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Transition to a Low-Emissions Economy in Poland

Erika Jorgensen and Leszek Kąsek

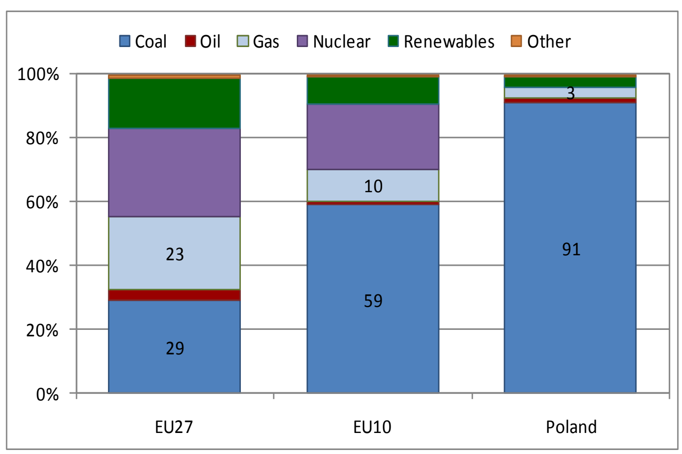
Key Messages[1]

- **Poland can cut its greenhouse gas emissions by almost a third by 2030 by applying existing technologies, at an average cost of 10 to 15 euros per ton of carbon dioxide abated.**
- **Costs to the economy will peak in 2020. However, by 2030, the shift towards low emissions will augment growth. Overall, this abatement will lower GDP by an average 1% through 2030 from where it otherwise would have been.**
- **The economic cost in output and employment of Poland's required abatement by 2020 under EU rules is higher than for the average EU country. Also, the restrictions on emissions trading between sectors aggravate that cost.**
- **The energy sector currently generates nearly half of Poland's emissions. However, the transport sector - with precipitous growth and the need for behavioral change in addition to the adoption of new technologies - may end up posing the tougher policy challenge.**
- **The World Bank's work on Poland advances the approach of low carbon studies. The methodological innovation is integrating 'bottom-up' engineering analysis with 'top-down' economy-wide modeling.**

Poland's Greenhouse Gas Emissions

Poland is not among the largest emitters of greenhouse gases globally, but its economy is among the least emissions-efficient in the EU. Poland's global share in greenhouse gas (GHG) emissions is just 1% and its per capita emissions are similar to the EU overall. But, given its lower income level, the Polish economy comes out as among the least carbon-efficient. Poland's transition to a market economy since 1989 had a co-benefit of sharply reduced CO2 emissions; however, the link between growth and emissions has re-emerged in recent years. A critical difference in the make-up of Poland's emissions is the dominance of the power sector and its extraordinary dependence on coal. Over 90% of electricity in Poland is generated from coal and lignite, the highest share in the EU. This makes Poland an outlier, both globally and in Europe (Figure 1). Outside the energy sector, Poland's transport sector has experienced very high rates of emission growth, and energy efficiency, although considerably improved over the past 20 years, has not yet reached Western European standards.

Figure 1: Electricity Generation by Fuel, 2007



Note: The EU10 consists of Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.
Source: European Commission, World Bank staff calculations.

In making the transition to a low carbon future, Poland faces several challenges. What are the technological options available and how expensive are they compared to existing technologies? Would there be high costs in lost growth and employment? Over a shorter horizon, to 2020, what are the implications for Poland of implementing EU policies on climate change?

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[1] This Knowledge Brief is based on the recent report *Transition to a Low-Emissions Economy in Poland*, part of the World Bank's series on low-carbon growth studies. The report explores the question of how Poland, an EU member state and an OECD member, can transition to a low emissions economy as successfully as it underwent transition to a market economy in the early 1990s.

Emissions Abatement Targets and Policy Challenges for Poland

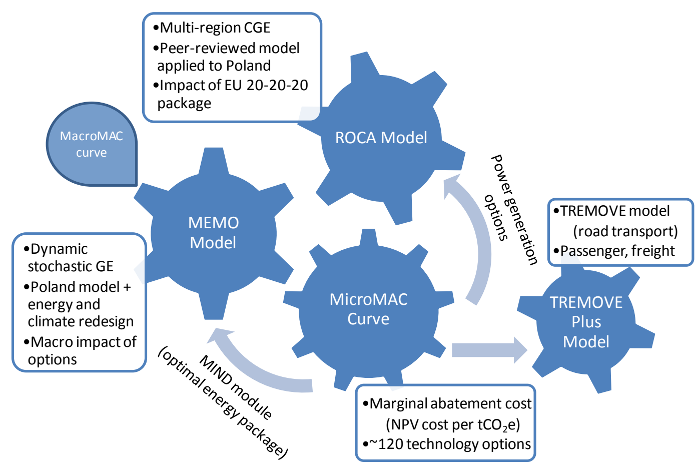
The international agreement on climate change that is expected to eventually supersede the Kyoto Protocol and, more immediately, compliance with EU policies on climate change, poses policy challenges for Poland. The contraction of GHG emissions that accompanied economic restructuring in the 1990s caused Poland to outperform against its Kyoto commitments by a large margin. The most demanding of commitments on emissions, however, comes from EU policies on climate change mitigation. The EU climate change and energy package (or the '20-20-20' targets) require comprehensive further action by EU members to achieve a 20% reduction in greenhouse gas emissions by 2020 relative to 1990, renewable energy as 20% of energy consumption, and a 20% improvement in energy efficiency.

The 20-20-20 package requires Poland's energy-intensive sectors to contribute to the EU-wide target of a 21% reduction in carbon emissions (compared with 2005) while allowing Poland's other sectors' emissions to increase by 14%. The EU package segments sectors into two groups while setting multiple targets. Large installations in energy-intensive sectors are covered by the EU-wide Emissions Trading Scheme (ETS sectors), a regional carbon market. Energy, heavy industry, and fuels are ETS sectors. For the non-ETS sectors, the package requires a reduction in emissions by 10% compared to 2005 in the EU as a whole. That EU-wide target was translated into a national target for Poland of an increase in its non-ETS emissions by 14%.

A Suite of Models to Assess Emissions Abatement

Three (and a half) complementary and interlinked models for Poland were developed to quantify the economic impact of CO_2 mitigation, taking advantage of available data and leveraging existing models. The most familiar of these models is likely the widely-used Marginal Abatement Cost (MAC) curve which provides a simple first-order ranking of technical options for GHG mitigation by sector, based on the net present value of costs and savings per metric ton of CO_2 equivalent avoided. Then, two different economy-wide models were developed for economic impact assessment. The Macroeconomic Mitigation Options (MEMO) model, a DSGE model of Poland revised to include energy and emissions, assesses the macroeconomic impact of the options costed in the microeconomic MAC curve. The Regional Options of Carbon Abatement (ROCA) model, a country-level CGE model for energy and GHG mitigation policy assessment adapted to Poland, analyzes implementation of the EU 20-20-20 policy in the context of global policy scenarios. The last "half" model is a detailed sectoral approach for road transport, the sector with the fastest growing emissions. It makes use of the EU transport and environmental model, TREMOVEPlus. Figure 2 summarizes the modeling approach.

Figure 2: Model Suite for Low-Emissions Growth Assessment for Poland



Source: World Bank, 2011.

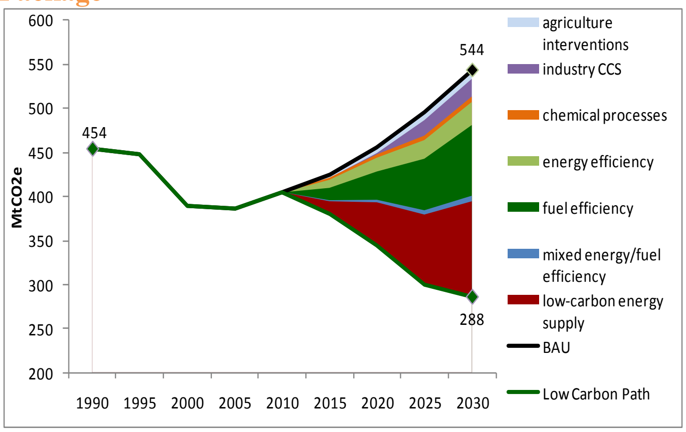
Poland's Growth Path before a Low-Emissions Strategy

A business-as-usual scenario is fundamental to the calculation of costs of emissions abatement. If Poland were to take no action (the "business-as-usual scenario"), the models developed in this report suggest that overall emissions in 2020 will stand roughly 20% above 2005, while 2030 levels will be 30% to 40% higher. It is difficult to project the path of an economy over a 15 or 25 year period, and it is not surprising that sectoral details differ significantly across models constructed via alternative methodologies and using separate datasets. For example, the overall projections of emissions for 2020 are similar across models. However, the MEMO projections indicate a heavier burden for ETS sectors to comply with EU targets, while according to ROCA projections, the major challenge will be faced by the non-ETS sectors.

Poland's Abatement Options

Poland can reduce emissions by 30% by 2030, compared to 2005, at an average cost of 10 to 15 euros per metric ton of CO_2 equivalent, according to the Marginal Abatement Cost (MicroMAC) curve, a bottom-up engineering approach. This approach creates a ranking by net cost of about 120 emission reduction options, based on existing technologies, and presents the measures via a well-known visual summary tool - the MAC curve. When measured against the level of emissions that would otherwise occur in 2030, the reduction is even more significant at 47%. The curve identifies that the majority of Poland's abatement potential is associated with the switch to low-emissions energy supply (via energy sector investments) and with energy and fuel efficiency improvements. The latter measures are most important in the early years (Figure 3).

Figure 3: Decomposition of Abatement by Micro-Package



Source: World Bank, 2011.

The Macroeconomic Impact of the Abatement Package

Implementation of the full abatement package will reduce incomes modestly, costing an average 1% of GDP each year through 2030. For the comprehensive abatement package, the MEMO model simulations find an economic impact that is generally negative but appears affordable. The MicroMAC curve can be transposed into a Macroeconomic Marginal Abatement Cost (MacroMAC) curve to examine in detail the impact on economic growth associated with the implementation of specific abatement measures (see Figure 4).

Onshore wind and small hydropower plants are superior to many energy efficiency measures by the metric of GDP growth. Nuclear power offers the biggest abatement potential but remains a drain on growth even with a twenty-year horizon - still myopic for plants with 60-year lifespans. The MacroMAC curve presents the marginal abatement impact in terms of GDP of each abatement option, making it easy to see which measures are 'cheaper'. The area under the MacroMAC curve defines the overall impact of the entire abatement package on real GDP, an interpretation similar to that of the bottom-up MicroMAC curve (in which the area under the curve equals the financial cost of the abatement package).

Implementing EU Climate Policy

In complying with the requirements of the EU's 20-20-20 package, Poland bears a higher economic burden than the rest of the EU en bloc because of the predominance of coal in power generation and the expected strong growth in sectors such as transport. The Regional Options of Carbon Abatement (ROCA) model, a country-level CGE model for GHG mitigation policy assessment adapted to Poland, considers key aspects of EU climate policy and several variations on climate policy design. The market segmentation created by the EU's division of economic sectors according to energy intensity greatly elevates the marginal cost of abatement for less energy-intensive industries. Removing that segmentation reduces overall compliance costs for Poland.

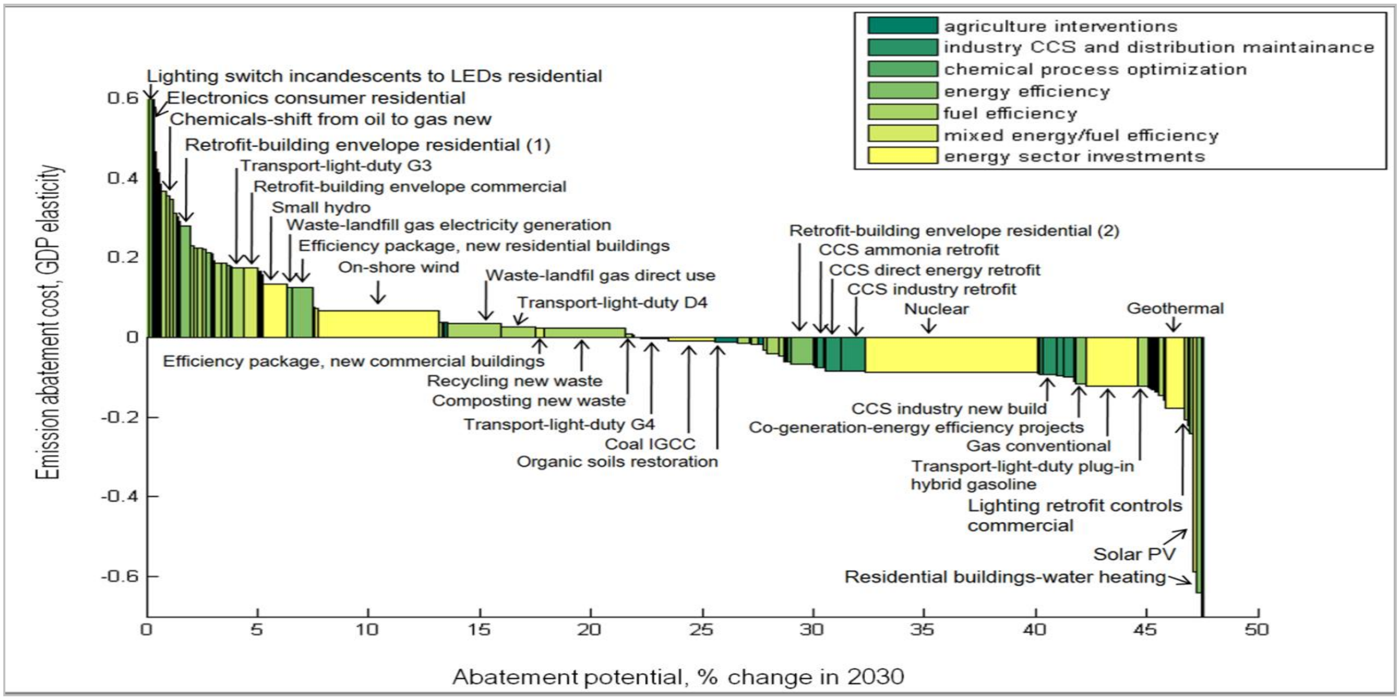
Similarly, allowing emission reductions in the least-cost location dramatically reduces compliance costs and the need for adjustment, as most abatement is off-shored. Then, an additional aspect of EU policy is incorporated into the ROCA model - overlapping regulation in the form of an EU target for renewable energy sources - to determine conditions in which it may be (counter-intuitively) welfare-improving. The model considers various policy choices under the control of the Polish government. First, alternative revenue recycling via wage subsidies is analyzed, which generates a weak 'double dividend' (reducing emissions while easing distortions in the labor market) and lower unemployment. Then, the loosening of restrictions on the scope of nuclear power is found to cut compliance costs for Poland by about one-third (although installation of so much nuclear capacity is unlikely to be feasible by 2020). Lastly, the granting of free emission allowances to energy-intensive and trade-exposed sectors, which might be vulnerable to 'carbon leakage' (the off-shoring of high-emissions production), preserves sector output but generates overall losses in GDP.

Energy, Energy Efficiency, and Transport

The switch to low-emissions energy supply, end-user energy efficiency measures, and transport policy will be the central pillars of Poland's low emissions growth strategy. The switch in the power sector, in which aging infrastructure is ready for replacement, provides a timely opportunity for a shift in direction. With long lead times of the investments, the structure of the power sector will shift slowly. Even if a full low-emissions package is implemented, coal will likely remain the fuel for half of Poland's electricity in 2030.

With lower capital costs and earlier returns, end-user energy efficiency measures hold out the promise of relatively low cost abatement that works directly to delink emissions from growth, the essence of a low-emissions economy. Energy efficiency measures play a central role in the MicroMAC curve analysis because of their substantial potential, apparent low price, and impact on growth.

Figure 4: Macroeconomic Marginal Abatement Cost (MacroMAC) Curve, 2030



Note: A positive value on the vertical axis means that an abatement measure increases GDP. Each column is one of the 120 abatement measures. The height of the columns is the marginal abatement impact in percent of GDP (for each percent of GHG abatement) compared to business-as-usual in 2030. The width is the percent emissions that can be reduced. The area of any rectangle equals the GDP impact (loss or gain) of emissions abatement via any specific lever.
Source: World Bank, 2011.

Although most energy efficiency measures individually have little potential, if they could be grouped together for implementation, they could be an important emissions abatement tool.

The transport sector may prove the most challenging to hold emissions growth within the EU target; most technological solutions are already in place, leaving behavioral solutions that are more complicated to implement, as perhaps the only choice. Road transport GHG emissions in Poland are converging from a low historic base towards EU averages. They contribute about 10% of overall emissions. Emissions from road transport are expected to almost double between 2005 and 2030. With most technological solutions already in place, difficult behavioral changes will be needed (moving from private cars towards public and non-motorized transport), but even proactive abatement policies are unlikely to hold emissions growth within the EU target for these sectors.

Conclusion

Capturing the full package of technologically feasible and economically sensible abatement measures requires coordinated and early action by the Government of Poland. With an ambitious approach, Poland can aim to reduce its GHG emissions by about one-third by 2030 (relative to 1990) with little cost to incomes and employment. Similarly, meeting the EU targets for 2020 appears generally feasible for Poland at modest cost, albeit likely more challenging for less energy-intensive sectors such as transport. Poland has already weathered one economic transition and emerged with a strong and flexible economy. This next transition - to a low emissions economy - while requiring an evolution in lifestyles and priorities over the next 20 years, may well turn out to be much easier.

About the Authors

Erika Jorgensen is an Economic Adviser in the Poverty Reduction and Economic Management Sector Unit of the Europe and Central Asia Region of the World Bank.

Leszek Kąsek is a Senior Economist in the Poverty Reduction and Economic Management Sector Unit of the Europe and Central Asia Region of the World Bank.