toward more efficient companies (Figure 4.9). The increase in emissions due to this misallocation of resources toward less-efficient firms indicates potential barriers to the efficient functioning of markets. This problem of misallocation of resources in the Polish manufacturing sector has also been evidenced in a recent World Bank study focusing more broadly on productivity dynamics (World Bank 2021b).[62] This misallocation and inefficiency functioning of markets could be driven by a mix of subsidies, regulations, and other types of distortions discussed in Table 4.1 While the initial evidence suggests the existence of such distortive factors, a determination of their scale and impact warrants further analysis.

176. There are large opportunities to reduce overall emissions, which could be nearly halved just by improving efficiency among Polish firms to moderate levels. To quantify the magnitude

Figure 4.8: Change in emission efficiency, NACE2 level-1 divisions, 2015-2016 vs 2019-2020



Note: Positive values mean improvement in efficiency (lower emissions per unit), and negative a deterioration.

Source: World Bank analysis based on Emissions data from the European Union Transaction Log (EUTL) and financial information from the ORBIS database.

Table 4.1 Potential barriers for resource reallocation in the manufacturing sector

Area	Examples	Impact
Unequal access to finance for SMEs and large firms	Interest rate spread on credit between SMEs and large firms	Financial incentives provided asymmetrically to large firms
Fiscal incentives	Size-related tax reliefs	Limit SME growth by incentivizing to remain below a certain threshold
Barriers to firm entry and exit	Broad role of the Industrial Development Agency in the bankruptcy regime	Prolonged activities of unproductive enterprises
Regulatory uncertainty	Frequent regulatory changes with limited stakeholder participation	Disincentivize new investments by hindering long-term planning
Public ownership	Challenges related to competition neutrality	Provide advantages for State Owned Enterprises (SOEs)

Source: World Bank analysis based on Marć and others (2021). Paths of Productivity Growth in Poland: A Firm-Level Perspective. World Bank.

62. *Marć Ł., U. Kilinc, M. Malec, and B. Skowron. 2021. Paths of Productivity Growth in Poland: A Firm-Level Perspective. World Bank.*

63. *The share of revenue or respective sectors in 2020 were 73 percent Manufacturing, 24 percent Electricity and Gas. Three percent of revenue was generated by enterprises from air transport, wholesale and retail and transport and storage sectors, which were excluded from analysis due to low number of firms participating in the EU-ETS system.*

of potential gains from improving firm-level efficiency, we simulate the consequences of improving firm-level efficiency within each sector to the level of the median firm. Bringing the "laggards" within each sector to the level of the "median" firm would reduce total emissions levels in 2020 by 46.2 percent (Figure 4.10). These improvements in efficiency would also lead to lower costs and higher profits with positive implications for growth.

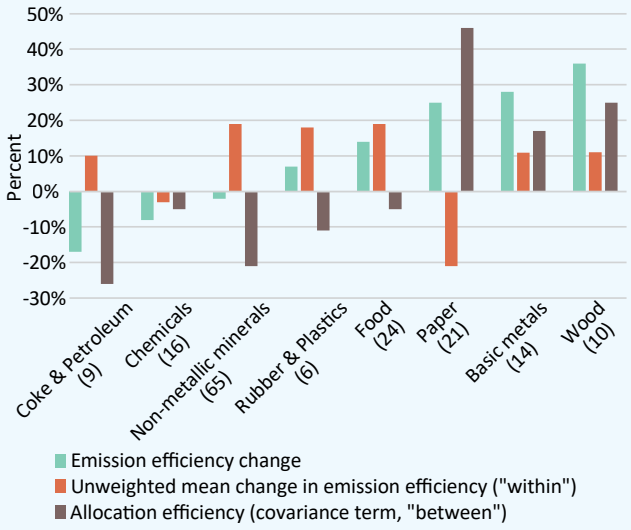
177. Three sectors alone would account for about half of the total reduction in emissions, according to this simulation exercise. Metals, coke and petroleum, and food processing would account for the largest contribution to the total reduction of GHG emissions. Which sectors contribute more to the total savings depends on two dimensions: the importance of the sector in terms of total energy consumption ("scale" effect) and the importance (weight) of a large tail of inefficient (relative to the median) businesses in the sector ("dispersion" effect).

178. Change of emission efficiency does not differ between more and less emission–intensive sectors, except electricity and gas. Firms covered by the EU-ETS from the least emission-intensive manufacturing sectors, such as wood, paper, and food, improved emission efficiency to the higher extent, while the efficiency of firms in the most emission-intensive sectors, including mineral, chemical, and coke, stagnated. The impact of the EU ETS system on behavior of high-emission enterprises might be limited by the high number of granted allowances, which domestic companies can use free of charge. In the Phase 3 of the EU ETS system (2013–20) Poland has auctioned approximately two-thirds of excessive granted allowances—the highest share among all EU member states (Haase and others 2022).

Green technology adoption by firms

179. Poland's performance in eco-innovation is lagging, and only a small share of Polish firms engages in eco-innovative activities. Poland persistently scores low in the European Eco-Innovation Scoreboard (European Commission 2020c), and in 2021 it was ranked second to last in the European Union, with aggregate scores almost 40 percent below the EU average. Poland consistently performs significantly

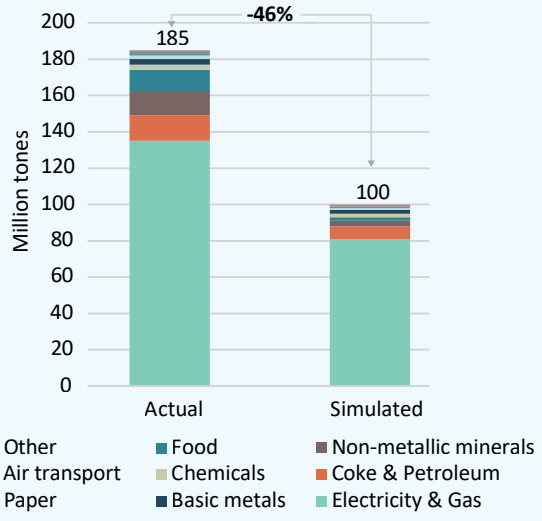
Figure 4.9: Change in emission efficiency in manufacturing, NACE2 2-level divisions, 2015-2016 vs 2019-2020



Note: Positive values mean improvement in efficiency (lower emissions per unit), and negative a deterioration.

Source: World Bank analysis based on Emissions data from the European Union Transaction Log (EUTL) and financial information from the ORBIS database.

Figure 4.10: Simulated impact of improving emission efficiency to sector median on emissions, million tones, 2020



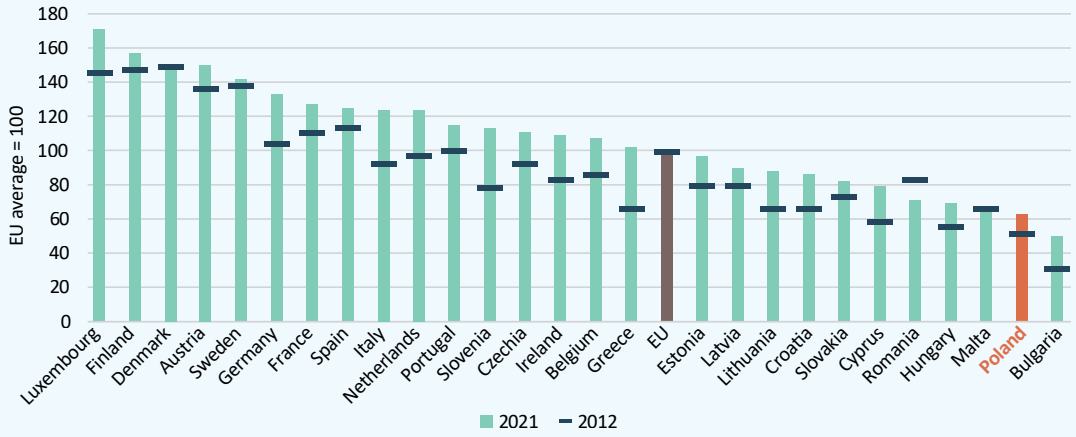
Source: World Bank analysis based on Emissions data from the European Union Transaction Log (EUTL) and financial information from the ORBIS database.

below the EU average in four out of five scoreboard components (Figure 4.12) and is particularly weak in resource efficiency outcomes and eco-innovation inputs. Despite progress over the past decade, Poland remains second to last in the EU. One-third of Polish manufacturing SMEs implemented eco-innovative activities, the most common of which are product innovations, with most firms implementing them to comply with environmental regulations.[64]

180. Eco-innovation investments and resource efficiency outcomes are the areas where Poland lags most. Even though the total R&D personnel and researcher score increased by over 135 percent for 2012–20, it remains 40 percent below the EU average (Figure 4.11).[65] The score for green early-stage investment remains the lowest among the Eco-innovation Index's indicators, although modest improvement occurred since 2012 when Poland scored the lowest in the EU. Poland's performance in the government's environmental and energy R&D appropriations and outlays score has decreased since 2012, and in 2019 was the lowest in the EU. Socioeconomic outcomes are high, and Poland places first in the ranking, mainly due to the relatively high percentage of employment in eco-industries and circular economy.

181. Adoption of green technologies, paired with organizational innovations, is associated with higher productivity and increased long-term resilience of the private sector. Results of empirical research show a positive impact of firm investments in reduction of emissions, conditional on implementation of complementary managerial improvements (Hottenrot and others 2016). As the adoption of green technologies alone does not improve productivity, governments could introduce interventions that aim to improve managerial capabilities to align their green and growth agendas. The adoption of sustainable technologies and green innovation also allows firms to become more resilient in the wake of tightening environmental regulations and rising energy prices (Wurlod and Nuoailly 2016). Despite the positive impact of green technology adoption on firm performance, enterprises in Poland and in other countries of the Eastern Europe and Central Asia do not prioritize it over other investments, which creates space for public intervention (European Investment Bank 2022).

Figure 4.11: Eco-innovation Index scores for the EU countries, 2012 and 2021



Source: World Bank analysis based on European Eco-Innovation Scoreboard data.

64. *Following the EC European Eco-Innovation Index, eco-Innovation activities are efforts undertaken by enterprises to limit their carbon footprint. Examples of eco-innovation activities include implementation of resource efficiency actions, introduction of sustainable products and services, and acquisition of certificates related to environmental management (ISO 14001).*

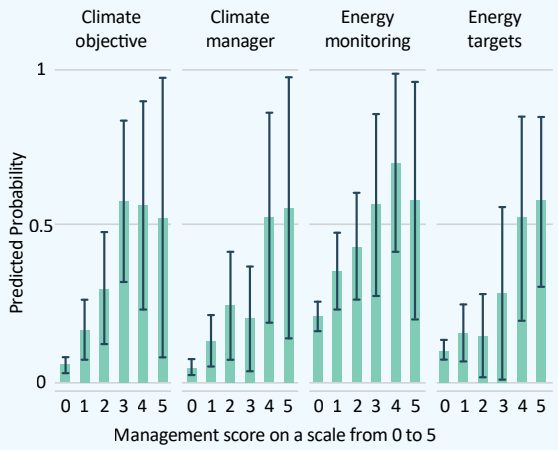
65. *The Eco-Innovation Index is a simple average of 16 indicators grouped into five dimensions, listed in Figure 4.11. Country specific score in each indicator is presented in relation to EU-27 average. Value of EU-27 average is derived by weighting country specific values of each indicator with the share of population of the EU.*

Firm-level drivers of adoption

182. Overall, improved firm capabilities (including managerial and innovative practices) are key for firms to become more energy efficient—but only to the extent that this is cost-effective. There is an increase in the probability that firms adopt green managerial practices (for example, energy monitoring) and green technologies (for example, low-carbon energy supply) that are driven predominantly by cost optimization but not by reduction of emissions (Grover and Karplus 2020). Thus, in the presence of financial friction, enterprises tend to limit investments in green technologies even after adopting green managerial practices,[66] and consume more energy when energy subsidies are available (European Bank for Reconstruction and Development 2018).

183. The adoption of green managerial practices is positively correlated with firm-level managerial capabilities and innovation. Firms with better management are more likely to adopt green managerial practices such as having specific climate objectives, climate managers, as well as monitoring energy consumption. Firms with greater managerial capabilities scores are more likely to adopt green managerial practices (Figure 4.13). The biggest motivation are environmental regulations, with access to finance reported as a barrier. Firm Management Index (FMI) scores are strongly correlated with firm size, thus sustainable management practices are more often introduced by large enterprises. There is no statistically significant relationship between adoption of sustainable management practices and other firm characteristics, such as ownership structure or participation in international trade. Improving overall management, however, is not just positively correlated to green management, and potentially improved emission efficiency, but it has direct implications for productivity and is a key priority to support firm growth in Poland (Bloom, Sadun, and van Reenen 2017).[67]

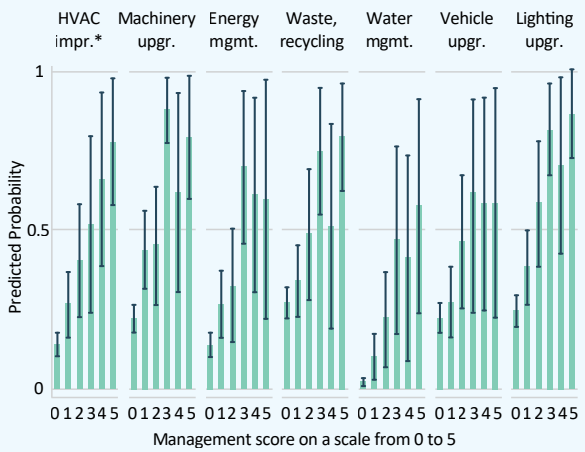
Figure 4.12: Firm Management Index score and sustainable management practices



Note: FMI is a sum of positive responses ("Yes") for each of the surveyed firms to the five questions identified as relevant to managerial capabilities. FMI ranges from 0-5 and is a proxy of how advanced companies are in implementing business management. There are four questions on green managerial practices included.[68]

Source: World Bank analysis based on WB Enterprise Survey 2019.

Figure 4.13: Firm Management Score and adoption of sustainable technologies



Note: FMI is a sum of positive responses ("Yes") for each of the surveyed firms to the five questions identified as relevant to managerial capabilities. FMI ranges from 0-5 and is a proxy of how advanced companies are in implementing business management. There are seven questions on sustainable technologies included.[69]

Source: World Bank analysis based on WB Enterprise Survey 2019.

66. *De Haas et al. 2021. Managerial and Financial Barriers to the Net-Zero Transition. European Bank for Reconstruction and Development Working Paper 254.*

67. *Bloom N., R. Sadun R., and J. van Reenen. 2017. Management as a Technology? Harvard Business School Working Paper 16-133.*

184. Firms with better management are more likely to adopt green technologies. The Green Technology Adoption is positively correlated with firm size. Technology adoption levels are similar for small and medium-size firms, suggesting that adoption barriers are similar for small and medium-size companies. In terms of green technologies, machinery upgrades are the most popular technological solution—adopted by 40 percent of all companies (Figure 4. 15). One in 10 companies adopted water management systems, with large firms as likely to adopt this solution as small and medium firms. While better management is key to supporting green technology, adoption is also crucial to promoting innovation and growth more broadly (Cirera and Maloney 2017).[70]

4.4. Green patent analysis

Innovations in sustainable technologies

185. Poland caught up with the production of green patents over the past decade, in line with its level of development. However, its contribution to green innovation remains very limited and below the overall EU average.[71] Applicants from Poland were granted 266 green international green patents during the period 2000–20. This is less than 0.1 percent of global patent green output and 10-50 times less (per capita terms) than those granted to other Western European countries. In fact, the European Union plays a leading role in green patents, responsible for almost one-third of patents related to sustainable technologies during this period, with marginal contributions from Poland. In relation to its population, in 2000–19 Polish applicants produced 6.7 green patents per 1 million inhabitants, which is close to the average for the new EU member states. However, this level is significantly lower than applicants in countries at the technological frontier—for example, USA, Japan, and advanced EU countries. In the decade 2000–10, Polish applicants were granted only 67 green patents, below the level expected for its income level (Figure 4.17). Following dynamic growth in 2010–15 Poland matched its level of development: in this period the number of green patents granted to Polish applicants increased by 14.4 percent on average annually (twice the rate of the global average). In the entire period 2000–19, applicants from Poland were granted more green patents per capita than four of the 27 countries of the European Union, ahead of only Romania, Croatia, Bulgaria, and Slovakia.

186. Production of green patents in Poland followed global trends, both in sectoral composition and growth dynamics. In 2000–09, the average annual growth rate of green patents was three times higher than the global average, albeit starting from a modest base. All broad technological categories rose, but the change was driven by inventions in energy substitution and efficiency, as was the case worldwide. Following a rapid rise in 2010–14, patenting activity in sustainable technologies slowed and the current growth rate remains below that recorded prior to 2015 (EPO-IEA, 2021).[72]

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68. *BMGa1: Does establishment's strategic objectives mention environmental or climate change issues? BMGa2: Does this establishment have manager responsible for environmental or climate issues? BMGc1: Over last 3 years, did this establishment monitor its energy consumption? BMGc16: Over last 3 years, did this establishment have targets on energy consumption?*

69. *The questions are: Did this establishment adopt heating and cooling improvements? Did this establishment adopt machinery upgrades? Did this establishment adopt energy management? Did this establishment adopt waste minimization, recycling? Did this establishment adopt water management? Did this establishment adopt upgrades of vehicles, vessels, aircrafts? BMGc23i: Did this establishment adopt improvement of lightning systems?*

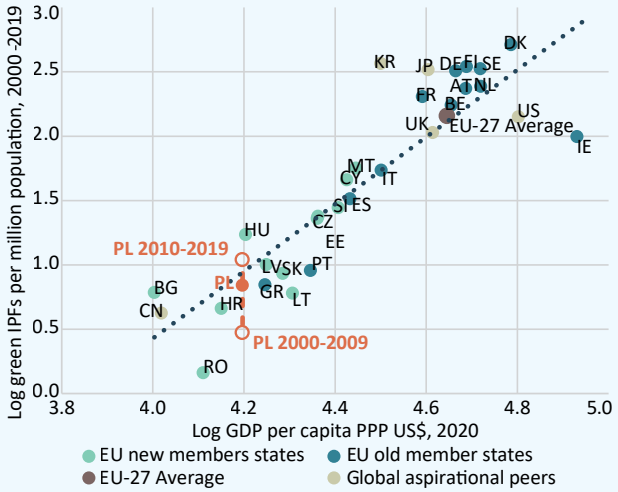
70. *Cirera X., and W.F. Maloney. 2017. The Innovation Paradox: Developing-Country Capabilities and the Unrealized Promise of Technological Catch-Up. World Bank*

71. *The international patents families (IPFs) are used as a measure of patent count, which are broadly used as proxy for high-quality innovation output. IPF is a collection of patents covering the same technical content – granted by multiple patent offices.*

72. *EPO-IEA. 2021. Patents and the Energy Transition. Global Trends in Clean Energy Technology Innovation.*

187. After a period of dynamic growth in 2010–14, Poland's revealed technology advantage in green patenting increased, indicating potential opportunities for the future. The revealed technology advantage (RTA) index indicates a country's specialization in terms of green innovation relative to its overall innovation output.[73] Poland improved its RTA due to patent growth in recycling and low-carbon energy supply, albeit starting from a low number of patents (Figure 4.15). Among the new EU member states, Poland advanced the most between 2015–19 and 2005–09. RTA indices for countries with high green innovation activity remained stable over time, except for Denmark, which further strengthened its position as a global leader. Denmark is the only EU country that improved its RTA in green technologies more than Poland.

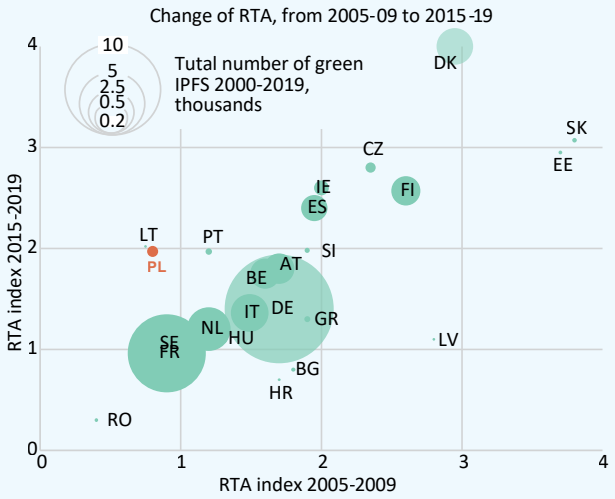
Figure 4.14: Number of green patents and economic development, 2000-2019



Source: World Bank calculation based on PATSTAT and Eurostat data.

188. Poland specializes in wastewater processing, recycling, as well as solar and geothermal power-related patents. Although half of the green patents granted to Polish applicants in 2000-19 are related to energy substitution and efficiency, Poland does not have a revealed technological advantage in this area. Compared to other EU countries, Poland specializes in the area of solutions for climate change mitigation—with the highest RTA in wastewater sludge among all EU member states. In the remaining subcategories, the differences in RTA between Poland and the EU average are smaller or negative. Technological areas with high RTAs indicate types of products and services that may play an increasing role in Polish exports (Zachmann and Kalcik 2018). High RTA approximates the potential of countries to excel in technologies on international markets.

Figure 4.15: Change of RTA in green IPFs, from 2005-09 to 2015-19



Source: World Bank calculation based on PATSTAT data.

Drivers of eco-innovation

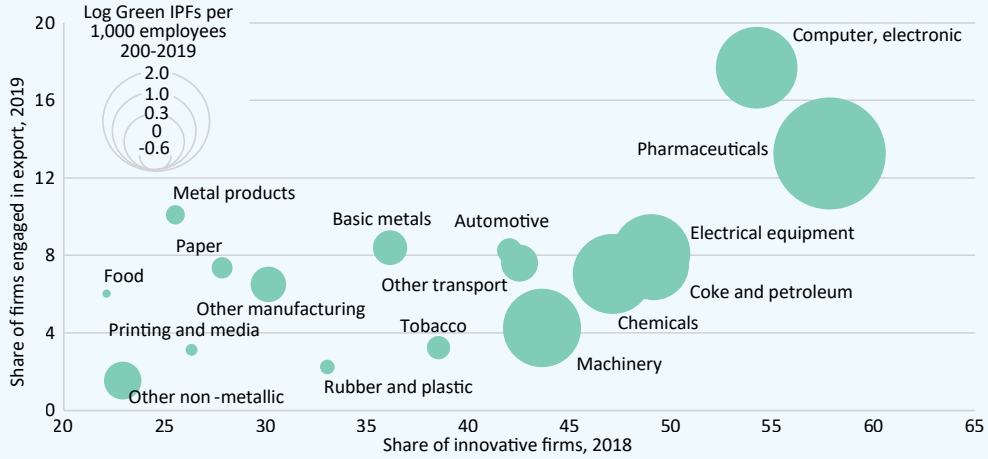
189. Sectors with a higher share of innovative firms produce more green patents. There is a positive correlation between introducing innovations in other areas of technology and inventive activity in sustainable technologies. These results echo those in Section 2.2, showing a positive correlation between the Firm Innovation Index and the adoption of green technologies and sustainable business practices. Results indicate that green innovative activity occurs across the economy and is not restricted to sectors producing sustainable goods or services (Popp 2019). A positive relationship between the general level of innovation and green patents at the sectoral level is present not only in Poland but also in economies with higher production of green patents.

[73] *RTA is defined as a country's share of patents in sustainable technologies divided by the country's share of patents in all fields of technology. An RTA above one reflects a country's specialization in a given technological field.*

190. Green patents are concentrated in sectors with a high share of firms active in international markets. As we measure patents that provide protection of intellectual property outside the inventor's country, a positive correlation between green-inventing activity and export activity is expected. The empirical data confirms such relationships, in relation to inventive activity both in green patents and in other types of innovation. The results regarding Polish inventors confirm the relationship observed in other countries between participation in international trade and patenting activity (Fagerberg 1996). Thus, it can be inferred that policies enhancing the internationalization of enterprises could also stimulate innovation, and specifically innovations in the field of sustainable technologies (Taglioni and Winkler 2016).

191. Most of the firms registering green patents were beneficiaries of public support programs co-financed from EU funds. During the period 2014–20, 80 percent of green patents registered by Polish applicants were filed by firms that had been beneficiaries of firm-level support instruments co-financed from EU funds. This result could indicate that public funding for green innovation has the potential of promoting green patenting among Polish firms (Azoulay and others 2017). Interestingly, we find no statistical difference between receiving support from horizontal R&D support programs compared to the instruments dedicated to green R&D in terms of likelihood of registering a green patent. While this could suggest that dedicated green R&D funds are not required, it could also be due to the very small sample size, as the number of instruments targeting the creation of sustainable technologies in this period was very small.[74]

Figure 4.16: Green IPFs, share of innovative firms and export activity, Poland



Source: World Bank calculation based on PATSTAT and Eurostat data.

4.5. Policy mix analysis

192. The overall firm support as a share of GDP in the programming period 2021–27 remains similar to the previous one, but the "potential" resources for green investments significantly increased, though this may not lead to an increase in investments. Despite the overall budget for firm support planned for the coming programming period (2021–27) remained constant, the value of potential green investments quadrupled from 5.1 EUR billion to 23.0 EUR billion (equivalent to 0.55 percent of GDP per year). However, this increase may remain on paper as these extra resources have limited "sole" targeting and could be used for

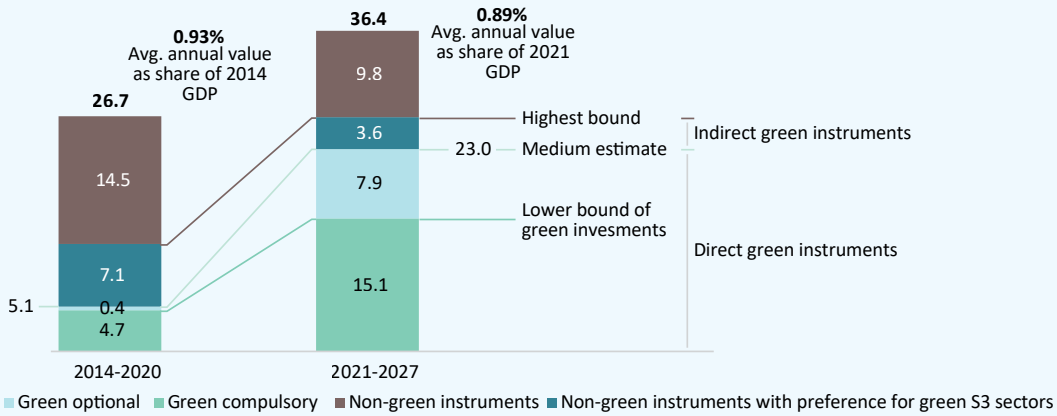
[74] *As discussed in Chapter 4, in 2014-2020 financial perspective, three out of 314 firm-level supports instruments included a compulsory green R&D component. They represented 0.4 percent of the cumulative value of total firm-level instruments in this period.*

other objectives. In fact, green investments are optional in programs that account for one-third of the "green" investment budget of EUR 23 billion. The increased alignment of firm-level investments with green objectives results from a change of national instruments that explicitly list greening objectives among noncompulsory objectives in their EUR4.4 billion horizontal instrument. Seventy-five out of 112 direct green instruments address one additional non-green outcome, most often productivity growth, and firm upgrading. These multi-objective instruments are responsible for over 75 percent value of instruments that include compulsory green component. Sixteen direct green instruments aim for achieving three types of outcomes simultaneously, while another 12 instruments target four outcomes, and eight instruments target five outcomes.

193. Limited support is offered specifically for green innovations at the frontier of technology, with multiple instruments targeting green technology adoption and infrastructure. Support provided by direct green instruments have been categorized into four types of activities: technology adoption, R&D, infrastructure, and skills. In both financial perspectives, the biggest share of budget aims specifically to support green technology adoption or in combination with the creation of green infrastructure (Figure 4.18). However, in 2021–27, two-thirds of the budget of direct green investments is allocated to instruments supporting more than one type of activity, compared to 35 percent in 2014–20. Addressing many challenges with a single instrument hinders the alignment between objectives and goals with desired high-level changes (Cirera and others 2020). This approach also impedes the measurability of progress toward reaching instrument objectives. A combination of support of various green activities in one instrument might create challenges in establishing a clear link between instrument and desired impact.

194. Green financing is highly concentrated in a few investments that also aim to promote other non-green objectives. Excessive fragmentation of support creates a risk of overlap between actions undertaken by various institutions in the national firm support ecosystem (Borowik and Iwanowski 2018). Smaller instruments may have difficulty in reaching critical mass of beneficiaries and achieve expected economic impact (World Bank 2019). The portfolio mapping highlighted considerable fragmentation of instruments supporting greening of the private sector. Five out of 112 instruments with the highest budgets are responsible for 52 percent of the cumulative value of all green instruments (Figure 4.19). Moreover, the eight biggest instruments are also among the least selective in terms of objectives—all of them support at least two or more non-green socioeconomic objectives along with a green

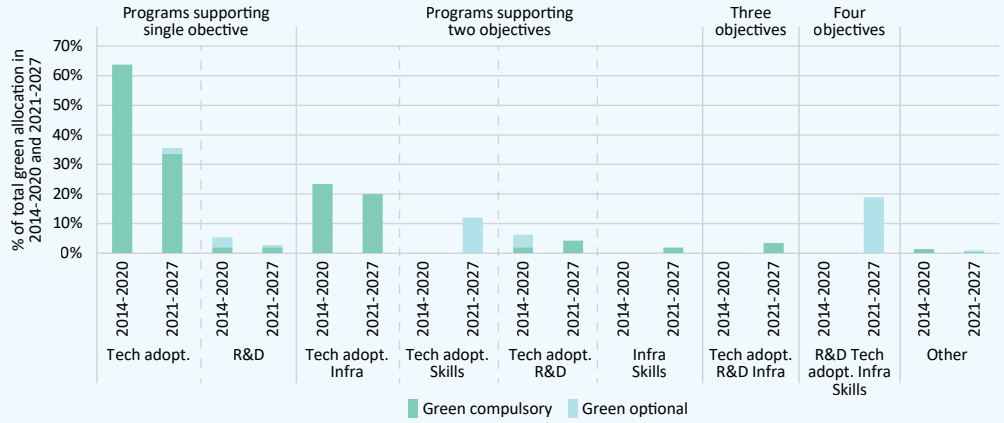
Figure 4.17: Value of firm-level support instruments per program type, EUR billion *,**



*Note: * green objectives are not compulsory in some programs*
*** most instruments support multiple objectives, including non-green S3 – Smart Specialization Strategy*
Source: World Bank analysis based on program documentation.

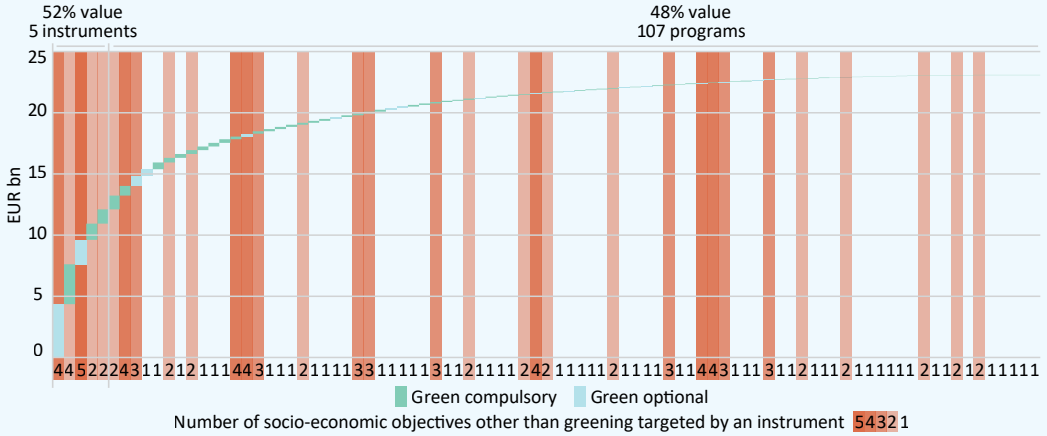
one, which could mean that these programs are used by firms for objectives others than green innovation. Fragmentation of green investments in a 2021–27 budgetary perspective closely resembles challenges related to this area in the 2014–20 period, with little sign of improvements despite well-documented risks resulting from such a setup (World Bank 2019).[75]

Figure 4.18: Distribution of value of direct green instruments per green objectives



Source: World Bank analysis based on program documentation.

Figure 4.19: Distribution of value between direct green instruments in 2021-2027, EUR billion



Source: World Bank analysis based on program documentation.

4.6. Policy considerations

195. Improve allocative efficiency in manufacturing by removing barriers between firms and between-sector resource allocation. Barriers in allocative efficiency in the manufacturing sector prevent more emission-efficient firms from increasing their market share. Such findings echo the results of the recent productivity decomposition (World Bank 2021b).[76] Policies that could address this "allocative inefficiencies" and promote reallocation of market shares towards more efficient firms include, for example, support for access to finance for SMEs or effective labour market interventions that would enhance labour mobility and support re-training of workers. These policies would not only benefit improvements

[75] *Ibidem*

[76] *Marć Ł., U. Kilinc. M. Malec. And B. Skowron. 2021. Paths of Productivity Growth in Poland: A Firm-Level Perspective. World Bank*

in emissions through increased economywide efficiency but also benefit overall growth, as they coincide with policies that could increase overall TFP by reducing productivity misallocation (World Bank 2021b).[77]

196. Introduce targeted policies for accelerating reduction of emissions in high-emitting manufacturing sectors. GHG emissions in Poland are highly concentrated in a few manufacturing sectors; thus, increasing their emissions–efficiency impact is crucial for achieving climate neutrality. Governments acknowledge the need for interventions dedicated to increasing productivity and promoting the long-term competitiveness of manufacturing sectors through various policy instruments (Box 4.1.). In the EU, the absence of a bloc-wide policy for reduction of manufacturing emissions creates opportunities for intervention at the national level.

197. Mainstream obligatory green investments among a wide group of support instruments. Optionality of green investments in support programs aiming for achieving environmental and climate outcomes, particularly among R&D support, risks that the beneficiaries of public programs would invest in non-green projects. Embedding obligatory green components in program design would not only increase chances for achieving climate objectives but will also build competences among firms to generate and implement projects reducing their GHG emissions.

198. Design public support instruments to maximize impact and limit fragmentation of programs. Limit the overlap and increase the specialization of investments for the development of green skills. Adapt and fund support to upgrading firm capabilities and management practices (both general and specifically aiming for achieving outcomes related to environment and climate change). Increase targeted funding for green research & development.

199. Promote energy-efficiency investments in manufacturing sectors to exploit opportunities provided by simply catching up with moderate

Box 4.1. Examples of policies aiming to decrease carbon emissions of manufacturing sector

Netherlands—Sustainable Energy Surcharge (ODE): ODE is a levy on natural gas and electricity for industrial enterprises, paid separately from a broad energy tax and EU ETS allowances. Its objective is to further incentivize the transition from fossil fuels to RES and promote energy efficiency in key sectors for reaching climate neutrality. The ODE resulted in reduced GHG emissions with limited distortive effect (Diederik and others 2020).[78] The scheme was introduced in 1996 and revised multiple times, with the last amendment in 2020 increasing tax rates for firms that consume high volumes of energy.

United Kingdom—Industrial Decarbonization Strategy: The strategy includes a set of supply-side policies for development of hydrogen energy and carbon capture and storage infrastructure for manufacturing use to cut emissions of seven industrial hubs with emissions greater than 0.1 MtCO2e produced by eight high-emitting sectors (UK BEiS, 2021).[79] The strategy presents an approach to maximize synergies with broader industrial and science policies, and operationalizes high-level objectives of national climate neutrality strategy.

[77] *Ibidem*

[78] *Diederik et al. 2020. Impact of the ODE energy surcharge on industry. Effects on costs and greening. CE Delft.*

[79] *UK Department for Business, Energy & Industrial Strategy. 2021. Industrial decarbonization strategy.*

levels of efficiency. The adoption of existing technologies that reduce energy consumption, widely used in Western European countries, has a significant potential for reducing GHG emissions. Public investments should also aim for increasing the usage of technologies after their adoption, which requires introduction of product and process innovations, embedding low-energy production activities, and upskilling employees.

200. Advance coordination and learning. Establish explicit structures for inter-agency coordination and exchange of best practices in greening of the private sector. Results of the portfolio mapping indicated that duplication of support between various institutions is highly probable, and most objectives are covered by many instruments. Facilitation of good practices and coordination of activities could ease these constraints.

201. Enhance support for management and export capabilities. Managerial capabilities are a complementary (and conducive) factor for adopting green technologies and green R&D. Support for improving skills of managers could thus achieve both goals of improving productivity and strengthening climate competitiveness. Participation in international trade is positively correlated with production of green patents. Thus, incentivizing enterprises to integrate into trade and intensifying their presence in foreign markets have the potential to green their products. Trade integration and improvement in managerial capabilities are not just good for emissions efficiency but also tend to directly benefit productivity and, therefore, promote growth.

202. Support development of emerging sustainable technologies. Poland could exploit opportunities to strengthen competitiveness in technology areas where it already has revealed a competitive advantage. Further research is required to determine the potential for expansion of patenting in respective technologies, and the design of public support instrument addressing technology specific constraints to growth. Instruments supporting technology specialization could include incentives for learning between firms operating in respective niches through technology-specific clusters (Giannitsis and Kager 2009).

203. Improve quality of and access to firm-level data on fuel and energy consumption. For most companies with manufacturing operations, Scope 2 emissions make up a very large part of their overall carbon footprint. Information allowing to determine a broader scope of emissions will allow for generation of more evidence to inform regulatory changes and fine-tune of public support instruments.

Chapter 5
Institutions and Financing for Decarbonizing the Economy

5.1. Introduction

204. The chapter assesses Poland's governance and institutional capacities in the context of decarbonization and the green transition. Climate change is an unprecedented challenge for governments and public institutions. Having robust state capabilities to mainstream climate change and green transition goals, programs, and projects is critical. Hence, it is necessary to understand how to strengthen institutions for the green transition. A successful green transition and decarbonization requires a "whole of economy and society" transformative approach. Achieving such sweeping reforms necessitates, among others, progressive (1) regulatory frameworks and strategic planning, (2) effective institutional coordination, and (3) efficient climate-sensitive public investment management, which presently underperform due to hurdles in Poland's governance regime.

205. There is general recognition that "institutions matter" for development. At the same time, the nature of the relationship is still debated and contested. It remains unclear what institutions feed into growth and whether institutions bring about growth or is their progression mutual. Many emerging economies—including post-transition Poland—have achieved robust growth and economic resilience as a result of swift institutional reform and related capacity building (World Bank 2017). Evidence also suggests that a wide range of deep institutional reforms are needed for profound structural changes. This is also true in the context of the green transformation; many of the barriers to a green economy are institutional in nature and are often the main reason for a lack of progress (UNEP 2019). Institutional capacity—especially as it relates to coordination across policy areas and levels of government—and regulatory stability are key preconditions to a substantive transformation toward a greener economy (OECD 2013). Without clearly defined policy targets, regulation, and institutional ambition, public and private resources are unlikely to be efficiently allocated to green investment, hindering long-term green growth.

206. The chapter draws on the in-depth review prepared for the 2022 Poland Country Economic Memorandum and (1) contextualizes Poland's institutional and governance aspects, (2) presents emerging leading practices in other countries, (3) presents evidence of and analyzes challenges to these institutional necessities, and (4) recommends policy options and reforms, as well as selected interventions. A 2-stage diagnostic was carried out. The key institutional challenges were identified based on country knowledge (desk research), the Bank's prior engagements, and also through initial consultations with key stakeholders. Following this initial analysis, the task team used the Climate Change Institutional Assessment (CCIA)[80] to drill down into specific areas and develop a guidance note for structured interviews carried out with key stakeholders.

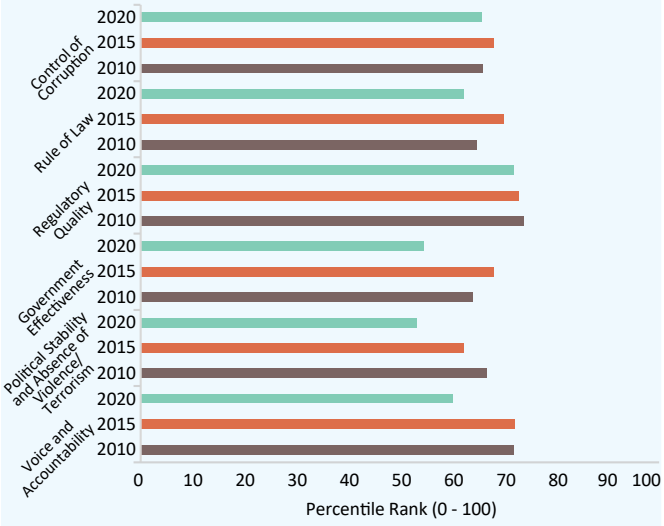
5.2. The Governance Context

207. In recent years, there has been a deterioration in governance quality indicators. In 2020 Poland was assessed to have the lowest performance in terms of governance quality since 2015, with most World Governance Indicators (WGI) showing a consistent deterioration over the last decade

[80] *"World Bank. 2021. Climate Change Institutional Assessment. Equitable Growth, Finance and Institutions Notes;. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/35438 License: CC BY 3.0 IGO."; https://openknowledge.worldbank.org/handle/10986/35438.*

(WGI World Bank, 2021, Figure 5.1). Poland ranks 22nd among the 27 EU countries in Good Governance (2020 Sustainable Development Indicators), and it has experienced the greatest deterioration of this indicator among EU comparators.

Figure 5.1: World Governance Indicators for Poland, 2010-2020



Source: WGI.

208. Arguably, this deterioration is linked to changes in the country's executive capacity and accountability. Regulatory impact assessments (RIA) and consultation mechanisms have been weakened and are often bypassed using fast-track legislation.[81] Confidence in the government is low—in 2020, at 27 percent, it was the second lowest among OECD members, roughly 20 percentage points behind the OECD average (Gallup poll 2021). Many local governments have seen their financial resources and administrative capacities decline (SGI 2020; COE 2019). A lack of coordination between levels of government may exacerbate challenges and information asymmetries impacting the green transformation.

209. Improving the quality of legislation and governance efficiency is part of the reforms foreseen in the National Recovery and Resilience Plan. These reforms provide for strengthening consultations with social partners, increasing the use of regulatory impact assessments, and limiting the use of the accelerated procedure in the law-making process.

210. The national development framework should be understood in the context of its territorial and administrative organization. Multilevel governance arrangements have improved with the adoption of legally binding contractual arrangements between the state and the subnational governments to enhance coherence in achieving nationally and regionally defined development objectives. Development policy is executed by the Council of Ministers (national) as well as by subnational governments at the voivodship (regional) and gmina and powiat (county and municipal) levels. The current development management framework identifies interdependencies between policy issues and focuses on enhancing policy integration to build synergies between strategic plans and to optimize the achievement of integrated development policy outcomes.

211. Citizens in Poland acknowledge the need for climate adaptation, but at the same time are concerned that it may have an adverse impact on their financial situation. Close to seven in 10 respondents (69 percent, below the EU average of 78 percent) consider climate change to be a very serious problem, according to the Eurobarometer survey on climate change (Eurobarometer, 2021). For 67 percent of respondents (75 percent in EU27), the national government is not doing enough to tackle the problem. Two-thirds of citizens (compared with 62 percent in EU27) believe that adapting to adverse impacts of climate change may have positive outcomes for citizens. At the same time only three in 10 respondents say they feel personally responsible for tackling climate change (below the EU average of 41 percent).

[81] *Regulatory policy requirements for the executive including public consultation do not apply to laws initiated by parliament, which constituted 21 percent of all laws passed on average between 2017 and 2020.*

212. The private sector's awareness of green transformation challenges is growing, but at the same time Polish firms report multiple obstacles to climate investments. The EIB survey related to climate change (EIB 2021) shows that a higher percentage of companies in Poland—60 percent compared with 58 percent for the EU—believe that climate change will have an impact on their growth and productivity. Three-quarters of surveyed companies have energy cost concerns (compared with 58 percent of the respondents in the EU), and only 10 percent have dedicated climate staff (23 percent in the EU). Polish firms report more obstacles to climate investments than the EU average, with uncertainty about taxation and regulation cited most frequently (eight in 10 respondents).

5.3. Institutional Assessment

Institutional Leadership

213. Russia's invasion of Ukraine has amplified the importance of energy security considerations. Concomitantly, governments must continue to focus on reducing environmental degradation and the lasting effects of climate change. In the wake of these developments, the country's leadership institutions may find renewed motivation to pursue a "whole of economy and society" green transformation.

214. The Ministry of Climate and Environment (MoCE) is a key institutional player in the green transformation. The MoCE is tasked with drafting national policies; preparing legislation, including environmental standards; and monitoring policy implementation in most environmental areas, including air, waste, water, and nature conservation. The MoCE also coordinates the development of environmental and energy policies within the government and supports their implementation at subnational levels.

Box 5.1. Emerging practices in climate change leadership and coordination arrangements

Decarbonization and adaptation to climate change require a whole-of-government response across the processes of strategy, planning and policy development, implementation, and evaluation. More effective coordination increases the chances of gaining buy-in from key agencies and is more likely to lead to successful efforts to address climate change. Effective coordination is achieved through alignment of actors around objectives and targets, strategies and plans, and specific policies. Coordination is required horizontally, between agencies at each level of government, and vertically, across national, regional, and local tiers of government.

Countries take different approaches to coordination on climate change: some establish dedicated coordination mechanisms, while others integrate climate change into the mandates of existing bodies. Either way, effective coordination also requires new processes, relationships, capabilities, incentives, and resources. There are still very few studies that assess in detail the institutional designs, processes, and results of national coordination on climate change; however, the following cases may serve as examples of good practices for Poland to build on.

Since 2015, Ireland's climate change mitigation policy making and project implementation has been informed by the Climate Change Advisory Council. The Council consists of the heads of the Environmental Protection Agency, the Sustainable Energy Authority, the Agricultural and Food Development Authority, and Economic and Social Research Institute.

The Council is tasked with conducting an annual review of the progress made in achieving planned GHG emissions reductions and furthering the green transition. A budget is allocated for research grants, independent auditors, and procedural reviews. As part of its mandate, the Council is responsible for proposing five-year economy-wide carbon budgets, to assist the state in achieving its national climate objectives and GHG emissions targets. The budgets serve as a foundational input for the development of sector-specific policies by relevant line ministries. Consequently, the Council conducts annual reviews of progress and reports on sectoral carbon budgets and policy impacts.

The United Kingdom ensures climate coordination and policy implementation through an independent statutory body. Created by the Climate Change Act 2008, the Climate Change Committee (CCC) has become the cornerstone of climate governance in the United Kingdom during its first 10 years of existence. It is central to the assessment of climate policies (on both adaptation and mitigation) and the definition of carbon budgets. The CCC doubles as a monitoring, reporting, and verification vehicle for national climate change frameworks and engages with a wide range of stakeholders to promulgate evidence and analyses. Its mandate is further strengthened by its close links with the British Parliament and the obligation of the government to meet the recommendations of this expert committee. The CCC provides regular analyses of climate change science, economics, and regulatory regimes, which in turn informs policies and activities. Having the status of an independent administrative authority, the CCC benefits from a strong autonomy in the management of its activities. With a secretariat of about 30 people and an annual budget of around 4 million euros, it has substantial resources that guarantee its ability to produce expertise relevant to public policies, which is the foundation of its legitimacy and ensures its independence.

Colombia's whole-of-government approach mobilizes key actors and places climate and sustainable development at the center of its efforts. The National Climate Change System (SISCLIMA) was established in 2016 to deliver the National Policy on Climate Change. SISCLIMA plays a key role in coordinating the country's NDC efforts and promoting national and regional climate action. The inclusion of SISCLIMA in various regional nodes, technical committees, and local actors enables green transition bodies to engage not only relevant national institutions, but also regional and local actors. The Inter-Sectorial Commission on Climate Change (CICC) sits at the center of SISCLIMA. The CICC's wide-ranging influence on Colombia's national climate strategy and action across government is a useful structure on which to review leadership and its links to better project pipelines. The CICC aligns various ministries and draws on their respective responsibilities and authorities to direct resources as needed. By doing so, the CICC can address institutional misalignments and streamline green investments. The CICC can engage directly with and encourage the private sector to invest. Through its technical committees, regional bodies, and direct links to ministries, the CICC can highlight investment opportunities and gaps, and work to deliver policy tools and incentives. In addition to the CICC's key role in the government's interface to engage the private sector, it can improve the dissemination of good practices from one region that may benefit another by incorporating regional and local planning processes and public consultations. Furthermore, the CICC has a strong link to the National Policy on Climate Change, meaning it can help to identify what areas of the institutional framework are working and which ones need support.

Source: WB staff.

215. Several other ministries have important responsibilities for the green agenda, including those for agriculture, state assets, development and technology, infrastructure, funds and regional policy, and finance. In addition, in Poland's decentralized administrative system, subnational governments are important partners (380 counties and 2,477 municipalities) for environmental and climate change policies. In principle, the division of tasks is clear, but in practice coordination is a challenge.

216. In Poland climate policy actions are driven mainly by Poland's international commitments (UN, EU). More intra-governmental consensus-building and greater coordination are needed for the development of a unified policy framework for the green transformation. The following elements illustrate challenges for climate change leadership:

- **The MoCE's climate portfolio should receive more attention from the Executive.** Dealing with recent and developing crises consume substantial bandwidth of MoCE decision-makers (for example, suspension of energy supply from Russia, high energy prices, risk of blackouts by 2030[82]).
- **Lack of intra-governmental agreement on climate change priorities.** There are few stakeholders that question the primacy of the EU's climate policy, affecting green transformation policy coordination.
- **Fragmented national climate change policy making.** Climate and energy policy setting (MoCE) is separated from the supervision of state-owned energy companies, which fall under the purview of the Ministry of State Assets. SOEs' decisions have an important impact on the pace and form of the green transformation. Additionally, the long-term zero-emission strategy is articulated by the Ministry of Development and Technology. This means that climate and energy policy making is dispersed across several stakeholders that do not necessarily coordinate.
- **Complex political economy of the energy sector.** The energy transformation policy is influenced by important stakeholders like state-owned energy companies and regional political constituencies.
- **Insufficient access to technical expertise on climate and energy policy issues.** In-depth institutional knowledge/understanding of green transformation issues is in some instances limited, especially when it comes to the business aspects (information asymmetry in relation to the SOEs). Some key decision-makers in the government prefer to rely on expert opinions, which are not always informed by market-competitive analyses and/or seem to emphasize political considerations.
- **The narrative of green transformation focuses on the risks of climate change,** while social and economic benefits are not often reflected in discourses and policies.
- **Addressing climate change and the green transition appear unpopular.** At the national and at the regional/local level, climate change is seen as carrying large financial costs with few political benefits.

Strategic Planning

217. An amendment to the Act on the Principles of Development Policy from November 2020 reformed the strategic management framework and introduced new regional policy instruments. The amendment cemented the Council of Ministers' 2018 decision, titled "Poland's development management system." Consequently, the long-term strategy was transformed into 1) a vision document, that is the National Development Concept; and 2) the medium-term national development strategy. The National Development Concept (in drafting) will present development options and challenges for the country's social, economic, and spatial dimensions. The medium-term country development strategy is to be prepared by the

[82] *The official analyses of the PSE SA (the Polish power system operator) show that after 2025 there may be problems with balancing the national energy system (capacity constraints may account for to up to one third of annual demand).*

minister in charge of regional development and adopted by the Council of Ministers.

218. Poland's medium-term strategy is based on the concept of sustainable development. The Strategy for Responsible Development (SRD) for the period up to 2020 (including the perspective up to 2030) introduced a new model of development. The SRD seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs. Its main objective is "to create the conditions for raising the income of citizens along with increasing social, economic, environmental and territorial cohesion to achieve inclusive social and economic development."

219. Within the EU, Poland lags on aspects of climate change ambitions and green growth strategic planning. Poland remains the only EU country that has not committed to climate neutrality by 2050; one of five EU countries that have not presented the long-term zero-emission strategy; and the last member state to submit a long-term Renovation Strategy to the European Commission. In general, climate policy stems from international commitments (for example, as part of EU and UN membership) and is motivated to a lesser extent by an urgent sense of action.

220. The climate adaptation strategy and key strategic plans for mitigation need to be updated. A 2020 study found that, given the outdated perspective of the Polish National Strategy for Adaptation to Climate Change by 2020 with the perspective by 2030 (SPA2020), many planned interventions at the subnational level (37 percent) would not be classified as mitigating nor adaptive (Kalbarczyk and Kalbarczyk 2020). The medium-term policy directions related to climate change mitigation are set by the National Energy and Climate Plan[83] for the years 2021–30 and Poland's Energy Policy until 2040, but these do not consider recent geo-strategic and market developments as well as the more ambitious European Commission agenda, such as Fit for 55. In March 2022, the MoCE announced an update of the energy policy, which should account for a shift in the energy paradigm as a result of the conflict in Ukraine; however, this is contingent on its acceptance by the Council of Ministers.[84]

221. In addition to the national strategic planning framework, there is a parallel strategic planning structure in place for EU funds. For each programming period there is a Partnership Agreement (PA) developed in cooperation with the EC. The PA defines the strategy and investment priorities and presents a list of national and Regional Operational Programs (ROPs) to be implemented, and it includes an indicative annual financial allocation for each Operational Program (OP). The National Reform Program (NRP) and the National Recovery and Resilience Plan (NRRP) bridge national strategies and EU programming—although the latter has yet to be approved by the EC. The plurality of strategic planning systems creates additional coordination challenges and leads to a multiplicity of progress in monitoring activities. Because of its direct links to funding sources, EU-related planning execution attracts more attention and has greater bearing on policy.

222. There is considerable regulatory uncertainty. This stems from a lack of political consensus on climate policy vision, and these uncertainties disrupt investment processes. Changes introduced every few years have a significant impact on the profitability of ongoing projects and sometimes even on their feasibility (for example, onshore wind facilities). The reliability of support schemes for RES is perceived as low due to frequent changes and short adjustment periods—for example, major change of prosumer settlements passed in December 2021, coming into force in April 2022.[85]

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[83] *This plan was prepared to meet the obligation under Regulation EU2018/1999 of the European Parliament and of the Council of 11 December 2018 on the on the Governance of the Energy Union and Climate Action.*

[84] *Tentatively mid-2023.*

[85] *Based on the review of regulation framework (see chapter dedicated to RES investments).*

Coordination

223. A comprehensive green transformation has multidimensional impacts, affects various socioeconomic actors, and requires multilevel governance. Multidimensionality calls for multistakeholder approaches and institutional frameworks that can be applied across regions, governments, and sectors. In Poland, global and especially EU policies provide an overarching framework for green transformation. These commitments are translated through climate change, energy and sectoral policies, and strategies at the national level, then duplicated and implemented by subnational government units. Implementation also occurs through national governance structures (including state-controlled enterprises that dominate coal-based power generation and energy distribution) and in partnership with other actors such as NGOs, research institutions, civil society, and private sector agencies. In most cases, collaboration among actors and between governance levels is facilitated by institutional structures such as committees or task forces.

224. At the EU level, the EC provides some overarching coordination for the green agenda. The Commission incentivizes Poland's decarbonization ambition level through structural funding facilities. The EU imposes obligations on the development of detailed plans, including the National Energy and Climate Plan, the National Air Pollution Control Plan, and the Long-term Renovation Strategy.

225. The coordination of activities that span cross-ministerial competences occurs mainly through working and task groups. Various subsidiary and advisory bodies are also designed to facilitate discourse and coordinate governance processes. The High-level Coordinating Committee for Development Policy (CCDP) plays a key role in supporting the implementation of development policy. The CCDP analyses the strategies, policies, regulations, and other mechanisms associated with implementing Poland's SRD and assesses their efficiency and effectiveness. Subcommittees may sometimes be designated to focus on regional or sectoral activities.

226. An amendment to the Act on Principles of Implementation of Development Policy has brought significant changes to the planning and coordination of strategic activities at the subnational level. As a result, spatial and socioeconomic development diagnostics must be in local development strategies to ensure stronger relations between the policies. A detailed process for consultation across levels of government for local development strategies has been defined—municipal strategies are submitted to the voivodeship board to ensure alignment with voivodeship development and spatial policies—adding another layer to an already complex framework. However, the possibility for neighboring municipalities to develop a supra-local development strategy presents opportunities for strategic coordination.

227. The desk review and CCIA interviews revealed the following gaps regarding horizontal coordination:

- **Fragmented systems.** Different institutional solutions (committees, intradepartmental working groups, and so on) and mechanisms are in place, but they lack sufficient empowerment to design and implement policies.
- **Weak consensus across governing stakeholders.** As a result of a wide spectrum of governing stakeholders, discussions often focus on issues of immediate relevance like the use of coal in the energy sector. This hinders the progression of discourse toward long-term policy considerations for the green transformation.

- **Parallel structures.** Substantial policymaking responsibilities have been transferred to the Chancellery, within the Prime Minister's Office, to strengthen horizontal coordination. The effectiveness of this solution is ambiguous, as it often leads to duplication of effort with limited coordination benefits.
- **Frequent changes in the organization of the government.** There is regular merging or splitting of ministries and reorganization of departments from one ministry to another, which creates additional coordination issues.
- **Administration is stuck with the sectoral, silo approach.** This does not work well in the case of green transformation where there is a distinct need for interdisciplinary and multidimensional approaches.

228. The governance of the state-controlled energy companies, which are responsible for most of the mining and energy production, represents the greatest challenge for vertical coordination:

- **State-owned enterprises** use their access to information and networks to influence the climate policy agenda.[86]
- **Views of the various SOEs on decarbonization differ.** Each lobby has its representatives in the various ministries. It is not easy to establish a consensus.
- **Vertical coordination measures do not address the problem of the right incentives for the state-owned network companies** (power, gas), so their investment plans are not adjusted to the needs of government support programs for development of RES and the exchange of coal-fired heat sources.[87]

229. Vertical coordination between government and subnational government units faces challenges as a result of the following factors:

- **Divergent policy objectives instruments.** Furthermore, climate change adaptation has been more emphasized than mitigation.
- **Insufficient inclusion and ad hoc coordination.** While in Poland consultations for the planning process or specific projects do occur, in some cases they are in place only to comply with formal regulations. In others, participation from municipalities remains limited. Moreover, as the planning documents do not necessarily include investments projects, coordination tends to occur on an ad hoc basis, depending on the project pipeline, in particular for those financed by EU funds.
- **Insufficient coordination on revenue-related issues between national and local government**. Structural tax reforms are negatively impacting local government revenues and their capacity to pursue the green agenda. Also, while criteria for tax sharing and general transfers to SNGs are set in law and well understood, information on national government financial support/transfers for investments is fragmented and spread across targeted transfer schemes and appropriated to different ministries, departments, and agencies. These transfers are usually accessed on a competitive basis at the start of the budget year, which creates uncertainty for SNGs with respect to their ability to implement investment plans.
- **Insufficient coordination on phasing out coal.** Mine-intensive communities oppose closing mines due to a lack of governmental transitionary vision/programs. These programs are missing due to coordination shortcomings and concerns by some politicians about the reaction of miners and local societies.

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[86] *SOE lobbying power is being perceived as a major barrier to RES development (for example, changes in prosumer settlement scheme in 2022) – for more details see chapter dedicated to RES investments.*

[87] *For example, at the beginning of 2022 Polska Spółka Gazownictwa (state incumbent in natural gas access) suspended accepting applications for new gas connections. This was due to the fact that the investment budget for the implementation of this type of connection for the years 2022-23 was exhausted. If someone wants to take advantage of the government support program and exchange its coal boiler to the gas one it cannot do this.*

Infrastructure governance and asset management

230. The EU provides overarching guidance on public investment management (PIM). The system is defined by the high-level climate commitments and legal framework derived from the EU membership. The EU legislation on environmental impact of projects (for example, SEA, EIA, Habitat/Natura 2000 Directives) [88] was incorporated into Polish law in 2008. Additional guidance on the EU's "green taxonomy" is needed for transparency in sustainable investment and implementation of the European Green Deal. In early February 2022, the European Commission issued a regulation setting out the conditions under which gas-fired and nuclear power plants can be considered "sustainable" by investors.[89]

231. Complex and inconsistent legal framework. These many norms (for example, environmental protection for investments, construction processes, and so on) are contained in several parliamentary acts. This poses difficulties and administrative inefficiencies for operating or prospective investors in Poland.

232. According to the desk review and interviews, infrastructure governance and asset management are adversely affected by the following (Tokarczyk-Dorociak and others 2019):

- **Insufficient commitment to existing standards.** Many assessments are performed pro forma (for example, in order to justify a large-scale infrastructure project), not as a result of an authentic need to consider environmental aspects.
- **Uneven incorporation of standards.** Some legal requirements—for example, biodiversity, water management, and air protection—are covered well; others (climate change, landscape, and cultural heritage) are less so, which is due to the fact that in their case detailed requirements set by the environmental institutions have not yet been developed.
- **Uneven implementation of standards across different funding sources.** There are insufficient tools to support assessments and analyses, especially with respect to climate and landscape changes. While it is expected that agencies apply the same appraisal procedures (project options, economic and financial appraisal, and risk assessment) as for EU–funded projects to locally funded projects, there is no regulation requiring it and no evidence it is done in practice for all projects.
- **Insufficient central guidance for implementation.** Perceptions among some stakeholders point toward a lack of support for project development and appraisals done by implementing agencies from the central government. As efforts for procedural standardization, including quality and enforcement, have lagged, existing standards struggle to achieve the necessary robustness for genuine green transformation.

233. Gaps in the legal framework. Inconsistent and outdated regulations affect project appraisal, project selection, portfolio management and oversight, and management of project implementation. These gaps in the legal framework contribute to fragmentation of approaches applied by sectoral entities—or for different funding sources—and do not guarantee that resources are assigned to the best projects. A lack of common project and portfolio management requirements may result in some sectors being less efficient than key leading institutions (IMF 2021a).

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88. *The Habitats Directive sets the rules for the selection of Special Areas of Conservation for the Natura 2000 network. The main aim of the European Ecological Network Natura 2000 is preserving particular types of natural habitats and species, which are considered valuable and endangered in Europe.*

89. *This regulation will become law if neither a majority in the European Parliament nor a reinforced qualified majority of more than 20 EU countries reject it. Therefore, it remains unclear if the regulation will survive.*

Box 5.2. Main messages from the Public Investment Management Assessment 2021

The International Monetary Fund's Public Investment Management Assessment (PIMA) assesses strengths and weaknesses of infrastructure governance and identifies potential bottlenecks for making the most of these investments in terms of quality infrastructure. The 2021 assessment for Poland identified areas to improve the country's public investment management framework. It found that infrastructure governance in Poland is complex, involving an extensive web of public entities with different and potentially overlapping roles, which causes fragmentation affecting all stages of the public investment cycle—planning, allocation, and implementation—in terms of institutional design and effectiveness:

Planning

Capital investment plans of subnational governments are not formally discussed with central governments unless they require financing from the State Budget or EU funds. Monitoring of the financial performance and investment plans of public corporations (PCs), which dominate many of the key infrastructure markets in Poland, is limited and fragmented, and public-private partnerships (PPPs) are not fully integrated in the government's medium-term investment plans. This may suggest that while institutional design is strong, effectiveness remains low.

Allocation

A large share of capital spending is executed outside the State Budget, and there is no unified project pipeline of appraised projects ready for selection. There is also an absence of standard methodologies and clear guidelines for estimating maintenance needs and costs for main asset classes, except for the national road network.

Implementation

Multiple implementing agencies are responsible for managing major investment projects that fall under their competencies, but there is no consolidated monitoring of the implementation status of the portfolio of major projects.

Source: IMF 2021a.

234. The current system of environmental institutions and processes has not been subjected to a thorough review and evaluation of its effectiveness. Environmental institutions operate the national environmental monitoring system, monitor compliance of hazardous industrial facilities, regulate transboundary movements of waste, as well as manage EIA/SEA and oversee the Natura 2000 network. These solutions have been around for almost 15 years, and a thorough review and evaluation of the system would allow for the improvement of the quality of governance processes and operational efficiency.

235. Improved spatial planning must be a starting point for climate change adaptation. In view of unresolved spatial planning problems (which, among other things, lead to excessive territorial expansion of settlements), the inclusion of climate change adaptation aspects remains a challenge. This problem became apparent, inter alia, during the consultation on a draft law amending certain laws to strengthen the climate dimension of urban policy. The bill, which would introduce the obligation to prepare adaptation plans for cities with more than 20,000 residents, has been criticized by local government units for its inconsistency with solutions related to spatial development.

236. Inefficient state asset management may lead to under-realizing the potential benefits of green change.

This applies, for example, to state-controlled production and service entities, which, if properly managed, could benefit from investments in offshore wind farms.

Monitoring, reporting and verification

Monitoring and reporting

237. The functions of environmental monitoring, modeling, and forecasting is delegated across three government institutions:

The Institute of Meteorology and Water Management (IMGW), Central Statistical Office (GUS), and the Institute of Environmental Protection (IOS). The IOS also provides knowledge (for example, risks, impacts, vulnerabilities) in the field of climate change. GUS is the source for most of the statistical data that is necessary for the performance of annual national emission inventories.

238. The National Centre for Emissions Management (KOBIZE) is a special body in charge of collecting emissions data. This agency is part of the IOS, which is subordinated to the Ministry of Climate and Environment and manages the national emissions inventory, data forecasting, and reporting. KOBIZE operates the National Database, where data on emissions of greenhouse gases (GHG) and other substances is collected. It is also an in-house scientific advisory body and conducts modeling and analytical activities in addition to assessing the impact of climate policy on the economy.

239. The Minister of Climate and Environment is responsible for climate change mitigation policies. The Ministry's measures and projections of GHG emissions are publicized in reports prepared by KOBIZE.

240. The Energy Market Agency (ARE) conducts empirical research and system analyses on energy issues. This state-owned company is the main source of data on the energy sector, but data access is limited (available on a commercial basis, and the methodology is frequently changed).

241. Interviews and desk research have revealed the following data challenges:

- centralized governance of information could be improved; environmental information and data is fragmented and dispersed across different databases and portals;
- estimates related to climate objectives are subject to methodological changes by the Central Statistical Office, which makes it difficult to assess the robustness of results;[90]
- verification of the data reported by the ministries on the implementation of strategic goals and projects, including those related to green transformation, is insufficient;
- climate discourse within the government is sometimes conducted based on selective (not always reliable) sources, and the analyses of the governmental think tanks are underutilized.

242. Monitoring of strategic initiatives is in place. The achievement of strategic goals and the implementation of related projects is monitored by the (1) managerial control system (Government of the Republic of Poland 2022); (2) strategic monitoring system (Ministry of Funds and Regional Policy); and (3) operational monitoring system (Strategic Project Portfolio Monitoring Council—SPPMC). Activity-based budgeting is also a potential monitoring tool. Strategy implementation is monitored and reported on a quarterly basis. The targets and responsibility for particular projects are assigned to ministries and public institutions, including

[90] *As noted in the chapter dedicated to investments in renewables, such last-minute adjustments to methodology make the 2020 target achievement questionable and decrease trust in Poland's Key Performance Indicators for 2030.*

those that report to the MoCE, but also by external entities (including private bodies) selected via collective procurement.

243. Projects implemented under EU programs are also monitored. The Ministry of Funds and Regional Policy is also responsible for monitoring the implementation of EU programs (those from the Partnership Agreement). The system is now being upgraded to meet the requirements of the NRRP—that is, to cover the implementation of reforms and investments provided for in the NRRP.

244. Deficiencies in the application of the monitoring systems hinder the fulfillment of their intended role.[91] This is due to (1) a lack of full participation of sector ministries and agencies; (2) failure to comply with the standards for entering information and data; (3) the lack of verification mechanism for the information and data entered; and (4) the absence of sufficiently specific evaluation standards (leaving room for discretion). The monitoring system dedicated to the use of EU funds stands out positively.

Box 5.3. Mechanisms to monitor, report, and verify progress toward national climate change goals

Besides international reporting requirements under the UNFCCC, national reporting on climate change is gaining importance, as citizens become increasingly interested in understanding the impacts of climate change on their lives and businesses and expect governments to report on and account for actions on reducing climate change impacts and GHG emissions. Reporting creates opportunities for a broader national discussion, which can help national governments to demonstrate their accountability to civil society and to the public.

Mexico's climate framework mandated the development of a registry, methodologies, and climate adaptation MRV system. In 2012, the National Institute of Ecology was transformed into the National Institute of Ecology and Climate Change (INECC), with a view to expand the Institute's scope and capabilities. INECC compiles and updates the National Emissions Inventory, and collaborates with line ministries, subnational governments, and other bodies within the climate framework on the development of strategies, plans, programs, instruments, and activities related to sustainable development and climate change. Reports on emissions, activities, and strategic progress are published regularly while a comprehensive review of the national climate change policy is conducted every two years. The Institute works closely with states and municipalities on decarbonization tracking, project evaluation, and policy improvements. The climate framework imposes penalties for noncompliance with requirements to submit information to the Institute.

South Africa uses its National Climate Change Response Database to allow users to access relevant information on mitigation, adaptation, and other projects throughout the country. The system highlights the country's progress in reaching its emissions reduction targets and allows for more informed decision-making. The databases use data from the Department of Environmental Affairs, Department of Energy, and Department of Trade and Industry, while users can also voluntarily register projects. The MRV system that serves the needs of the UNFCCC simultaneously permits the government to do the following:

- support South African negotiation positions in international climate change negotiations,

[91] *The findings from interviews are in line with the Supreme Audit Office post-inspection statement ("Post-inspection statement - Implementation of selected flagship projects of the Strategy for Responsible Development," 2021).*

- avoid duplicating mitigation, adaptation and research projects, and
- track the impact of mitigation actions in the country, among others.

This system is designed to inform different national stakeholder groups. Thus, South Africa is able to generate its Annual Climate Change Reports from its MRV system that originally had been conceived for serving the UNFCCC requirements.

The Danish Economic Councils are an independent economic advisory body consisting of two councils—the Economic Council, established in 1962, and the Environmental Economic Council added in 2007—each representing diverse stakeholders from unions, employers, NGOs, and the public sector. The Councils are overseen by a chairmanship of university professors in economics and supported by a single secretariat consisting mostly of economists. The primary objective of the institution is to provide independent analysis and policy advice to Danish policy makers. The Councils engage in (1) monitoring compliance with green budgeting initiatives, (2) economic and fiscal forecasting and scenario analysis with climate and ecosystem considerations for budget plans, (3) costing and program evaluation with a green perspective, and (4) research on climate, ecosystems, and the circular green economy Though formal monitoring of emissions targets is carried out by the Climate Council, the Economic Councils provide additional analyses and advice on how to reach emissions targets. The Danish Economic Councils communicate with the Climate Council, but the two generally carry out their work independently from one another. The Danish Economic Councils have a secretariat with 25 analysts—most of whom have backgrounds in environmental economics. The Councils do much of their analysis using in-house models or by applying research by outside academics.

Source: WB staff.

245. The Strategic Project Portfolio Monitoring Council aims to increase the effectiveness of monitoring and control mechanisms. The Council was set up in 2018 under the Prime Minister's Office and is composed of the members of the Council of Ministers, including the ministers, whose departments are responsible for the implementation of each project. The role of the Council is not only to monitor and coordinate the programs and projects resulting from the Council of Ministers' strategic documents (operational monitoring), but also to promote the improvement of governance and the standardization of methods for managing the portfolio of strategic projects in central government agencies. The experience gained so far from the activities of the Council shows that it is struggling with the same problems as with other monitoring and control tools (Supreme Audit Office 2021b).

Executive enforcement

246. Compared to other EU member states, Poland's climate targets are relatively unambitious. Poland justifies this by its heavy dependence on fossil fuels. The principle of differentiation of the EU climate policy targets, depending on the conditions of individual countries, is favorable for Poland; both the 2020 and 2030 targets are below the EU-wide level (Table 5.1) and are at some of the lowest levels among the member states. When assessing Poland's national targets for 2030—presented in the National and Climate Plan for the years 2021–30—the European Commission found they are not particularly ambitious (European Commission 2020b, 2020d).

247. The 2020 climate targets were only partially met. While the EU's medium-term emission

reduction targets are becoming more ambitious, Poland faced challenges in meeting its 2020 national targets. In the years of economic expansion (2017–19) emissions in ESD sectors exceeded the reference level, indicating that the drop of these emissions below the reference level in 2020 (due to the COVID-induced recession) had no fundamental justification. The same situation applies to energy efficiency, measured by the level of primary energy consumption; the 2017–19 levels indicate that 2020 consumption being close to the reference level was rather temporary. As far as renewable energy sources are concerned, for 2020 Poland reported the share of RES in gross final energy consumption to be above the targeted level (15 percent). According to GUS, however, the change in methodology for calculating household consumption of solid biofuels had a significant impact on the achievement of the target.[92]

248. Independent estimates suggest that effective implementation of existing programs and projects could lead to lower emissions. Partial implementation of government programs led to at least 27 million tons[93] of excessive CO2 emissions in 2020. In 2030, their value is estimated at 53 million tons (Instrat 2021d). Full implementation of existing climate policies could achieve as much as 69 percent of the 2030 reduction target of the PEP until 2040 and 31 percent of the reductions required by the EU's GHG-55 percent target. Factors that slow progress on achieving the target include (1) excessive subsidies for coal-based power generation; (2) a fundamental change in the rules for the establishment and operation of onshore wind installation, halting many advanced investment projects; (3) omissions in transport (no effective system to exclude excessively emitting vehicles from roads, delays in the electromobility program); (4) delays, resulting, inter alia, from inappropriate design in individual heating program (thermal modernization, replacement of boilers); and (5) administrative bottlenecks in the functioning of the white certificate system, leading to underutilization of the potential for energy efficiency improvements in industry (Instrat 2021).

Table 5.1: EU and Poland climate policy targets for 2020 and 2030

Target		2020	2030 (binding)	2030 (proposal[94])
GHG emission reduction	EU	-20% vs. 1990	-40% vs. 1990	-55% vs. 1990
	Poland	Max. +14% in ESD sectors[95] vs. 2005	-7% in ESR sectors vs. 2005	
Share of RES	EU	20% in total energy use (10% in transport)	32% in total energy use (14% in transport)	38-40% in total energy use[96]
	Poland	15% (10% in transport)	21-23% (14% in transport)	
Energy efficiency	EU	+20% vs. forecasts for 2020	+32.5% vs. forecasts for 2030	+36% for final energy use or +39% for primary energy vs. forecasts for 2030
	Poland	Max. primary energy use: 96.4 Mtoe	+23% vs. forecasts for 2030[97] (max. primary energy use: 91.3 Mtoe)	

Source: WB staff analysis.

92. *With the change in methodology, additional data sources have been added to the range of data used for the calculation. According to the new methodology, the data for the years 2018-20 were recalculated.*

93. *Around 7 percent of the annual GHG emissions in Poland.*

94. *European Commission. 2021. "Fit for 55 package. 2021" https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/package-fit-for-55.*

95. *The Effort Sharing Decision (ESD) No 406/2009/EC established annual greenhouse gas emission targets for member states for the period 2013–2020. These targets concern emissions from most sectors not included in the EU Emissions Trading System (ETS), such as transport, buildings, agriculture and waste.*

249. Monitoring bodies have been ineffective in ensuring that reporting is widely used to influence policy objectives by line ministries and implementing agencies. These include the Ministry of Funds and Regional Policy (MFRP), the Ministry of Finance (MoF), and the Office of the Prime Minister (OPM). Beyond these ministries, the SPPMC has the greatest power—deputy ministers and ministry representatives participate in it. However, the Ministries and SPPMC have struggled to act on their green transformation mandates, particularly in the current context of geopolitical and domestic tensions. The discord among leadership institutions often renders monitoring reports ineffective in furthering policy objectives and hinders the promulgation of more ambitious targets.

Box 5.4. Climate change technical units in ministries of finance

Ministries of finance are beginning to play a fundamental role in ensuring countries take ambitious climate action. They can lead the mainstreaming into and alignment of national climate action goals with macroeconomic policy, fiscal planning, budgeting, public investment management, and procurement practices. As recognized by the Coalition of Finance Ministers for Climate Action, their role is fundamental in aligning overall public sector practices with Paris Agreement commitments.

To fulfil this new mandate, finance ministries require enhanced institutional and organizational processes, capacities and resources, and the right set of incentives. Typically, finance ministries have broad mandates and handle competing demands in collecting and allocating resources, managing the treasury administration, ensuring financial controls, and executing the budget efficiently. Their primary objectives are commonly maintaining fiscal discipline and achieving allocative and technical efficiency. These duties now need to be fulfilled in a climate-conscious manner, which in many cases requires adapted structures, operations, and skills.

The Danish Ministry of Finance has undertaken significant organizational restructuring to address climate change. In 2019, the Ministry of Finance embarked on a triple-helix partnership–GreenReform–with the private sector, public, and private research institutions to create economic models for the country's sustainable development and evaluate national climate policy frameworks within the Climate Council. To this end, the ministry formed the Centre for Climate, Green Economy and the EU as a climate-specific department. The Centre is directly responsible for the budgets of the two most climate-sensitive entities–the Ministry of Environment and Food and the Ministry of Energy, Utilities, and Climate–as well as for the country's contributions to EU green initiatives. The division also represents the Ministry of Finance on the national Green Transition council (national level coordination body) and undertakes sustainability and environmental impact assessments of all government administrations. Finally, the Centre publishes annual voluntary reports on the country's progress toward nationally determined contributions per SDGs.

Colombia developed the Climate Finance MRV framework (which is one of the three elements of the National MRV framework), operated by the National Planning Department of Colombia. The main objective of the Climate Finance MRV framework is to build information management processes to track climate finance flows for climate change mitigation and adaptation in order to enhance understanding of the latter. This in turn helps to increase their effectiveness in several regards: Investment gaps can be identified, greater resources to address climate change can be

[96] *Latest indications would suggest parties are considering an increase to 50 percent.*

[97] *European Environmental Agency. Accessed November 2021. PRIMES2007 forecast. https://www.eea.europa.eu/data-and-maps/figures/primary-energy-consumption-baseline-primes/fancybox.html*

mobilized, and planning and decision-making can be informed in a useful manner. The methodology for monitoring climate finance flows in Colombia complies with four fundamental principles: flexibility, transparency, comparability, and consistency.

The Planning Institute of Jamaica (PIOJ) is the public service planning arm of the Ministry of Finance, and it initiates and coordinates planning for the economic, financial, social, cultural, and physical development of Jamaica. In addition, the Institute provides guidance on climate issues (disaster impacts on GDP, lives, and livelihoods; coping strategies; population distribution and shifts; and reviews of legislative and institutional frameworks). The Institute works on institutional capacity-building (personnel, systems, tools, equipment), awareness raising (national campaigns, communications strategies, and action plans), knowledge management, donor coordination around climate priorities, and policy reviews (scanning the environment for policy gaps, promoting coherence, and setting the agenda). In addition, the Institute works with academia in shaping and implementing its work program, including by having representatives of academia on its Board.

Source: WB staff

250. External rules and verification mechanisms or funds seem to be the most effective enforcement mechanisms. These rules and mechanisms tend to come from EU directives and rules. The newest European instrument—the RRF—requires the implementation of reforms as a condition for financing specific investments. The drafting of the NRRP for Poland led to revisions of some public policies and their implementation.

251. The complex legal environment is not conducive to judicial enforcement of climate commitments and goals. Poland has a complex legal framework. The Environmental Protection Act provides the legal framework for commercial and environmental activities in Poland. However, relevant provisions are also included in codes such as the Code of Civil procedure, the Civil Code, and the Labor Code, as well as in several other special laws (Centre for European Constitutional Law 2021).

252. Key environmental protection procedures can be legally circumvented. Legally mandated public participation in environmental protection and environmental impact assessments was intended to solve the issues pointed out in the European Commission opinion of March 7, 2019 (infringement No. 2016/2046), regarding the incorrect implementation of the provisions of the directive on access to justice. However, in the opinion of NGOs, inconsistency with the EU law still exists (Wojtkowska 2021; Ślusarczyk 2021). Issuing building permits based on non-final environmental decisions and circumventing procedures by calling on special acts hinders the procedures' intended efficacies. [98]

Financing for the green transition – private capital mobilization

253. In the context of the green transition, an important enabling role will have to be played by the financial sector. Public and blended finance have a vital part to play in the shift to a greener and more resilient economy, but ultimately private capital is needed to help all companies realign their business models for net zero and fund the initiatives and innovations of the private sector.

[98] *These acts are aimed at streamlining investment processes, for example, building motorways.*

254. Mobilization of capital toward environmentally friendly activities and technologies is supported by disclosure and reporting initiatives, improved risk management practices, and increased demand for green assets. Opportunities in the low-carbon space are becoming increasingly visible, while evidence that "value investments" do not necessarily carry lower returns and may even deliver additional yields is adding a boost to demand. More and more investors are seeing green and sustainability indices perform just as well as conventional indices and sometimes even outperform them. Market growth in green bonds and loans, on the other hand, has been further underpinned by principles and reporting standards. These aim to address investor concerns about greenwashing and facilitate comparability. Although green bond and loan markets are still relatively small in size, these instruments can play a transformative role by raising awareness and boosting accountability and transparency.

255. Municipality finance can play a catalytic role in developing green markets in Poland and help mobilize private capital. Local governments are a potential source of many projects eligible for green financing in fields such as transportation, infrastructure and utilities, heating, building and housing maintenance, or environmental protection for which they are responsible. A lot of these tasks are public goods, which can hardly be delivered by private actors alone. Local governments also own and operate a large stock of public buildings such as offices, schools, and hospitals. As the supply of investable green projects from the public sector and companies is increasingly seen as a bottleneck for green finance in Poland (Forum Energii 2021, 22), removing institutional barriers in municipalities' access to financial markets needs to become a priority.

256. Past engagement of local governments in climate-related investments can give some information as to its scale in the future. The value of local governments' investments in low-emission energy projects from 2013 to 2019 was equal to PLN 9bn, with the bulk of financing coming from EU funds (66 percent) and only 25 percent supplied by commercial banks. Investments by local governments made up 7 percent of all investments in low-emission technologies in this period, though the share varied annually (WiseEuropa 2020a). The value of local governments' investments in the modernization of buildings was equal to PLN 10bn, with EU funds supplying 72 percent of that sum and commercial banks less than 20 percent. Local governments' investments constituted 43 percent of all investments in this field (WiseEuropa 2020b).

257. EU funding is bound to supply a critical part of financing for projects to be realized in coming years, as substantial portions of funds from the National Resilience and Recovery Plan are earmarked for local government use (Forum Energii 2021; WiseEuropa 2021). However, that might not be enough to cover all of the relevant expenditures. In any case, using EU funds to crowd in private finance willing to supply financing on favorable conditions for such projects could allow for economizing on EU funds and direct more EU financing toward projects that cannot secure external funding or funding from other public sources. At the same time, a lack of funds was consistently listed as the main obstacle for climate action in a periodic survey of local government officials (Instytut na Rzecz Ekorozwoju 2019).

258. The authorities are actively engaging in facilitating external funding of municipal (and corporate) green investments, as set out in the Capital Market Development Strategy (Ministry of Finance 2019, 61). At the moment, there have been only two issuances of green bonds by municipalities: Łódź for PLN 50mn and by Grudziądz for PLN 63mn. At the same time, there were 10 issuances of corporate green bonds, including seven by nonfinancial companies with combined nominal value of PLN 7,249mn (KPMG 2021, 55; WiseEuropa 2021, 18). One specific action taken so far by the Ministry of Finance was procurement of a report identifying current barriers to development of the green bond market in Poland (KPMG 2021). The report identified several challenges, including an overwhelming preference for loans as

opposed to bonds (Rada Ministrów 2021, 37), especially due to the high costs stemming from certification and use of proceeds monitoring, which make issuances of low nominal value bonds uneconomical. Additionally, the Indywidualny Wskaźnik Zadłużenia (IWS) budget rule limits the value of debts local governments can incur based on their past revenues. IWS serves as a budget disciplinary device, yet it might prevent some municipalities in sound financial condition from using external finance and benefiting from the current low yields environment (KPMG 2021; WiseEuropa 2021; Dmuchowski 2020; Gołaszewski 2017).

259. Aligning public development finance institutions (DFIs)' strategies, investments, and operations with climate objectives could be a powerful way of redirecting finance flows. Globally, many national DFIs already have the capacity to analyze sustainable investment opportunities, provide technical assistance, offer blended capital market vehicles, and de-risk financing in the form of guarantees. In addition, DFIs can support green securitization as a way of reusing existing bank capital and unlocking new private green/sustainable loans. Polish DFIs such as Polski Fundusz Rozwoju (PFR) and Bank Gospodarstwa Krajowego (BGK) could contribute to the development of a pipeline of bankable projects and support the development of new markets (for example, voluntary offset markets) and products, thus catalyzing private investment. Yet despite the growing offer of sustainability-related projects and programs, neither PFR nor BGK has set a climate neutrality target or announced that their financing will be aligned with the Paris Agreement, which would allow for a more systematic integration of climate concerns within their investment practices.

260. PFR is operating a Green Hub fund, a strategic program aiming to support the energy transition in Poland by investing in renewable projects–under market conditions and without crowding out private capital. The Green Hub is organized around four main pillars: (1) direct investments (equity or subordinated loans) in infrastructural energy projects; (2) indirect investments in the form of dedicated Fund of Funds within PFR Ventures, investing up to PLN 200mn in start-ups developing climate related technologies; (3) work with municipalities on energy projects, where PFR provides both capital (equity or subordinated loans) and expertise; and (4) educational projects such as Szkoła Liderów and Akademia Miast Przyszłości (Future Cities Academy), which are expected be supplemented by projects with a climate focus (Pawlak 2021). Setting up of the Green Hub was accompanied by changes to PFR's governance structure. An Energy Transformation Bureau was established with the objective of actively seeking out and assessing investable projects. PFR reports that in 2020 it made investments in 11 biogas projects to the tune of PLN 130mn (PFR 2021, 60). PFR also revealed plans to facilitate the development of CPPA market in Poland with the aim of stabilizing energy Opex for large Polish companies (Pawlak 2021, 124).

261. BGK, the Polish national development bank, has also engaged in various green finance initiatives. BGK is engaged in distribution of funds from programs financed from public budget or EU funds, such as Biznesmax guarantees for loans with beneficial environmental effects, partial subsidies for retrofitting loans from Funduszy Termomodernizacji I Remontów, participation in investments by local governments within the Program Inwestycji Strategicznych, and Czyste Powietrze, where BGK offers credit guarantees for the replacement of furnaces (Kwiecień 2021). Recently, BGK launched a new incubator-type project, "Idea 3W," with the objective of "facilitating cooperation between inventors, companies looking to commercialize innovation and financial institutions" in the technologies of water, hydrogen, and carbon (Woda, Wodór, Węgiel). However, the role of BGK, in particular in any direct financial involvement, remains unclear (BGK 2021).

Table 5.2: Green finance market in Poland – overview and main issues

Area	Overview	Identified issues
Disclosure	• Non-financial reporting is regulated by the law transposing the EU's NFRD; the number of entities required to report certain climate-related information is limited (~150). • Listed companies need to align their governance practices with the corporate governance code of the WSE (comply-or-explain principle), which includes ESG issues. • Private reporting standards can be adopted voluntarily by listed as well as private companies, irrespective of whether they are obligated to report under NFRD. • Another form of issuers' disclosure is the disclosure of net-zero or climate/carbon neutrality targets and similar commitments together with policies to reach them. • Financial market participants are regulated by the EU's SFDR.	• Low standardization of nonfinancial reporting (around half of NFRD reporting companies rely on their own standards) and the quality of climate-related information needs strengthening. • The proliferation and use of private reporting standards and/or climate neutrality targets remain low. • KNF issues a limited number of supervisory notices with respect to non-financial reporting, and most of them were related to completeness of disclosures rather than their quality.
Risk management	• Prudential regulation, which is highly harmonized at the EU level in the CRD/CRR package, has recently started to incorporate climate-related considerations. • Polish banks can be plausibly assumed to have significant exposures to transition risks in particular, by the virtue of supplying the bulk of financing to the second most carbon intensive economy in Europe.	• Detailed and sophisticated assessments of banks' exposures to climate risks are lacking. • Little is known about the practices of banks with regards to climate risks and broader sustainability issues. • Supervisory action on climate risks by authorities is lagging.
Private capital mobilization	• EU funding is bound to supply a critical part of financing for green projects in coming years (substantial part of funds from the NRRP is earmarked for this purpose). • Green bond and loan markets are relatively small (only two issuances of green bonds by municipalities – 113 million zł in total: 10 issuances of corporate green bonds). • The supply of investable green projects from public sector and companies is seen as a key bottleneck for green finance in Poland. • An overwhelming preference for loans as opposed to bonds, especially due to the high costs stemming from certification and use of proceeds monitoring, which make issuances of low nominal value bonds uneconomical.	• Municipality finance could play a catalytic role in developing green markets in Poland and help mobilize private capital.

Source: Based on "Green finance market dynamics in Poland: an overview," World Bank 2022b.

262. There is large potential for climate change financing optimization—non-commercial entities are financially excluded. This would imply choosing the right form of financing, as well as creating complementary, and not competing, subsidy programs at the national and local levels. From the point of view of local governments, financing the green transformation is not very attractive (the vast majority of the expenditure falls on politically unpopular building renovation programs), and their ability to allocate their own funds for these purposes is decreasing (the effect of tax reforms). Credibility/collateral shortcomings make non-commercial entities like energy communities, energy clusters, and so on financially excluded.[99]

[99] *Based on the review of regulation framework (see chapter dedicated to RES investments).*

5.4. Institutional and policy considerations

263. With respect to institutional leadership, Poland could consider committing to climate neutrality. Current geopolitical developments underscore the importance of decarbonization for energy security and independence, creating favorable conditions to renew high-level commitment to the green transformation of the energy mix. Poland could consider aligning mid-term strategies with the existing long-term strategic perspective. The updated strategies should provide functional and financial clarity, with measurable outputs and outcomes, milestones, and built-in monitoring and evaluation mechanisms. Poland could also consolidate all aspects of climate change policy under a single authority. This may require some functional transfers from certain ministries and agencies to the Ministry of Climate and Environment. The strengthened departments would facilitate policy coordination, streamline implementation, and evaluate impacts across frameworks.

264. With respect to strategic planning, Poland could consider reviewing and updating the strategic framework. This would entail 1) building intra-government political consensus around climate neutrality; 2) adopting a long-term climate neutrality strategy that provides functional and financial clarity, with measurable outputs and outcomes and built-in monitoring and evaluation mechanisms; and 3) aligning medium-term strategies with the long-term vision and current EU ambition level.

265. To enhance coordination, Poland could designate a central intra-ministerial coordinating institution to coordinate all aspects of the green transformation, consider a technical secretariat for financial aspects of climate policies that could be in the Ministry of Funds and Regional Policy or the Ministry of Finance, and review the SOE governance framework. The central authority for the green transformation requires greater access to information, as well as assurances that policies will be implemented across the national investment framework. A review of SOE governance practices may be necessary to evince challenges and gaps that facilitate SOE-influence on policy making and a reluctance to invest in transformational areas.

266. On infrastructure governance and asset management, Poland could prepare a legal framework for project appraisal, selection, and portfolio management. As the current framework does not foresee nor regulate all aspects of project cycles and portfolio management, it is desirable to ensure that legal requirements are harmonized across sectors and public entities. This would ensure efforts are sufficiently targeted and that coordination on the green agenda is improved. Within the ensuing two years the Ministry of Justice, Ministry of Environment, Ministry of Infrastructure, and Ministry of State Assets could consult relevant stakeholders to determine existing gaps and articulate a unified legal framework. Poland could also streamline infrastructure assessment and monitoring, compile information and monitor large infrastructure projects from a portfolio perspective, and identify complementarities and systemic issues in investment projects across the government. This may entail the development of criteria to select strategic infrastructure projects in Poland; the compilation of key financial and performance information on selected projects; and the development of publicly available reports, including basic statistics at a project level, status of implementation, key challenges, and success factors. This could follow the definition of the legal framework. The system of environmental institutions, which was set up 15 years ago, needs to be comprehensively reviewed. A thorough evaluation of the effectiveness of processes such as EIA and SEA is also needed.

267. For monitoring, reporting, and verification Poland could consider an independent body. International practices have shown that shifting certain MRV functions to an independent entity, staffed by officials from the various ministries and agencies responsible for climate change and decarbonization, may yield effective results for strengthened implementation and policy learning. The body could function outside the

purview of ministries and agencies, assuring depoliticized policy making and strategic planning. Its scope could include a centralized and updated registry of emissions, sinks, mitigation and adaptation measures, and green financing schemes. The priority is high, and an MRV body should be deployed in tandem with the adoption of long-term strategies, as it may contribute to their successful implementation.

268. With respect to financing Poland could review the financing framework. An assessment of national and subnational financial regulations, incentives, and activities may streamline strategic planning and direct policy design and implementation more effectively. Poland could also strengthen both the supervisory dialogue and analytical work on climate risks in the financial sector. It could also consider a municipal bonds agency to lower financing costs and achieve economies of scales in green bonds issuance as well as remove other institutional barriers.

269. A Technical Secretariat for green finance could be considered. The Technical Secretariat could analyze and inform stakeholders on climate financing possibilities. A cross-ministerial entity may be considered, which seeks to facilitate access to finance, financial policy coordination, streamline implementation, and evaluate impacts across green finance frameworks. In order to relieve information asymmetries and provide reliable advice on climate financing policies and activities, the Technical Secretariat may be entrusted with capacities to conduct independent and comprehensive research and analysis. The Technical Secretariat could support public investment systems of subnational governments. SNG green investments are not always optimal or sufficiently targeted. An empowered Technical Secretariate for Climate Finance may review and support SNG investment plans and, in turn, achieve better-targeted projects and facilitate the transformational direction at the subnational level. It could also consider a centralized green project pipeline. A singular database of projects, including how they relate to green transformation objectives, and their implementation readiness status may facilitate climate financing from public and private sources. This should be considered subsequent to the adoption of strategic frameworks.

270. Poland could consider transparent and comprehensive financing communications. This would entail an annual budget annex or a separate document (public investment plan) that could include (1) data on public investment spending covering central government, including extrabudgetary funds and eventually SNGs and PCs; and (2) financing sources for public investment; and (3) a breakdown of major projects in each sector.

Chapter 6
Implications for Green, Inclusive Growth in Poland

6.1. Introduction

271. Poland, like other countries, faces the challenge of how to ensure economic growth is sustainable in the face of environmental problems. Environmental degradation is seen by many as undesirable in itself, directly reducing human welfare. But it also threatens growth in the long run. Evidence is mounting that environmental factors are a significant influence on productivity growth (Bowen 2016).[100] Such considerations have led multilateral economic institutions to advocate "green growth." For the World Bank, green growth is about "making growth processes resource efficient, cleaner and more resilient without necessarily slowing them" (Hallegatte and others 2011); the concept was the centerpiece of Inclusive Green Growth: The Pathway to Sustainable Development (World Bank 2012).[101]

272. The biggest challenge to Poland with respect to the environment is contributing to the global effort to reduce greenhouse gas (GHG) emissions and limit global temperature increases to, if possible, 1.5°C or less, in line with the Paris Agreement of the UNFCCC in 2015. The EU intends to become climate-neutral by 2050, and the EC's 2030 Climate Target Plan proposes reducing GHG emissions to at least 55 percent below 1990 levels by 2030, a substantial increase in ambition compared with the existing target of at least 40 percent. If Poland's GHG emissions are assessed using a carbon price in 2019, they are likely to have caused damages (then and in the future) of around $600 per Polish person (around 1.8 percent of its 2019 GDP).[102] This can be regarded as a reduction in the global environment's "natural capital" (World Bank 2021a).[103] The performance of Poland with respect to GHG emissions is considered in Chapter 2 and 4.

273. Moving Poland toward a green growth trajectory will require structural changes in its economy in the short to medium term. This will likely entail the accelerated obsolescence of physical capital associated with environmentally damaging technologies, higher investment in capital-embodying greener technologies, reallocation of labor across sectors, and changes in the level and direction of R&D spending. That said, when compared to changes in the Polish economy after the Communist era, the

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100. *Recent official reports have detailed the worldwide dangers of climate change and loss of biodiversity. See, for example, the IPCC Sixth Assessment Report (2021-22) on climate and The Economics of Biodiversity: The Dasgupta Review (2021) on biodiversity. The Stockholm Resilience Centre has documented how the global economy is overstepping limits – planetary boundaries – to the sustainability of the environment along several dimensions; see https://www.stockholmresilience.org/research/planetary-boundaries.html.*

101. *Similarly, The United Nations Environmental Programme defines a green economy as one that results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP 2011). According to the Organisation for Economic Co-operation and Development, green growth means "fostering economic growth and development while ensuring that natural assets continue to provide the resource and environmental services on which our well-being relies" (OECD 2011).*

102. *This calculation uses the middle of the range suggested by the High-Level Commission on Carbon Prices (2017) for 2020. Greenhouse gas emissions are total emissions without LULUCF, with industrial CO2, including international aviation, but excluding international maritime transport.*

103. *The adverse impact on global natural capital compares with increases in Poland's local natural capital, both renewable natural assets such as forests and sub-soil assets such as oil; Poland has outperformed Germany on this measure between 1995 and 2018, according to the World Bank's "The Changing Wealth of Nations" databank https://www.worldbank.org/en/publication/changing-wealth-of-nations/data.*

structural changes that are required for this transformation are not so large.[104] However, these changes would likely have a proportionally greater impact in high-carbon sectors, particularly energy, construction, transport. and some manufacturing processes; a lesser impact is expected for services.

274. Chapter 1 presents several scenarios that could allow Poland to sustain growth and achieve income convergence with the EU-27 average faster, and we complement this analysis with a simulation of macroeconomic impacts of green transition-related reforms. The "moderate reforms" scenario envisages an increase in Poland's investment from 20 percent to 24 percent of GDP and argues that reforms are needed to boost total factor productivity growth, which slows in this scenario in the longer term. Such reforms would facilitate the move to a "green growth" trajectory. The chapter's "ambitious reforms" scenario would boost growth in the period 2020–50 from an average of 2.59 percent per year in the "business as usual" (BAU) case to an average of 3.55 percent per year. This increase of nearly 1 percentage point per year is much larger than typical estimates of the gross costs of climate-change mitigation (around 0.06 percentage points of consumption growth per year; see Köberle et al., 2021). The next section assesses the impacts of the additional investments needed for the decarbonization of the energy sector and its macroeconomic impacts using the World Bank's Mitigation, Adaptation and New Technologies Applied General Equilibrium (MANAGE) model.

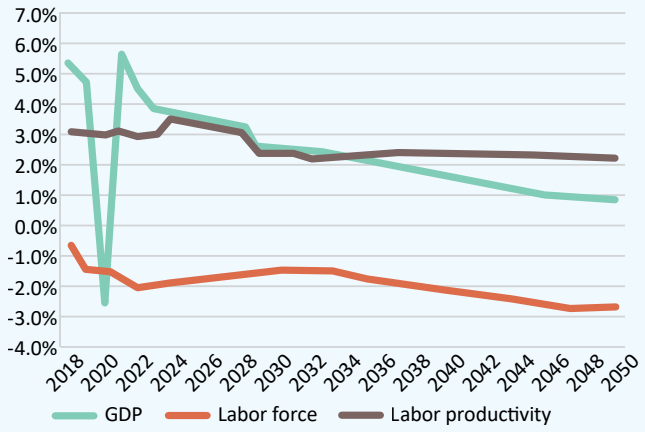
275. Simulations of the impact of a potential increase in labor force as a result of the war in Ukraine show that the macroeconomic impacts are positive. Beyond the short-term impacts, the war in Ukraine could result in an increase in the labor force in Poland over the medium to long term, if some of the forcibly displaced people remain in Poland, contributing positively to growth. Simulations show that if 1 million Ukrainians join the labor force, GDP could be 3 percent higher by 2030, with the magnitude of the impact depending on the skill distribution.

6.2. Potential macroeconomic impacts of selected decarbonization scenarios

276. Chapter 2 presents three alternative decarbonization paths and the additional investment needs associated with these scenarios. Using the World Bank's Mitigation, Adaptation and New Technologies Applied General Equilibrium (MANAGE) model, a recursive dynamic single country computable general equilibrium (CGE) model, we assess the macroeconomic effects of the different decarbonization paths considered. MANAGE includes all the standard features of CGE models that deal with fiscal policies (that is, tax, expenditure, and investment changes), structural changes in the economy, and it is designed to also analyze energy, emissions, and climate change policies. The baseline ("business as usual") scenario was constructed using the latest World Bank real GDP growth projections for the short to medium term and the Poland LGTM growth estimations for 2023 to 2050 (Chapter 1). Labor supply and labor productivity growth are also taken from the Poland LGTM (Figure 6.1). After the decline in GDP caused by the COVID-19 pandemic, there is an initial rebound, followed by a gradual decline in the real GDP growth rates. Labor productivity is expected to stabilize at around 2 percent, while the labor force is declining over time due to an aging population with relatively low replacement rates.

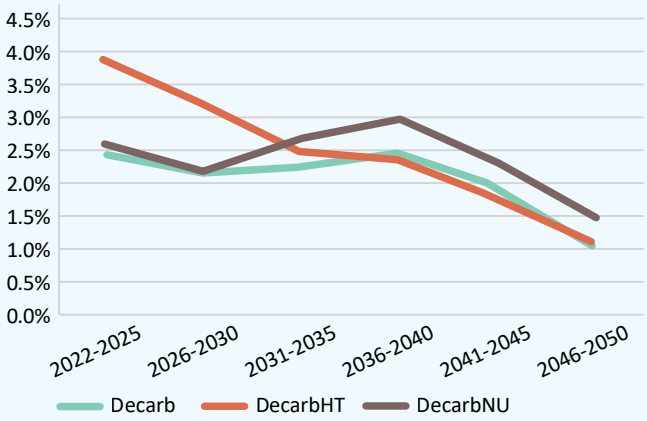
[104] *The scale of past change is illustrated by the fall in the number of jobs in coal mining from almost 400,000 in 1990 to 87,600 by the end of 2020 (Chapter [X]) and the reduction of the contribution of agriculture, forestry, and fishing to GDP by more than a half since 1995.*

Figure 6.1: Baseline, projected growth rates



Source: World Bank, LGTM.

Figure 6.2: Adjustment costs, share of total BAU investment (5-year averages)



Source: World Bank Poland EPM.

277. Even without policy intervention, the baseline implies a shift away from coal to mainly three other energy sources (gas, solar, and wind).[105] EPM expects that the decarbonization process of the Polish economy is already well underway in a business-as-usual scenario, and, hence, it is less costly to advance the transition with policy interventions. By 2050, around half of the energy is expected to be generated by fossil fuels with the share of gas four times higher than that of coal. Regarding renewable energy sources, solar energy is expected to generate 26 percent of total energy, with 21 percent generated by on- and off-shore wind.

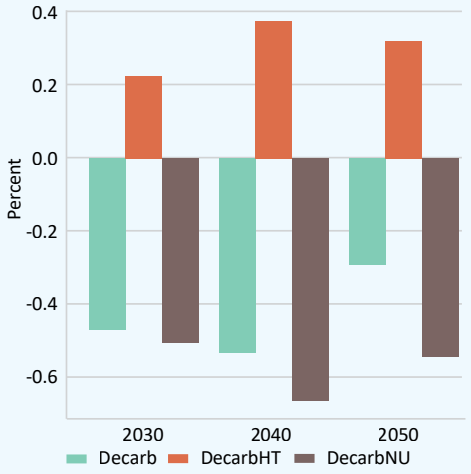
278. The three decarbonization paths considered for the power sector are 1) Decarbonization (decarb) with 50 percent power sector emission limits by 2030, compared to 2015 levels, 90 percent by 2040, and net zero by 2050; 2) decarbonization HT (decarbHT) with the same emissions reduction path but with additional electricity demand for electrifying heating and transport (HT); and 3) decarbonization Nuclear (decarbNu) with 50 percent power sector emission limits by 2030, compared to 2015 levels, 90 percent by 2040, and net zero by 2050 but with available installation of nuclear units from 2033 - one 1.1GW unit available every two years from 2033 onwards with total available nuclear capacity of 9.9GW by 2050. For the higher electricity demand scenario, adjustment costs, in particular, accrue to the next decade, while high investments in nuclear energy predominantly take place in the period 2030–40 (Figure 6.2).

279. How additional investment costs are financed matters for the overall macroeconomic impact. If the additional energy transition-related investments are publicly financed through domestic debt accumulation, there is a slight decline in real GDP per capita with respect to the BAU (Figure 6.3). The increase in debt is not large enough to change debt servicing costs, but these energy investments have a crowding-out effect on non-energy investment that reduces the overall capital availability in the economy. The decline in adjustment costs[106] drives the decrease in negative GDP effects in the Decarb scenario after 2040 (Figure 6.3). In contrast to a de-carbonized economy that relies mainly on wind and solar, including nuclear energy into the mix requires higher investments, particularly after 2030. This leads to higher adjustment costs, crowding out of investment, and consequently

[105] *Based on the least cost optimization of the EPM.*

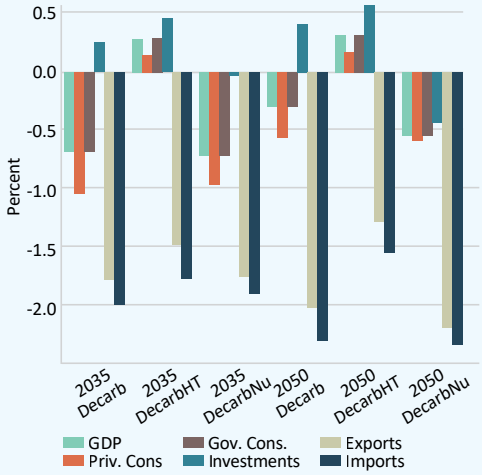
[106] *The adjustment costs are the additional investments required to reach lower levels of GHG emissions for a given level of energy supply. Adjustment costs represent the opportunity cost of investing in electricity-related emission reductions and generates a crowding-out effect on the investment into other sectors.*

Figure 6.3: Real GDP per capita effects
Percent changes with respect to BAU levels



Source: World Bank.

Figure 6.4: Macroeconomic effects
Percent change with respect to BAU



Source: World Bank.

a more negative impact on GDP compared to the non-nuclear scenarios (Figure 6.4). Additional investment requirements by the energy sector (that is, positive investment effects) crowd out investment in other sectors, with capital becoming relatively scarcer, which means more investments are required. To finance these investment increases, private and public expenditures are reduced, leading to an overall negative GDP effect. The loss in sectoral output in turn leads to lower government and private consumption, as well as a reduction in exports mainly manufacturing exports.

280. The sectoral gross output by broad economic sectors is expected to be lower in the case of manufacturing and services and higher in the case of agriculture. Services output is anticipated to decline, notwithstanding the increased demand for services inputs as a result of the energy transition. Given fewer capital requirements in the services sector, the decline is not as high as for manufacturing sectors. The decline in manufacturing output is a direct result of decreasing investment in non-energy sectors. Furthermore, closing coal power plants means that domestic coal production sharply declines by around 20 percent until 2050, which is additionally captured by the decrease in manufacturing output. In this case agricultural output increases by around 0.4 percent to 1.1 percent, but this has a marginal effect on the total economy because of agriculture's low share in total economic activity.

Labor effects

281. With services declining relatively less than manufacturing sectors, the share of services sectors as an employer increases in each labor category. The shift ranges from between 0 percentage points for skilled, male, urban workers to 14.4 percentage points for unskilled, female, urban workers. The stronger shifts for female workers correspond to the higher wage-leisure elasticity, reflecting increasing female participation in the labor force. Furthermore, the overall decrease in manufacturing output is also reflected by shifts in the sectoral composition of employment—that is, across each labor category we expect a drop in the share of manufacturing employment. These drops are particularly pronounced for unskilled labor for which manufacturing shares can be 14.1 percentage-points (unskilled, female, urban) lower in 2050 compared to 2020.

282. Patterns in real wage changes follow the changes in labor demand, and overall, the GDP per capita changes presented above. Comparing different labor groups, the effects are more pronounced for skilled labor. It is likely that unskilled labor groups are better

able to benefit from an increasing services sector demanding more labor, which is indicated by the more noticeable reshuffling of unskilled labor toward services sectors. The relatively large decline of real wages for skilled, male workers vis-à-vis skilled, female workers is likely caused by their comparably high share in declining manufacturing and energy sectors that take a diminishing role in overall employment.

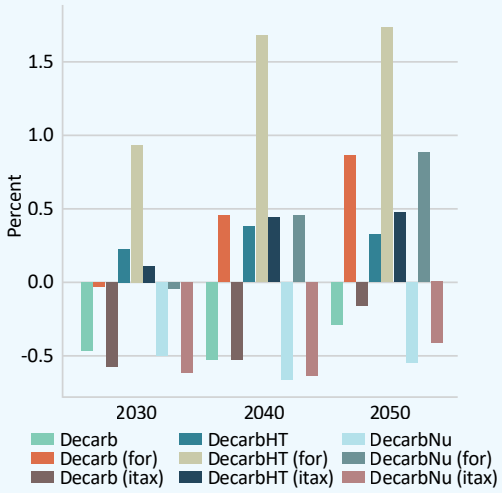
Macroeconomic effects of alternative financing options

283. Alternative financing options have different macroeconomic impacts. In a budget-neutral scenario energy transition investments are fully financed by an increase in direct income tax rates (itax). The second alternative assumes that the additional energy transition investments are fully financed through EU funds (for). In reality, the financing of the energy transition will be a mix of different financing options that will be decided politically over the 2020–50 period, but these scenarios provide some guidance on the macroeconomic effects of using different financing tools.

284. Financing energy investments through EU funding has the most positive real GDP effects of all scenarios. When using this financing option, all decarbonization scenarios have positive GDP effects: DecarbHT has the largest effects, but now the other two scenarios (decarb and DecarbNu) have similar positive effects in 2050. On the other hand, financing through an increase in direct taxes has similarly negative GDP effects as the initial debt-financed scenarios for the Decarb and DecarbNu scenarios, but positive effects for the DecarbHT scenario (Figure 6.5). For all scenarios, investment is increasing relative to GDP, while trade is decreasing for all scenarios. In the case of the EU funding ("for") scenarios, trade reductions are lower, as this scenario is increasing GDP and consumption, and the additional investment requirements require relatively smaller reductions in both domestic and external absorption. In the case of the direct tax financed scenarios ("itax"), we observe that government consumption is, by construction, changing in the same proportion as GDP, and the investment requirements and subsequent GDP reductions are possible only with a reduction in both domestic and external absorption. The sectoral output effects follow the same pattern as in the debt-financed scenarios. The direct tax financing ("itax") has negative real wage effects for all worker types. Conversely, the EU funding scenario provides positive real wage changes for all workers, except unskilled female workers. These patterns are a combination of the overall GDP effects, combined with the labor type intensity of different activities and how these activities are affected in each scenario.

Figure 6.5: Real GDP effects for each scenario.

Percent change with respect to BAU levels



Source: World Bank, MANAGE.

285. In conclusion, the macroeconomic effects of decarbonizing the Polish economy are relatively modest. In the main decarbonization scenario (Decarb) the real GDP level is -0.25 percent lower in 2050 in our main scenario where the additional energy investments required are financed through public debt. This level change in GDP in 2050 translates into a very modest reduction in annual growth of around 0.01 percentage points.

6.3. Transition risks, trade-offs, and macroeconomic implications

The impact of the green transition on aggregate supply

286. The structural changes required to reach the target of net zero by 2050 are large enough to have a macroeconomic impact in the short run, especially if they are brought about rapidly. The EU target of net zero carbon emissions by 2050 entails rapid decarbonization, which is analogous to an adverse supply-side shock. Internalizing environmental externalities is likely to reduce conventionally measured productivity growth, as producers substitute away from emissions-intensive activities. Hence, there is a trade-off between productivity growth and bringing about the green transition. The analogy is not exact for two reasons. First, decarbonization is expected to have positive consequences for supply at the global level in the longer term due to the avoidance of damage from exceeding the limit on global temperature increases.[107] Second, the term "shock" is not appropriate for all agents in the economy, given the long and continuing discussion of the need for a net zero target and the ability to phase in low-carbon technologies. Nevertheless, a sudden intensification of policies to promote green growth, such as an increase in the level and scope of a carbon price, may not have been widely anticipated. As Pisani-Ferry (2021) notes, "decades of procrastination have turned the expected smooth transition into what is likely to be an abrupt one." This gives rise to a transition risk for the Polish economy if the resulting unanticipated adjustments to relative prices (of products and assets) trigger losses of wealth and cashflow difficulties.

287. Poland faces the prospect of a larger supply shock than average because of the relatively high carbon intensity of its economy compared with the European average, as documented in the section on the climate performance of the Polish private sector in Chapter [X]. That chapter notes that the Energy and Manufacturing sectors emit over twice as much greenhouse gases per unit of output as the EU average and account for two-thirds of national emissions. The building sector also has relatively low carbon efficiency. The energy intensity of space heating is still one of the highest among European countries. The Report of the High-Level Commission on Carbon Prices (2017)—also known as the Stern-Stiglitz Commission—estimated that a 2degC-compliant price per ton of CO2 equivalent in 2020 would be between $40 and $80. If a carbon price in the middle of this range was suddenly imposed across the whole Polish economy, the impact relative to GDP would be similar in scale to around half the global impact of the 1974 oil price shock (3.6 percent of world GDP, according to Pisani-Ferry 2021).

288. In the near term, the risks to Poland are exacerbated by the difficulties policy makers have in assessing how the European economy will respond to the waning of the COVID-19 pandemic. The pandemic imposed an unusual macroeconomic shock, with the adverse effects on labor supply dominating in some sectors, lowering spending by quarantined households, inducing increases of demand in others (for example, pharmaceuticals and other medical supplies), and disrupting international supply chains (Guerrieri and others 2020). The risks to inflation are higher if central banks underestimate the pent-up demand in the wake of the pandemic or the long-term disruption of the international division of labor.

289. A large adverse supply shock poses a risk to financial systems, as relative asset prices change unexpectedly and some firms find themselves with stranded real assets embodying carbon-intensive technologies. Such a shock can also make controlling inflation and maintaining employment more difficult in the short run as central banks have to assess how to stop necessary relative price increases

[107] *These avoided damages include the adverse impacts of extreme weather events, including the loss of infrastructure capital and the consequences of higher temperatures for labour productivity. The growing literature on measuring the economic consequences of climate change are discussed in Auffhammer (2018) and the IPCC Sixth Assessment.*

in some sectors of the economy, leading to expectations of a persistent rise in general inflation expectations.

290. Efforts have increased over recent years to improve financial disclosures about climate impact risks and transition risks (see, IFRS Foundation and CDP). The Network of Central Banks and Supervisors for Greening the Financial System (NGFS) was established in 2017 in order "to help strengthening the global response required to meet the goals of the Paris agreement and to enhance the role of the financial system to manage risks and to mobilize capital for green and low-carbon investments in the broader context of environmentally sustainable development." The NGFS is developing guidance for central banks and scenarios for stress-testing financial systems to assess their resilience to climate risks and the risks of both orderly and disorderly transitions to net zero carbon emissions (NGFS 2021a and NGFS 2021b). According to the NGFS website (accessed 13/05/22), the central bank of Poland, Narodowy Bank Polski, is not a member, despite the potential transition risks that Polish firms and financial intermediaries face.

Factors mitigating the adverse supply shock

291. A range of factors is likely to mitigate the impact of making firms and households internalize the economic cost of greenhouse gas emissions, resulting in the apparent trade-off between productivity growth and greening the economy being less steep (Pisani-Ferry 2021):

1. An immediate global imposition of a common carbon price is very unlikely.
2. The prospect of carbon pricing is not new; firms and consumers have had time to adjust to the idea, if not to the carbon price levels likely to be necessary to achieve compliance with the UNFCCC Paris Agreement.
3. The global economy might be more flexible than in past episodes of widespread "stagflation" (but the COVID pandemic and the war in Ukraine have illustrated the vulnerability of global supply chains).
4. The transition to net zero is expected to be achieved over the next three decades, so structural changes will be spread over time.
5. Carbon pricing need not redistribute income from consumers and firms with high spending propensities to consumers and firms with low spending propensities (unlike the oil price shocks of the 1970s and 1980s).
6. The costs of decarbonization could fall dramatically once economies of scale and endogenous technical change in key, currently high-carbon sectors are considered (wind and solar power, but not nuclear power, have become much cheaper than anticipated by the International Energy Agency).
7. The expansion of demand due to green investment programs may increase aggregate demand if there is spare capacity in the economy, giving rise to a Keynesian growth boost. However, this benefit is likely to be small in the immediate future, given the post-COVID and Ukraine war-related bottlenecks in supply chains and the relatively low level of unemployment in Poland.

292. Perhaps the most important mitigating factor is that action on climate change and many other environmental problems requires policy makers to address market failures brought about by harmful externalities and other economic phenomena (such as lack of information, monopoly power, and "short-termism" among investors). If the capacity of policy makers to do so improves across all domains, this will improve economic efficiency. Such an aspiration is one of the main reasons for the optimism of projects such as the Global Commission on the Economy and Climate (2014, 2018). Several possible "co-benefits" of action against climate change have been suggested, such as improved health from the reduction in particulate air pollution accompanying declines in fossil fuel use and reduced expenditure on energy as a result of higher building standards. However, the case for public intervention to correct market failures depends on good policy design; proper project appraisal ex-ante and ex-post; the credibility of public authorities, particularly with respect to the consistent pursuit of stated long-term goals; and control of public spending. That is why an assessment of the institutional factors determining policy effectiveness discussed in Chapter 5 is so important.

293. Another mitigating factor is the opportunity to develop comparative advantages in new, low-carbon sectors and to increase R&D investments in sectors where the returns are higher and positive spillovers are likely to be larger. This issue is discussed more fully in Chapter 4, which also notes that developing competitiveness in green technologies and low-carbon manufacturing can reduce transition risks. It identifies several opportunities for Poland to exploit its current comparative advantages in elements of the value chains—for example, in wind power, solar power, and electric vehicles. The chapter also makes it clear that countries' comparative advantages relative to other nations can deteriorate; this is especially the case if they are not supported by adequate R&D. Clean technologies have more general applications, and they are radically new compared with more incremental dirty innovation. Knowledge spillovers from clean technologies are comparable in scale to those observed in the IT sector.

Making the transition to net zero more efficient: Pricing environmental externalities

294. Economic theory suggests that global uniform carbon pricing is the key economic tool for bringing about efficient abatement of greenhouse gases.[108] A uniform global carbon price would act as a pervasive encouragement for businesses to adjust their investment, their mix of inputs, and their innovation away from greenhouse-gas-intensive technologies, and for consumers to reduce their spending on high-carbon products. This would also align with the principle that the polluter should pay.

295. Carbon pricing is becoming more pervasive across countries, as shown by the World Bank's carbon pricing dashboard.[109] In 2021, some 21.5 percent of global GHG emissions were covered by some sort of carbon pricing, compared with less than 6 percent 10 years earlier. But prices vary considerably. Few schemes bring about a carbon price in the range recommended by the Stern-Stiglitz Commission.

296. Poland is subject to the carbon price established by the European Union's Emissions Trading System, which covers heavy industry and electricity production but not road transport or the heating of buildings. About 48 percent of Poland's emissions are within its scope. This price has been volatile and for a long time below the levels recommended by the Stern-Stiglitz Commission. However, more recently it has risen sharply and was above EUR80 per ton CO2 in early May 2022. Other taxes on energy use are also low. As in other OECD countries, tax rates on energy use are relatively higher in the road sector, but they are low or absent in the residential sector and the electricity excise tax rate is low. Major exemptions from energy taxes are in place, such as exemptions from tax for the use of coal in the agriculture sector and for households' consumption and exemptions from coal and gas excise duty offered to some energy intensive industries (OECD 2020).[110]

297. Poland has also had a carbon tax since 1990, in principle applying to all sectors except those covered by the EU ETS, but with a number of exemptions. It covers only 4 percent of Poland's GHG emissions and is levied at a very low rate ($0.08 per ton CO2 equivalent, according to the World Bank carbon pricing dashboard). Proposals from the European Commission may lead to more extensive and

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[108] *The Stern-Stiglitz Commission referred to in paragraph 5 discusses the issues in detail. Bowen (2011) and Baranzini and others (2017) succinctly put forward several arguments for carbon pricing. There are arguments for departing from uniform pricing on grounds of local public acceptability, lack of compensating transfers across borders, and the desirability of using a carbon price for revenue raising, output-related incentives for R&D and encouragement of key sectors (see, for example, Vogt Schilb, Meunier, and Hallegatte 2013).*

[109] *https://carbonpricingdashboard.worldbank.org/.*

[110] *The scope for greater environmental taxation in Poland extends beyond carbon pricing to areas such as congestion charging and charging for extraction of water for industrial purposes (especially given that fresh water supplies are not high relative to population).*

higher carbon prices. This would be desirable. The Polish authorities could unilaterally increase the rate and coverage of their own carbon tax in the meantime.

Making the transition to net zero more efficient: promoting green investment and technical progress

298. Chapter 1 argues that Poland's growth would be enhanced if investment rates rise. The chapter's moderate scenario assumes that reforms could raise private investment in Poland from 16 to 20 percent of GDP, which is about the median of the EU–27. Its "ambitious" scenario assumes that, in addition to moderate private-sector reforms, public investment could increase from 4 to 5 percent of GDP, rising to the 90th percentile of the EU–27 distribution.[111] This illustrates that there is a trade-off between consumption and investment in the short run, although not solely due to the need to green the economy.

299. Investment rates will also need to rise to build a physical capital stock embodying new low-GHG technologies and replacing stranded high-carbon physical assets. Investment will also be needed to help the economy adapt to climate change (for example, flood defenses). As Chapter 2 points out, investment in renewable energy will be particularly important. Although the energy sector is very carbon-intensive, route maps for its decarbonization have been able to draw on known technologies, which has not been the case for some other sectors such as agriculture. Decarbonization of electricity production combined with electrification of energy-using sectors such as transport would achieve relatively early reductions in emissions. The government estimates that modernizing the energy sector and achieving the 2030 targets embodied in the National Energy and Climate Plan will require EUR 195 billion from 2021 to 2030 (around 3.5 percent of annual GDP). However, Chapter 2 also reveals a relative lack of ambition on the part of the government of Poland up to 2040, with the Polish Energy Policy 2040 aiming for 32 percent of power generation to come from renewables by then, compared with 48 percent in Chapter 2's scenario. That scenario, with electrification of heating and transport, suggests that a cumulative capital investment of $129 billion will be needed by 2050. Decarbonization of the manufacturing sector will require new equipment. The building stock needs renewal given its age and poor energy efficiency. Public transport systems need to be extended and improved. Electric vehicle charging networks will need to be expanded rapidly. Higher investment will also be necessary if Poland is to exploit the emerging comparative advantages in low-carbon production identified in this chapter.

300. Private investment associated with the transition to net zero emissions merits fiscal measures in its support. The rationale for fiscal incentives for private green investment is two-fold. First, private sector investment is the larger part of investment in Poland, as it is elsewhere, and affects the environment for good or ill. Fiscal policies can help make that private investment greener. Macroeconomic demand management usually places emphasis on stimulating private investment, which tends to be more volatile and responsive to changes in the economic outlook than is consumption. Fiscal incentives can help ensure that the private sector "builds back better" after recessions. Second, governments may prefer economic activity to take place in the private sector in the belief that the private sector is likely to have stronger entrepreneurial and management skills than the public sector and is subject to more pressure for cost control and efficiency (if private markets are competitive and stakeholders monitor managers effectively).

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111. *Carbon pricing revenues should cover incremental investment. Bowen, Campiglio, and Tavoni (2015) found that, world region by world region, incremental energy-supply investment (and saving) needs are well within the range of past variation of aggregate investment. They argue that the challenge is rather to ensure that revenues from carbon pricing and other sources are complemented by investment in the appropriate sectors.*

301. The key fiscal measures that are necessary are environmental taxes, especially carbon prices, and subsidies. Public authorities must carefully consider the design of public policies, including fiscal measures, to try to correct the many market failures that exacerbate environmental problems in the first place. Taxes and subsidies can be used to help ensure that private companies and individuals internalize social costs and benefits associated with their activities that are not already reflected in market prices.

302. It is easy to point to examples of economic behavior harmful to the environment that warrants taxing because of market failures—GHG emissions are the obvious case in point. It is perhaps less easy to identify positive externalities that warrant subsidies, which is not surprising when the evidence suggests that adverse environmental externalities have been more prevalent over recent decades. But various market failures inhibit green innovation that has positive externalities. First, there can be spillovers from the creation of new knowledge because its use by its creator does not prevent its use by others (the use of knowledge is "non-rival"). As a result, the benefits to society from R&D investment are often much greater than the benefits captured by the firms undertaking the investment. Popp (2006) estimated that the social returns are of the order of four times the private returns and are comparable in environmental and energy R&D to those in other fields. Second, there are externalities from the adoption and use of new technologies, due to network effects, learning-by-using, and learning-by-doing (Jaffe, Newell, and Stavins 2003; Edenhofer, Bauer, and Kriegler 2005). These can lead to path dependence of the choice of technologies and the "lock-in" of high-carbon plant and equipment (Unruh 2000; Acemoglu and others 2012). Temporary subsidies to output of green sectors are thus theoretically justified to push economies from a dirty equilibrium growth path on to a greener one. But the detailed design of subsidy schemes matters (see, for example, the critique by Johansson and Kriström (2019) of the Swedish "green certificates" energy scheme). Third, the generation of knowledge is affected by uncertainties and asymmetric information (Böhringer, Mennel, and Rutherford 2009), which can hold back the private sector from green innovation. Fourth, market failures in the rest of the economy can have implications for climate change mitigation and renewable energy support.

303. Hence, there is a strong argument not only for carbon prices to influence private firms' behavior but also for fiscal subsidies to investment in green R&D (and to the output of green sectors to the extent that technical progress is a function of cumulative output and/or (green) capital investment) (Fischer and Newell 2007, and Kalkuhl and others 2013). This is particularly important in Poland given that Poland persistently scores low in the European Eco-Innovation Scoreboard and is particularly weak in resource efficiency outcomes and eco-innovation inputs (Chapter 4). Where fiscal support is available, Polish patenting activity has been encouraged. Chapter 4 points out that, in 2014–20, four in five green patents granted to Polish applicants by the Polish Patent Office and patent offices in other countries were awarded to beneficiaries of firm-level support instruments co-financed from the relevant EU funds.

304. Broader investment subsidies for green sectors are less desirable. Deadweight losses reflecting incentives granted to firms that would have invested anyway are common; surveys suggest that most firms would invest even without incentives (IMF-OECD-UN-World Bank, 2015). Profit-based incentives are more likely to incur deadweight fiscal losses than cost-based incentives; the latter reduce the costs of investment (rather than benefiting firms that are already profitable) and hence may make marginal investment profitable, increasing the chances of creating additional investment. Reviews of investment incentives in general have tended to be skeptical about their efficacy (Zee, Stotsky, and Ley 2002, and Klemm 2009).

305. Fiscal authorities need to help establish a supportive framework in which private firms

can be confident of the public commitment to more sustainable growth. This requires, inter alia, a supportive macroeconomic environment that reduces macro policy uncertainty and maintains private-sector expectations of aggregate demand growth; green procurement practices in the public sector; the development of appropriate property rights in key areas as disparate as intellectual property and land use and the imposition of charges for using up natural capital; credible fiscal measures to cushion any adverse distributional effects of environmental policies; and the promotion of green finance to channel savings to private green investment.

306. Higher levels of public green investment are also desirable. Credible plans for public green investment are an important token of the public sector's commitment to professed environmental goals. Also, the private sector will tend to under-supply and over-use natural capital because much of it has the characteristics of public goods.

307. However, green public investment requires careful cost-benefit analysis, while acknowledging that environmental objectives are difficult to reduce to a single financial metric. Governments need to improve their capacity to undertake environmental cost-benefit analysis, be transparent about how investments relate to overall green objectives, and recognize the need for the involvement of civil society in weighing issues not amenable to economic judgments alone. Such analysis needs to be an integral part of annual budgetary procedures and longer-term planning exercises. But ex-post appraisal of green public investments—preferably by an agency independent of the investment's sponsor—is also needed so that project appraisal methods can be improved over time. The ex-post returns to green public investment need to be measured across a range of criteria, especially including environmental criteria, to evaluate its effectiveness. Simply estimating gross "green job" creation is not good enough. Chapter 5 strongly suggests that the Polish authorities need to improve their management of public investment.

308. Managing the transition to net zero emissions entails a form of industrial policy (Rodrik 2014; Altenburg and Assmann (Eds.) 2017). Chapter 5 shows that Poland's institutional frameworks for green growth need to be made more robust, both with respect to developing a coherent green growth strategy encompassing the whole economy and encouraging best practice in ex-post and ex-ante project appraisal.

Making the transition to net zero more efficient: creating green jobs and raising labor productivity

309. The transition to green growth is likely to render some skills redundant as well as stranding some capital assets. At the same time, it will create a demand in the labor market for new skills associated with new green technologies and some existing skills that will be in higher demand in a low-emission, less materials-intensive economy. New jobs are likely to be created as low-GHG technologies are introduced in currently high-GHG sectors such as energy, manufacturing, and construction. But green growth is also likely to entail an increase in employment in service sectors, most of which are already relatively minor producers of GHGs. Over the period 2005–15, emissions per worker in a sample of advanced economies fell by around 27 percent; almost a quarter of this fall was the result of workers moving from higher to lower emissions-intensive sectors (IMF 2022b). The labor market ramifications of green growth, therefore, extend beyond jobs in the environmental services sector, which are sometimes the jobs defined as "green" in the literature. They also extend beyond the sectors where widespread technological change is required to achieve decarbonization. As Bowen (2012) argues, the term "green jobs" can refer to employment in a narrowly defined set of industries providing environmental services. But it is more useful for the policy maker to focus on the broader issue of the employment consequences of policies to correct environmental externalities, such as anthropogenic climate change. Counting "green jobs" created by green growth policies is not a very good metric for the benefits of

those policies, because they may displace other jobs, particularly in an economy with a low unemployment rate.

310. The more highly skilled and educated is a workforce, the easier the necessary job transitions will be (IMF 2022b). In this respect, as Chapter 3 shows, Poland is relatively well positioned, with recent labor force entrants having relatively high educational attainments by international standards and above the EU average. However, this is not true of the over-50s. There is also the problem of relatively low levels of training and education of adults, which will be more necessary in sectors undergoing changes in technologies and processes in order to decarbonize. That is especially so in comparison with countries such as the Netherlands and Sweden, which have more active labor market and skills policies. The geographical concentration of jobs in some currently high-carbon sectors poses challenges, too. Poland has some useful experience of managing this problem in the context of the winding-down of the lignite coal industry.

311. The problem of labor reallocation needs to be put in perspective, given the amount of churning that takes place in advanced economies' labor markets all the time. In a sample of advanced economies, 8 percent of workers switch jobs each year while employed. Fifty-two percent of those who were out of work the previous year find new jobs in the current year. Around 6 percent of workers move from employment each year. Yet the IMF estimates that, in the typical advanced economy, only about 1 percent of employment would need to shift to greener activities (performing tasks that improve environmental sustainability) over a 10-year period, a target that is well within the capacity of flexible and dynamic labor markets to deliver. The transition to net zero will only require about 2 percent of the global workforce to change the sector in which they work over the next 30 years.

312. Skilled green jobs in Poland appear to receive a wage premium in the private sector (Chapter 3). Valero and others (2021) note that there is evidence from the United States and the United Kingdom that "green" jobs can pay higher wages than the national average. Their analysis of European Labor Force data for the EU–15 (that is, excluding Poland) suggests that green job workers tend to be older, fewer are female, more are higher skilled, and (for employees) more are likely to be on permanent contracts. New and emerging jobs tend to drive these results. Greener jobs command higher wages—and, controlling for individual-level education and experience, this effect is more pronounced for lower-skilled occupational groups (this last finding is contrary to the results reported in this Memorandum for Poland, but in other respects the results are broadly similar). Directly green jobs—in particular, those that are new and emerging in the transition—are at less risk of automation.

313. Environmental policies are likely not only to induce a reallocation of labor but may also improve labor productivity directly. In the Polish context, tackling air particulate pollution is likely to increase productivity. The OECD has noted that fine particulate air pollution is the highest in Europe; 36 of the 50 most polluted cities in Europe are in Poland (OECD 2015 and OECD 2020). The estimated mortality from exposure to ambient PM2.5 particles is around 70 percent higher than the OECD average. However, the pace of decarbonization of district heating systems and of other home retrofitting improvements has been sluggish, despite a clean air program and a "Stop Smog" campaign. Dechezleprêtre, Rivers, and Stadler (2020) find that, across the EU, a 1μg/m3 increase in PM2.5 concentration (or a 10 percent increase at the sample mean) causes a 0.8 percent reduction in real GDP that same year. Ninety-five percent of this impact is due to reductions in output per worker, which can occur through greater absenteeism at work or reduced labor productivity. The authors note that the large economic benefits from pollution reduction uncovered in the study compare with relatively small abatement costs. Hence, more stringent air quality regulations could be warranted based solely on economic grounds, even ignoring the

large benefits in terms of avoided mortality. The results imply that if the 37µg/m3 level of pollution in urban areas of Poland could be reduced to the EU average of 25 µg/m3, GDP in Poland's urban areas would increase by nearly 10 percent.

314. Carbon pricing and other regulatory measures may discourage labor market participation by reducing real incomes, particularly among low-income families, who typically spend a larger portion of their incomes on fuel. For this reason, more extensive environmental taxation needs to be accompanied by increased financial support for those at the bottom of the income distribution.

Making the transition to net zero more inclusive: addressing distributional implications and advancing household behavioral change

315. Under the three reform scenarios, household incomes will see income shifts through the labor market, capital incomes and fiscal policy channels. The magnitude of income shifts is expected to reflect exposure to the sectors experiencing demand and wage shifts as well as the composition of the household's broader income portfolio. Combining the parameters and outputs from the MANAGE model with the Polish Household Budget Survey of 2019 allows for an analysis of the medium-term household income impacts[112]. While labor incomes are expected to register small declines of between 0.5-1 percent on average across the three scenarios compared to the business-as-usual scenario, the overall impact on total disposable income is expected to be moderated among those receiving incomes from transfers and earning income from capital, which is expected to grow under each scenario.

316. Targeted support to those whose income sources are disproportionately affected can be used to cushion the impact on poorer households and to support those who see labor market transitions. Poorer households are expected to see muted impacts of the reforms, since labor incomes account for only 10 percent of the incomes of the bottom 20 percent of the income distribution (Figure 6.6)[113]. However, a small rise in income poverty of 0.1-0.5 percentage points over the business-as-usual equilibrium poverty rate of 19 percent is expected under each decarbonization scenario (Figure 6.7). Means-tested benefits - including those that reach poorer working households - could be used to alleviate the impact for this segment, alongside active labor market programs that can support the labor market transition of workers in sectors experiencing sectoral shifts in employment. The direction of the impact on inequality is expected to vary by reform and financing scenario. For example, under tax financing household incomes in the bottom two deciles are expected to see a more limited income impact, while a higher tax burden on better off groups leads to a drop in the Gini coefficient. As such, the tax financed approach to decarbonization has the lowest poverty impact alongside a reducing effect on income inequality.

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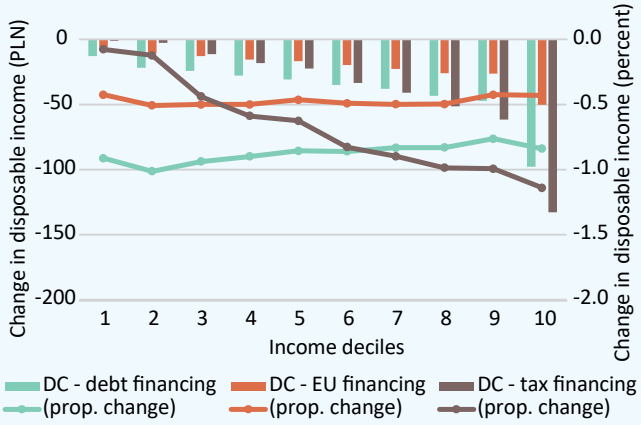
112. *The distributional analysis combines parameters and outputs from the MANAGE model into household data to simulate the macro-economic dynamics of the economy in a horizon up to the year 2030. The information from the simulated equilibrium includes employment and wages in 424 worker type categories disaggregated by gender, residence, skills, and 53 employment sectors, as well as transfers disaggregated by income deciles, and total population aggregates for agriculture and capital incomes. The CGE generated equilibrium value of welfare payments is calibrated to the new structure of incomes from work and capital using a combination of microsimulation and uprating. First, using household level information form the PHBS and SIMPL microsimulation model (Myck and Najsztub, 2015), we simulate household level means-tested benefits conditional on the new structure of incomes from work, capital, pensions and universal welfare benefits. All welfare benefits are then combined and uniformly uprated to align with aggregated welfare payments as generated in the CGE 2030 equilibrium. The implications of each policy are presented in reference to the simulated 2030 baseline.*

113. *It should be noted that results capture impacts through the income channel and thus do not capture potential welfare losses on consumption as a result of higher prices.*

Figure 6.6: Proportion of household disposable income from labor, pensions and social assistance

Figure 6.7: Household income shifts in decarbonization scenario, by financing source



Source: calculations based on a combination of the WB CGE model and microsimulations based on the 2019 PHBS data and the SIMPL microsimulation model.

317. Alongside compensating reforms, behavioral and technology shifts will be needed as households adapt to higher prices. Households account for approximately 18 percent of direct CO2 emissions in Poland,[114] which place their contribution to emissions above the EU average of 17 percent. Direct emissions from households are predominantly accounted for by heating and cooling needs (GUS 2020). As carbon prices rise, household behavioral responses that shift away from carbon-intensive products and technologies will be needed to support societal carbon ambitions. A wide body of literature has shown the significant impact of household-level behavioral and attitudinal shifts in reducing energy consumption (Dietz, T. G.T. Gardner, J.M. Gilligan, J.M., P.C. Stern, and M.P. Vandenbergh, 2010), with estimates suggesting that behavioral change alone can reduce the carbon footprint by 6 to 16 percent (Van De Ven, D.-J. M. Gonzalez-Eguino, and I. Arto, 2017).

318. The distribution of energy consumption and household carbon footprints is highly unequal in Poland, mirroring assessments across other European countries. Differences in carbon footprints in Poland reflect the socioeconomic situation of the household as well as household choices. Carbon footprints in Poland are estimated to be 67 percent higher in the richest 20 percent of households than in the bottom 20 percent (Figure 6.8), reflecting higher incomes translating into expanded consumption in absolute terms. While the carbon intensity of household consumption—measured as carbon dioxide emissions divided by total expenditures—is higher among poorer households (reflecting a higher share of carbon-intensive housing and transportation-related costs in the baskets of poorer households), absolute emissions are higher among better-off households since the decline in carbon intensity of bundles is not sufficient to offset the impact of rising consumption on emissions.

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[114] *2018 Environment Accounts.*

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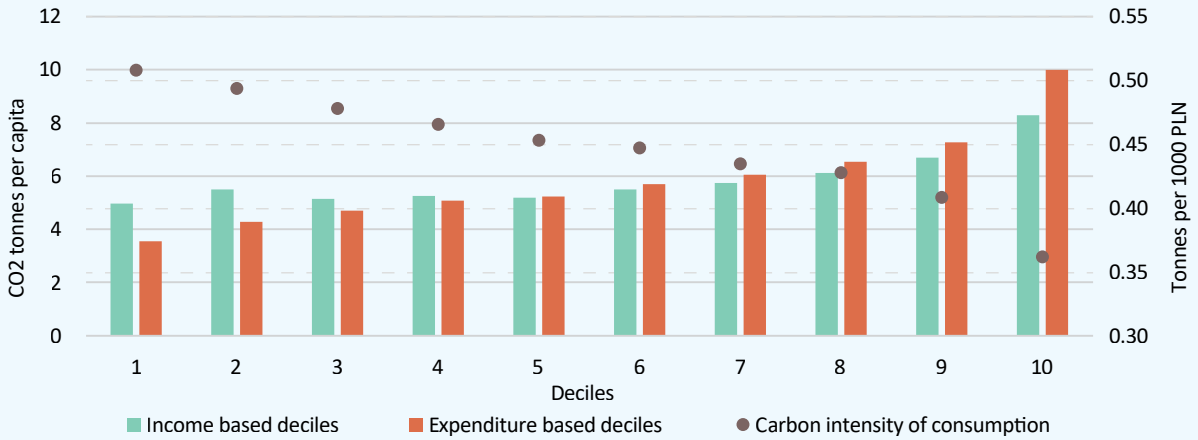
320. Rising incomes do not, however, automatically translate into larger carbon footprints but instead reflect lifestyle as well as broader consumption choices made by households. Figure 6.8 contrasts the tonnes of carbon dioxide emitted per person by income and consumption decile. While there's a clear relationship between income and the value of expenditures, there are clear lifestyle choices and taste factors that contribute to the variation between households—choice factors that can be influenced by behavioral shifts and technology choices. For example, a clear and positive relationship between floor area per capita and emissions, after considering the overall consumption bundle, can be seen (Figure 6.9).

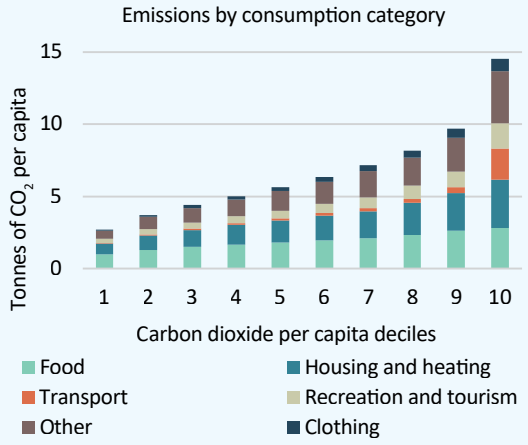
321. Individuals living more carbon-intensive lifestyles in Poland consume 5.4 times more tons of carbon dioxide than those living less carbon-intensive lifestyles. The shares of carbon emissions shift from necessity-related needs toward more recreation and leisure-related emissions. The top 20 percent of carbon dioxide-emitting households in Poland emit 36 percent of total emissions, while the bottom 20 percent of emitters contribute 10 percent of total household emissions. The highest emitters have larger shares of travel-related GHG emissions, both for land and air travel for recreation purposes. Transport and recreation related emissions rise from 13 percent of the emissions of low-emitting households to 27 percent among higher-emitting households, who in absolute terms emit 10 times more carbon dioxide in this category than low emitters. Indeed, air travel is estimated to have the highest consumption elasticity in the EU, with an average expenditure elasticity of 1.5 that rises across the income distribution, from near zero among poorer households to 2-2.7 among the highest spenders (Ivanova and Wood 2020). Travel by land, and in particular public transport, is, however, also an important spending category for poorer households and also among lower emitters. The necessities of food and housing account for 63 percent of all emissions among lower emitters while they account for 42 percent of emissions among higher emitters.

Figure 6.8: Carbon dioxide emissions are greater per person in households with higher incomes and expenditures



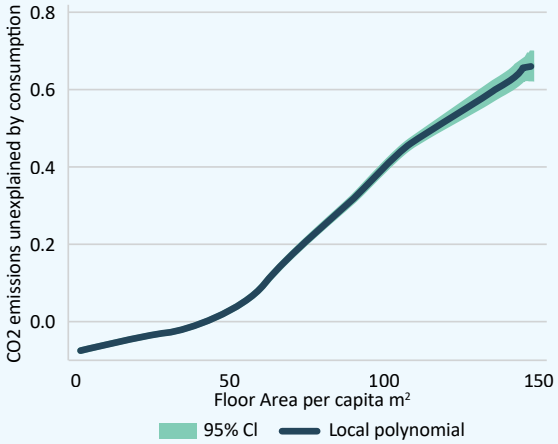
Source: World Bank staff estimated of household C02 emissions using 2018 Household Budget Survey

Figure 6.9: The biggest carbon emitters have a carbon footprint that is more than twice the median



Source: World Bank analysis using 2018 HBS. Note: Deciles are determined based on the percentile of carbon emissions per capita in the households.

Figure 6.10: Lifestyle choices, and in particular housing and transportation choices, are important components of a household choice set in determining carbon dioxide emissions



Source: World Bank analysis using 2018 HBS. Note: Residuals of a regression of CO2 emissions against the value of consumption are greater than 0 for those households that have more carbon intensive lifestyles for a given absolute consumption envelopes.

322. Carbon footprints strongly reflect the technologies that households use for housing, heating, and transportation. This suggests a strong role for policies that promote behavioral and technological change to reduce carbon emissions alongside the energy sector and society-level transitions that need to occur. Differences in carbon footprints reflect socioeconomic effects, such as income, education, household size, social status, and urbanization; geographic effects, such as temperature and location that affects needs; and technical effects, which include the technology employed. In Poland, we see that the role of socioeconomic effects is largely, but not fully captured, by technology and lifestyle choices, which includes whether the household lives in a single or multifamily building, the type of heating modality used, and whether public transport is used. Supporting technology transitions to advance energy efficiency, including through thermal modernization of the residential housing stock, has the potential to reduce household direct emissions while also increasing thermal comfort. It is also clear, however, that significant variations in carbon footprints remain even after taking into account household assets, which suggests a role for household behaviors that can significantly influence energy consumption.

Fiscal implications

323. The transition to green growth is likely to increase tax revenues as environmental taxation, particularly of fossil fuels, is raised. However, it is also likely to increase upward pressure on government spending.

324. On the revenue side, environmentally related tax revenue in Poland, as a proportion of GDP, is higher than the OECD average (2.48 percent compared with 1.52 percent in 2019, according to the OECD's database) and has increased since 2000, unlike in the OECD as a whole. Despite the emphasis in the economics literature on the merits of environmental taxes to correct harmful environmental externalities, this has not been widely reflected in government policies around the world in practice. Economic models of the global transition to net zero emissions suggest that, with the appropriate carbon prices (rising over time), receipts from carbon pricing are likely to rise to several percentage points of GDP (for example, Bowen, Campiglio, and Martinez 2017). As argued above, Poland should extend the scope and level of its carbon tax (and consider more environmental charges generally).

325. On the spending side, tax receipts could be used for spending on complementary green policies, particularly support for green R&D and green public investment, which this Memorandum has argued should rise. Poland's carbon pricing system is based mainly on the EU ETS. The government has announced a plan to set up an Energy Transformation Fund that would use 40 percent of ETS revenues through 2030 to modernize the energy sector. Tax revenues could also be used to cushion any adverse impacts of the taxes on consumers, particularly low-income families, through some combination of more generous general social security benefits and payments targeted to particularly affected families—for instance, those living in poorly insulated homes. Receipts could also be used to support firms, particularly those facing international competition from countries with low or no carbon taxation, although there is a danger of muting the price signal to high-carbon firms to change their technologies. There is a pragmatic argument for some form of per capita carbon dividend to generate political support for green policies (as advocated by, for example, the Citizens' Climate Lobby in the United States). But revenues could also be used to help improve the tax-benefit system as a whole by allowing lower rates of the most distortionary taxes to finance additional spending on other government objectives or to reduce outstanding public debt. Poland would benefit from a fiscal strategy that explicitly weighs these different possibilities. As Pisani-Ferry (2021) argues, it seems likely that the net zero transition will put upward pressure on public finances over time, leading to higher public debt. As current climate policy will benefit the future generations who will have to finance this additional debt, this is not unreasonable.

326. Following a single, simple rule for distributing carbon pricing revenues—one that does not vary over time or according to circumstance—is unlikely be the optimal approach. In particular, strict earmarking, or hypothecation, of carbon pricing revenues is unlikely to be a good idea in the long run, given their uncertainty and time-varying spending needs. For example, there is no reason why finance for low-carbon R&D should be of the same order of magnitude as carbon pricing revenues or follow a similar trajectory over time (Bowen 2011 a, b). The Polish authorities should assess and re-assess regularly what best to do with new revenues.

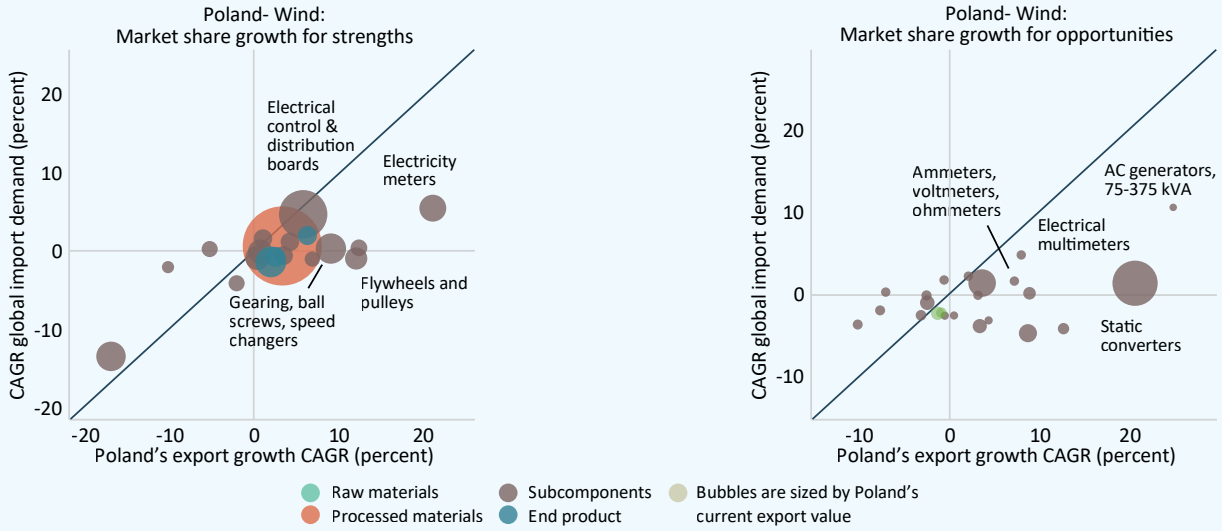
327. In the near term, there is a danger that intensifying green policies to accelerate the transition to net zero will exacerbate the risk of "stagflation." Fiscal policy should take account of this, slowing the growth of consumption to make room for the increased investment spending that the transition requires. The distributional implications depend on what tools the fiscal authorities choose to use. There are arguments on the grounds of equity to lessen the impact of the necessary tax changes on the old and the poor.

Competitive strengths and opportunities in Poland[115]

328. Poland's current productive capabilities and export competitiveness place it in a strong position to capitalize on the transition to the green economy. Poland has a diversified export portfolio, with strong manufacturing capabilities and competitive strengths in a range of products and technologies that will be in high demand as the world transitions to a green economy. Poland's ranking of 12th on the Green Complexity Index has been relatively consistent over the last few decades, and its Green Complexity Potential ranking of seventh suggests that Poland has significant potential to build on its existing capabilities and unlock further green, complex export opportunities.

[115] *This section presents the conclusions from the background paper "Navigating the green transition: Competitive strengths and opportunities in Poland" prepared by Samuel Fargher [Climate Change Specialist] and Penelope Mealy [Economist].*

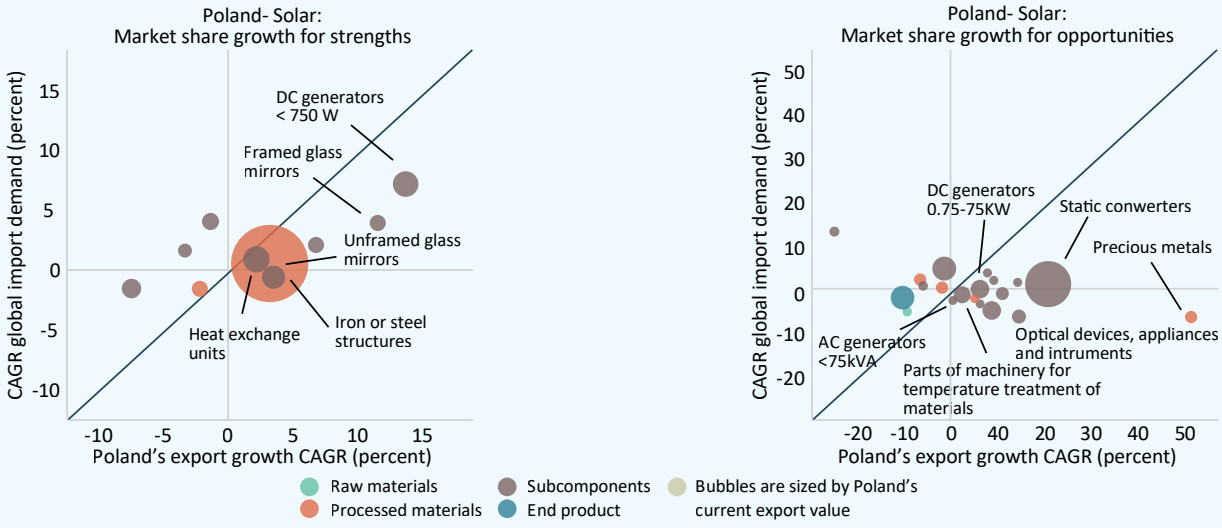
Figure 6.11: Poland's competitive strengths and potential opportunities in the wind value chain



Source: Author's analysis.

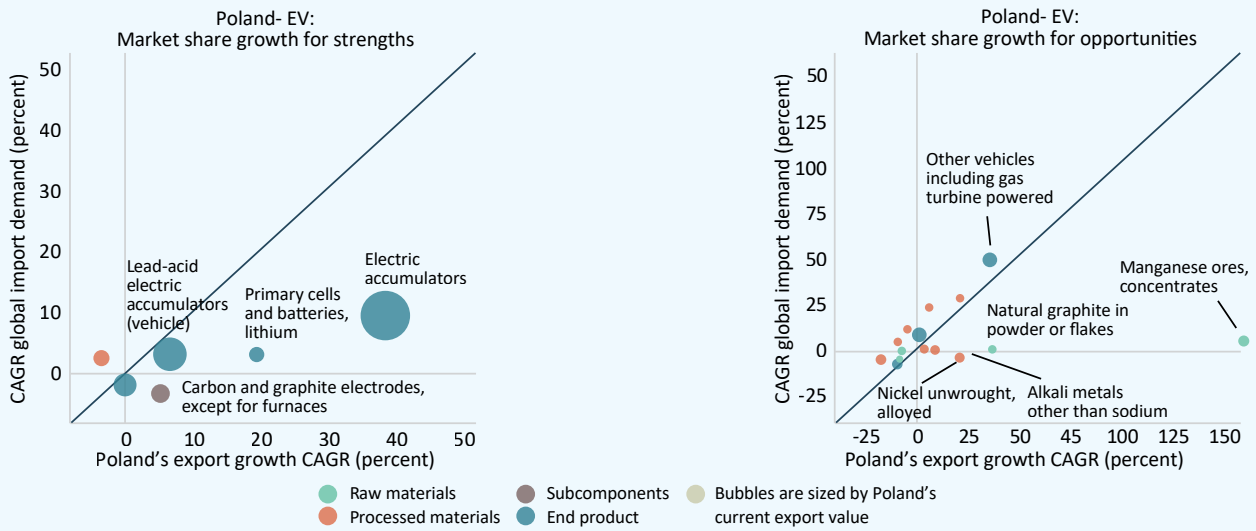
329. Poland is also well positioned to participate in green global value chains that are set to see significant demand uplifts in the next 10 years. Solar photovoltaics, wind turbines, and EVs are technologies that will experience immense growth as countries around the world decarbonize. Poland's competitiveness in end products related to batteries place it in a particularly strong position to take advantage of the global shift to low-carbon transport and battery technology. Poland's strengths in processed materials (for example, iron and steel structures) and a range of sub-components (for example, electricity meters) in the wind turbine value chain also bode well for Poland to reap economic benefits from the continued growth and expansion of wind power around the world (Figure 6.11). In the solar value chain, Poland has strengths in DC generators (<750W) and framed glass mirrors (Figure 6.12). Poland has the potential to leverage its strength in DC generators (<750W) in a manner that promotes opportunities in other generator products, while also exploring opportunities to make strategic bets that, while riskier, could increase the competitiveness of products like static converters.

Figure 6.12: Market share growth for products in the solar value chain – strengths and potential opportunities



Source: Author's analysis.

Figure 6.13: Market share growth for products in the EV value chain – strengths and potential opportunities



Source: Author's analysis.

330. Poland could potentially exploit opportunities to develop competitiveness in other products in GGVCs that align with its current capabilities. Products such as electricity transformers, AC generators (<75kVA), and parts of electric accumulators (including separators) are reasonably proximate to Poland's existing capabilities. While Poland's RCA in these products is currently less than one, Poland may be able to develop competitiveness more easily in these products in the future. However, further analysis is required to better understand the likely export destinations for this product, existing competitors in this market, and current barriers to growth.

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