McKinsey&Company

Assessment of Greenhouse Gas Emissions Abatement Potential in Poland by 2030

Summary of findings

Foreword

Climate change has become a business reality. Countries around the world are adopting stringent greenhouse gas reduction targets.

For Poland to be able to make an assessment of what greenhouse gas reductions are possible, when, and at what cost, a comprehensive analysis of the potential and costs of different greenhouse gas abatement measures is required. This is what this report intends to do.[1]

McKinsey & Company, under the Honorary Patronage of the Ministry of Economy, cooperated with over 40 institutions and companies to assess the greenhouse gas reduction opportunities for Poland.

All assumptions and results were discussed in numerous interviews with leading experts. Using a methodology proven in over 20 country studies worldwide, the study investigated over one hundred individual abatement measures in all major areas of the economy.

This report does not evaluate the science of climate change. It also avoids any assessment of policies, political implementation programs, and other governmental interventions. It is strictly intended to provide an objective fact base of the abatement potential and costs of abatement measures in Poland. This data can serve as a starting point for further discussions and decisions.

We would like to thank all of the participating experts, companies and associations as well as independent experts for their constructive cooperation and valuable inputs over the past few months.

Warsaw, December 2009

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[1] This document presents the key conclusions of the analysis. A full report will be published in January 2010, in Polish and English. Please note that minor differences may occur between language versions.

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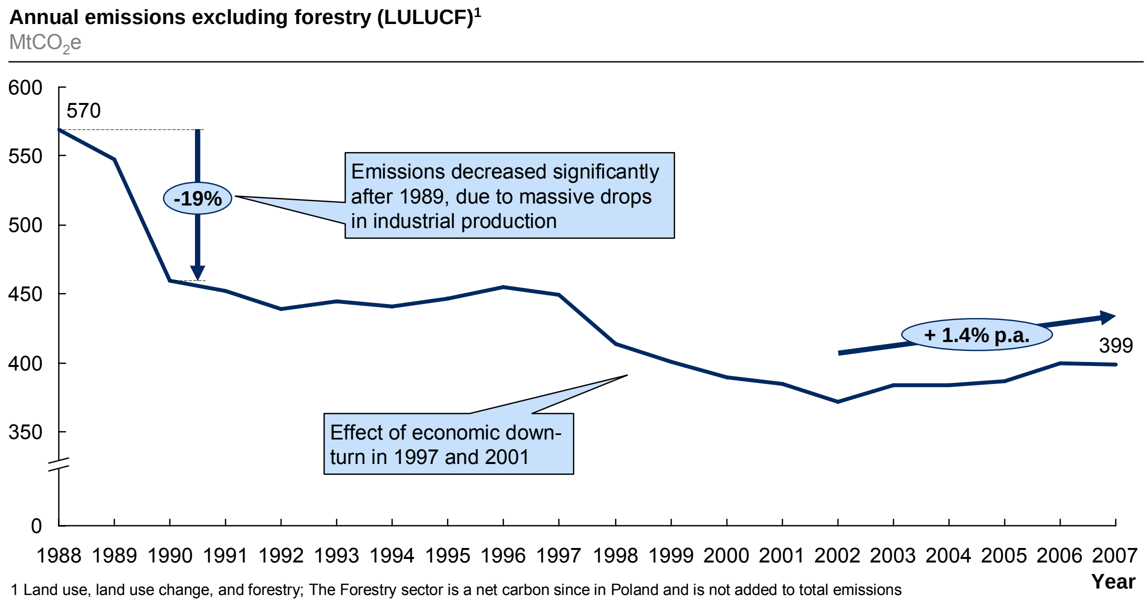
All countries are looking into how to reduce their greenhouse gas emissions. Poland has significant potential to reduce its emissions, but seizing this potential will be a challenge. Fast and decisive action will be needed to seize the opportunity.

Many scientists and policy makers believe that the rise in global average temperatures since pre-industrial times has been closely related to human activity and the release of large amounts of carbon dioxide and other greenhouse gases (GHGs[2]) into the atmosphere. Many also believe that capping this increase at 2 degrees Celsius above pre-industrial temperatures – a threshold beyond which the implications of global warming become very serious[3] – is an important goal, and that reducing GHG emissions would be a key step to ensure not only environmental stability but also long-term economic sustainability. To this end, the majority of governments ratified the Kyoto Protocol. Set to expire in 2012, the Protocol stipulates a 5-percent reduction target for the world's industrialized countries against 1990 emissions levels.

To account for the sharp decrease in industrial production levels following the collapse of communism, 1988 was set as the base year from which emissions reduction will be calculated for Poland. The massive drop in production since this time has led to a significant decrease in GHG emissions (Exhibit 1).

Exhibit 1

Historical GHG emissions in Poland



1 Land use, land use change, and forestry; The Forestry sector is a net carbon since in Poland and is not added to total emissions

SOURCE: KASHUE; National Inventory Reports

[2] The main greenhouse gases, also analyzed here, are carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). To quantify the effect of all GHGs, values are expressed in CO_2e (carbon dioxide equivalent) – the unit of emissions that, for a given mixture and amount of GHGs, represents the amount of CO_2 that would have the same global warming potential.

[3] The primary source of the climate science in this report is Climate Change 2007, Fourth IPCC Assessment Report, Intergovernmental Panel on Climate Change.

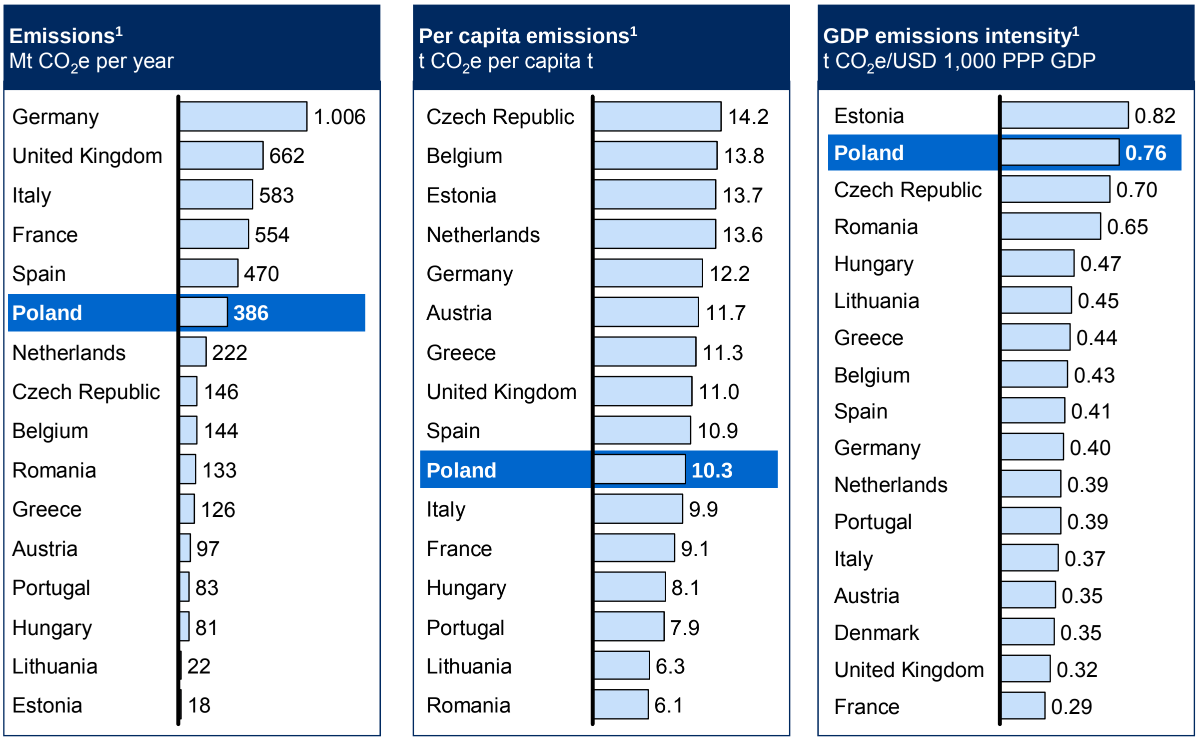
Regardless, continuing dependence on coal-generated power (~95%) makes Poland one of the most carbon-intensive EU economies (Exhibit 2). Decisions taken now on the fuel mix, will shape GHG emissions in Poland for years to come. A key question for Poland will be how to fulfill its climate change commitments whilst maintaining its economic competitiveness and growth.

To inform the discussion on greenhouse gas abatement opportunities, McKinsey & Company has developed the GHG abatement cost curve for Poland. Providing a consistent view of available abatement measures and their related costs, the methodology allows for reduction opportunities to be mapped across the major sectors of the economy (Exhibit 3)[4].

Exhibit 2

Emissions and GHG intensities of EU economies

2005



1 Excludes emissions associated with forestry and land-use changes

SOURCE: KASHUE; EUROSTAT

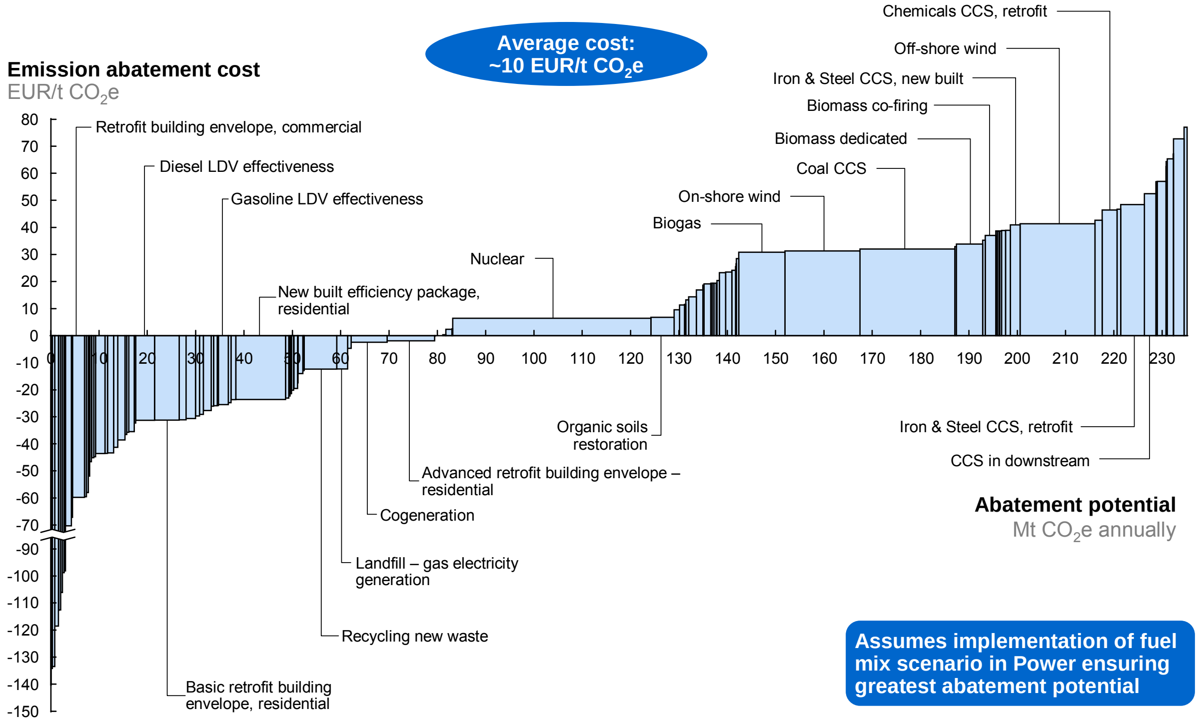
The report focuses on measures representing technical abatement opportunities without assuming any significant behavioural change (e.g., reduced driving or average home temperatures). Also excluded are nascent abatement technologies, such as biodiesel from algae or tidal energy. Whereas such technologies could offer potential in the future, their development remains uncertain, and it is unlikely they would have significant impact before 2030.

[4] We analyzed in detail 10 sectors, which accounted for about 86% of Polish emissions in 2005, namely: Power, Buildings, Road transport, Chemicals, Iron & Steel, Petroleum & Gas, Cement, Agriculture, Waste, and Forestry.

Since fuel mix development in the power sector is uncertain, we have modelled five potential scenarios (see Exhibit 8 for a summary). Unless stated otherwise, all summary analyses assume that the fuel mix scenario that results in largest abatement would be implemented by 2030.

Exhibit 3

GHG abatement cost curve for Poland 2030[1]



1 Only the most significant abatement opportunities are named

SOURCE: Poland GHG Abatement Cost Curve

How to read the Polish greenhouse gas abatement cost curve?

McKinsey's greenhouse gas (GHG) abatement cost curve summarizes the technical opportunities (those without material impact on consumer lifestyle) to reduce emissions at a cost of up to EUR 80 per tCO_2e. The cost curve shows the range of reduction actions possible with available technologies or those whose potential can be estimated with a high degree of certainty within the 2030 horizon.

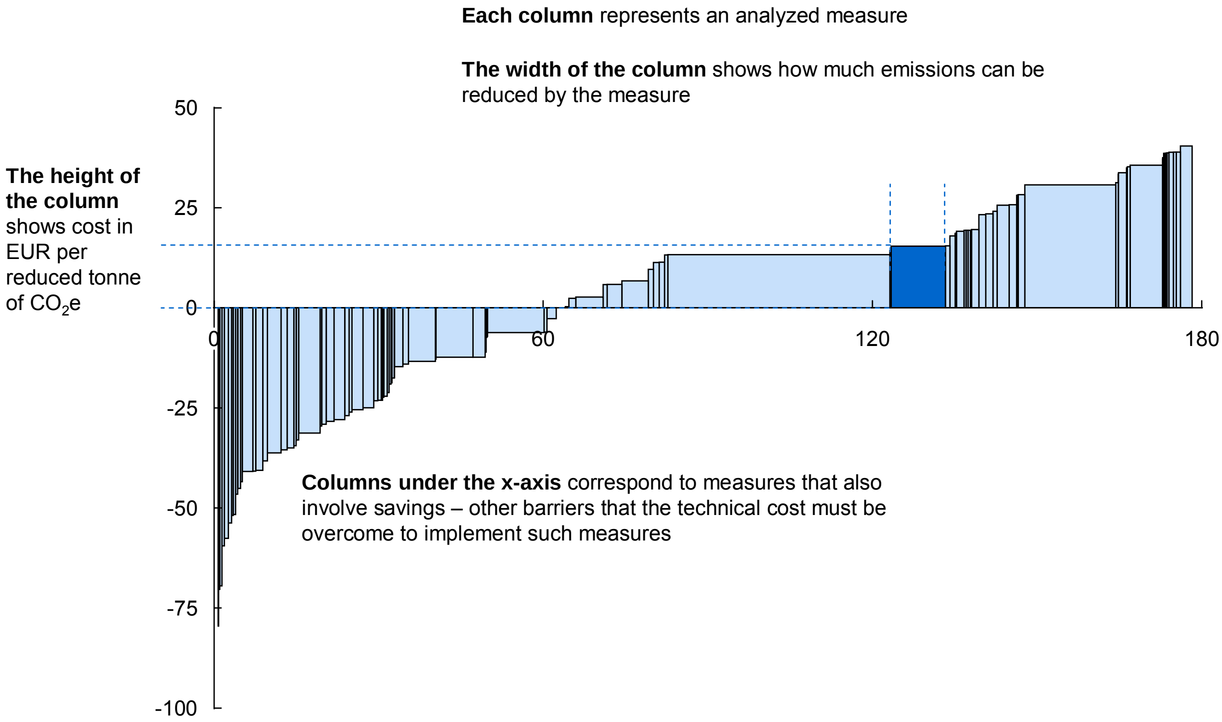
The width of each column represents the GHG reduction potential of a specific opportunity in a specific year compared to business-as-usual (BAU) (Exhibit 4). The potential of each opportunity assumes aggressive action starting in 2010 and does not represent a forecast of how each opportunity will develop. The height of each column represents the average cost of abating 1 tonne of CO_2e by 2030 through that opportunity. All costs are in 2005 real EUR. The graph is ordered left to right from the net profit positive abatement opportunities to the highest-cost ones. Uncertainty about volume and estimated costs can be significant for specific opportunities, especially emerging technologies.

We have applied a consistent methodology to all emissions reduction opportunities considered in this report. Therefore, the curve can be used to compare the size and cost of opportunities, assess the relative importance of sectors, and estimate the overall size of the emissions reduction opportunity, rather than to predict the development of technologies. It can also be used to test implementation scenarios, energy prices, interest rates, and technological developments.

The reader should bear in mind that abatement costs are calculated from a societal perspective (i.e., excluding taxes and subsidies, and with capital costs close to real risk-free rate of 4%). This methodology allows to compare abatement potential and costs across countries, sectors, and opportunities. However, it means that the calculated costs differ from the costs that a company or a consumer would incur, as the latter would include taxes, subsidies, and different interest rates in their calculations. Therefore, the curve cannot be used to determine when it might be profitable to switch from one investment to another or to forecast CO_2 prices. The cost of each opportunity also excludes the transaction and program costs of implementing it on a large scale. The reason for this is that such costs reflect political choices about which policies and programs to implement and vary from case to case. It is therefore not possible to incorporate these costs in the abatement curve in an objective way and maintain the ability to compare abatement potentials across regions and sectors.

Exhibit 4

How to read the cost curve diagram?



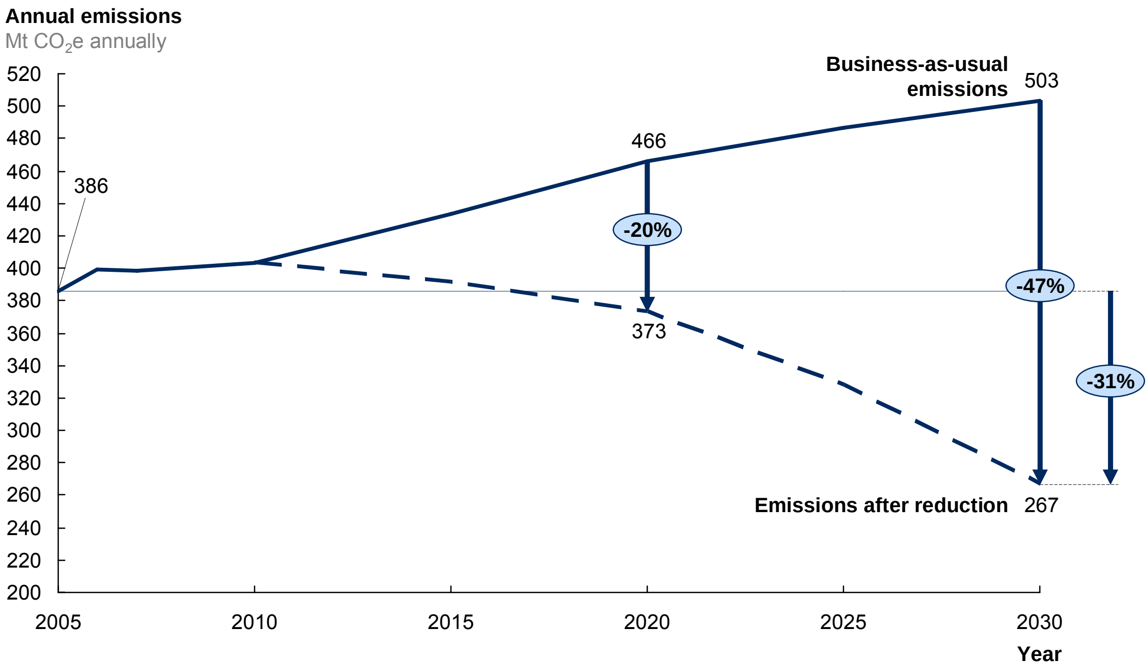
SOURCE: Poland GHG Abatement Cost Curve

Potential exists to significantly reduce emissions against the baseline, but capturing the full potential would be a major challenge

The cost curve identifies potential abatement of 236 $MtCO_2e$ by 2030 (Exhibit 5), which would represent a 31% reduction from 2005 levels, or 47% from the levels we would see in 2030 if Poland made little attempt to curb current and future emissions (business-as-usual, or BAU, scenario)[5]. The pace of abatement would pick up significantly only after 2020, when major projects in the Power sector (e.g. large-scale off-shore wind generation, nuclear or carbon capture and storage – CCS) become operational.

Exhibit 5

Emissions reduction potential relative to business-as-usual baseline



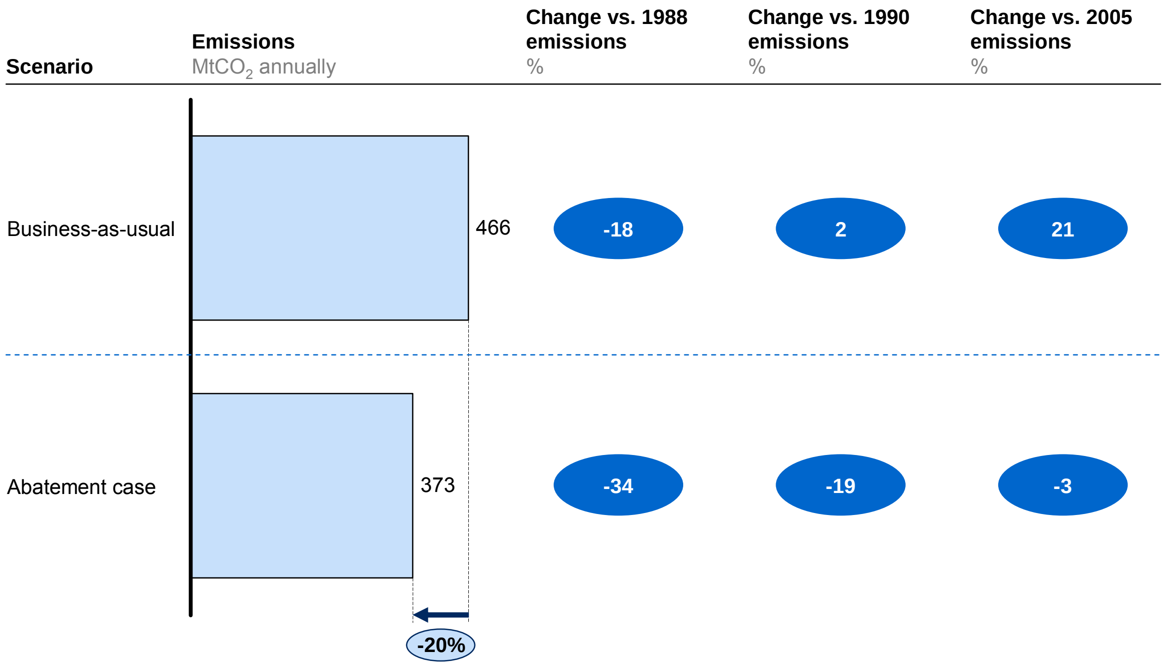
SOURCE: Poland GHG Abatement Cost Curve

An opportunity exists to reduce emissions by 20% against BAU by 2020. If the full technical potential were achieved, 2020 emissions in Poland would be 34% lower than in 1988, and 19% lower than in 1990 – the two potential baseline years for calculating emissions reduction targets. However, compared to 2005, even capturing the total 2020 technical potential would only reduce emissions by 3% (Exhibit 6). Any greater abatement would require measures not currently included on the cost curve, such as consumer lifestyle changes or investments in more expensive technologies (e.g., electric cars).

[5] Our business-as-usual emissions projection represents the theoretical emissions trajectory that would occur under current trends, with little additional efforts made to address climate change. It was constructed from the bottom up, based on industry production levels and assuming natural improvements in technological efficiency. BAU emissions do not reflect current climate change regulation and targets.

Exhibit 6

Emissions reduction potential in 2020 vs. base year



SOURCE: Poland GHG Abatement Cost Curve; KASHUE; National Inventory Report

Even though there is potential in Poland to make deep cuts in GHG emissions, capturing them would require concerted, targeted actions by government, business, and consumers. Significant gains would have to be made in, for example, the energy efficiency of buildings and transportation, and the share of low-carbon energy sources would have to rise to over 50% of the total electricity supply in 2030, up from less than 2% in 2005.[6]

After careful analysis we believe such changes would indeed be feasible but fully implementing all of the opportunities on the cost curve would represent a major undertaking.

Another way to illustrate the challenge is to look at GDP emissions intensity: the amount of carbon produced per EUR 1,000 of GDP. To achieve the total identified technical potential by 2030, Poland would have to decrease its GDP emissions intensity by almost 70% against current levels, and by over 40% against the BAU scenario level.

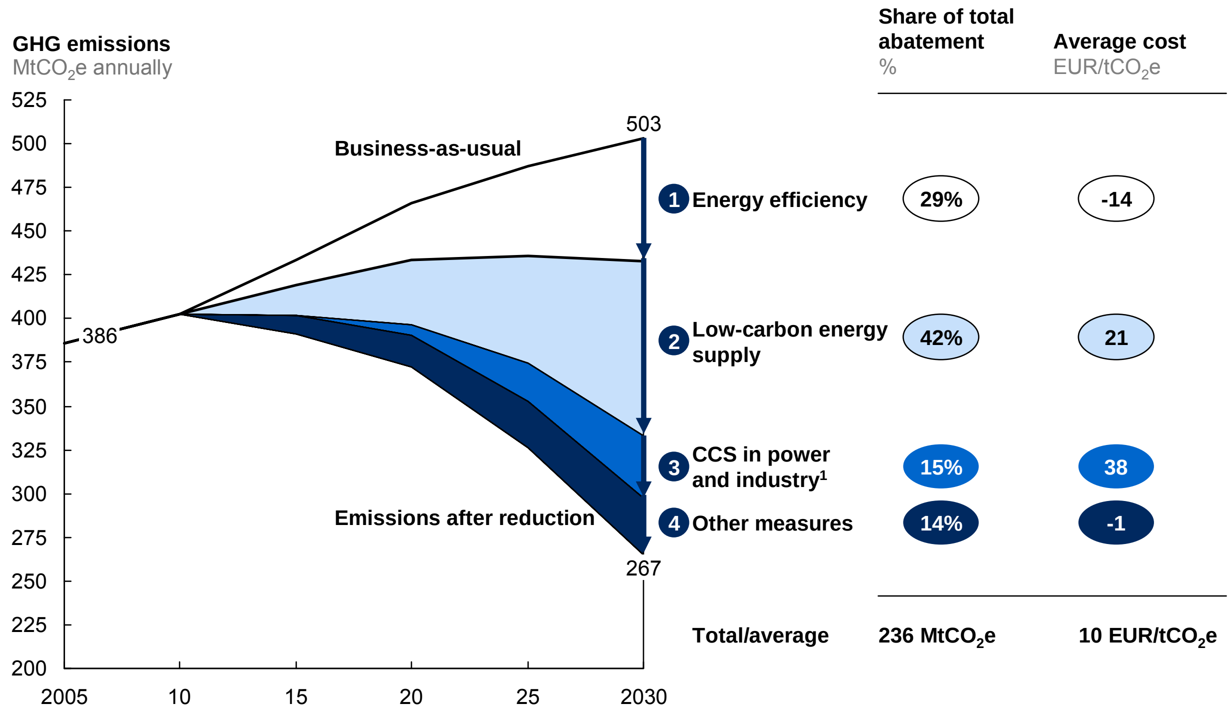
[6] The exact share of low-carbon technologies would depend on the fuel mix in the Power sector. We have analyzed several potential fuel mix scenarios, described in more detail on page 13.

70% of total abatement potential is related to efficiency improvements and low-carbon energy supply opportunities

If Poland is to address the emissions reduction challenge successfully, action should be taken between now and 2030 across four abatement categories: energy efficiency, low-carbon energy supply, CCS and other measures (industry, waste management and agriculture) (Exhibit 7).

Exhibit 7

Reduction potential by category



1 Abatement opportunity of CCS in Industry (Chemicals, Iron & Steel, Petroleum & Gas, and Cement) amounts to ~16 $MtCO_2e$ with an average cost of ~46 EUR/tCO_2e; in Power the abatement opportunity of CCS amounts to ~20 $MtCO_2e$ with an average cost of ~32 $MtCO_2$

SOURCE: Poland GHG Abatement Cost Curve; KASHUE; National Inventory Report

Energy efficiency (opportunity of 68 $MtCO_2e$ in abatement potential per year in 2030 – 29% of total). A large number of opportunities exist to reduce energy consumption by improving the energy efficiency of vehicles buildings, and industrial equipment. More fuel efficient cars, better insulation of buildings, and tighter efficiency controls on manufacturing equipment are just a few of the possibilities. If all of the energy efficiency opportunities identified in our research were captured, annual growth in electricity demand in Poland between 2005 and 2030 would be reduced from 1.5% per year in the BAU scenario to ~0.9% – a difference of 29 TWh by 2030.[7] The most important opportunities in this group are

[7] Gross electricity production in BAU is projected to grow from 157 TWh in 2005 to 227 TWh in 2030 (including industrial and commercial power plants). This growth is driven by the assumed annual GDP growth in Poland of 3.4% (Global Insight) and the continued improvement in energy intensity of the economy (e.g. it assumes reduction of transmission loss). The potential energy efficiency improvement in our abatement case would reduce electricity demand by 29 TWh. Abatement in the Power sector is calculated assuming that electricity demand in 2030 is 198 TWh.

in the buildings sector, where implementing stricter efficiency controls for new buildings and better insulating existing ones could abate almost 30 $MtCO_2e$ by 2030 – about 13% of the total potential. Efficiency improvements in passenger cars could reduce fuel use by as much as 40% from current levels and represent an abatement opportunity of ~ 10 $MtCO_2e$ by 2030.[8] This equals the approximate efficiency opportunity of the entire industry sector, with CHP (~3 Mt) and efficiency measures in the petroleum and gas industry (~3 Mt) offering the greatest potential.

Low-carbon energy supply (excluding CCS) (opportunity of 100 $MtCO_2e$ per year in 2030 – 42% of total). Numerous opportunities exist to shift from coal to low-carbon alternatives. Key examples include electricity generated from wind, nuclear, or biomass and biogas fuel. The level of abatement would depend on fuel-mix decisions and the timeliness of implementation.

The coming years will be critical for determining the future fuel mix of the Polish power sector, as a significant share of currently operating coal plants are set to be retired. The chosen mix would have profound, lasting implications for CO_2 emissions. Balancing the multiple factors influencing the chosen fuel mix constitutes one of the biggest challenges facing Poland in the context of CO_2 abatement.

We have modelled five power sector scenarios to illustrate the options. Each scenario entails different costs, benefits, and risks. Exhibit 8 summarizes the costs and the level of CO_2 reduction[9] in each scenario. The low-emissions scenario offers the largest abatement opportunity (120 $MtCO_2e$) and is the one we have used to summarize the entire technical abatement potential for Poland[10]. Other scenarios focusing on nuclear, renewables, and gas could abate 93, 81, or 68 $MtCO_2e$ by 2030, respectively[11]. Additionally, we have analyzed Poland's "Energy Policy 2030" in the context of GHG abatement. The reduction potential of this scenario is 97 $MtCO_2e$.

[8] In this report, we intentionally only include technical abatement measures and do not attempt to quantify the costs of behavioural changes in transport, such as increased use of public transport, reducing driving through better city and traffic design, etc. While such changes are desirable, their costs and benefits are very difficult to quantify and depend on policy decisions and lifestyle changes, which makes their potential uncertain.

[9] Reduction potential is shown for the entire power sector, including CCS.

[10] In this scenario we assumed that by 2030 in Poland installed capacity will reach: 6 GW in nuclear, 10 GW in on-shore wind, 6 GW in off-shore wind, 1.7 GW in solar, 1.4 GW in biogas, 0.9 GW in dedicated biomass and the cogeneration capacity will be enlarged by 2.8 GW. Additionally, some of coal based capacities will be equipped with CCS (3.2 GW) and 5.3 GW will co-fire of biomass.

[11] Key differences are in installed capacities in nuclear, on-shore wind and off-shore wind. In max nuclear scenarios the capacities will reach 6 GW, 3 GW and 0 GW respectively; in max renewables 0 GW, 10 GW, 6 GW; in max gas: 2 GW, 3 GW, 0 GW and in gas technology 7 GW; in scenario E: 4.8 GW, 4.9 GW and 3 GW.

Exhibit 8

Cost and abatement potential of different power scenarios

Scenario	Abatement potential $MtCO_2e$	Weighted average cost of abatement EUR/t CO_2e	Scenario description
A Low-emissions	120	22	▪ Natural retirement of coal power blocks (new blocks will still be required until 2020) ▪ Remaining power demand is met by wind and nuclear energy
B Maximum nuclear	93	18	▪ Maintain current levels of coal-based production ▪ Remaining power demand is met by nuclear energy
C Maximum renewables	81	32	▪ Maintain current levels of coal-based production ▪ Remaining power demand is met by wind energy
D Maximum gas	68	24	▪ Maintain current levels of coal-based production ▪ Remaining power demand is met by gas plants
E Energy Policy 2030	97	21	▪ Assumptions from Poland's current official energy policy

SOURCE: Ministry of Economy; Poland GHG Abatement Cost Curve

Clearly, decisions about the future fuel mix will be shaped by factors outside the climate change debate as well. Costs, execution risks, environmental concerns, safety issues, and energy security have to be taken into account. The final decision will have to balance various priorities. In this context, our analysis aims to provide the facts on only one set of numerous factors.

Carbon Capture and Storage (CCS) (opportunity of ~36 $MtCO_2e$ per year by 2030 – 15% of total). Just over a half of the GHG abatement potential (20 $MtCO_2e$) is related to equipping coal power plants with CCS. The remaining 16 Mt could be achieved in industrial sectors, with the largest potential in iron and steel (~7 Mt) and in chemicals (~6 Mt). Since CCS technology is still being tested, our analysis assumes that 30-40 Mt per annum of storage capacity and transportation infrastructure would exist in 2030. However, if the technology matures faster and technical difficulties related to storage and transportation are resolved by then, storage potential in Poland could be much greater, resulting in a significant increase in abatement potential, from 36 to ~74 Mt. Clearly, CCS could offer important emissions reduction opportunities in the future, but its large-scale deployment before 2030 remains uncertain.

Other measures (opportunity of 33 $MtCO_2e$ per year by 2030 – 14% of total). In addition to the above-mentioned categories, we have identified major opportunities to reduce nitrous oxide and methane in agriculture and waste management, as well as industry-specific measures. Over half of the abatement potential in this group could be derived from measures in waste and agriculture. The largest opportunities in the waste sector include intensified recycling (~7 Mt) and capture and use of methane from landfills (~4 Mt). In agriculture, improving agronomic practices and re-flooding peat lands offer the greatest potential (~2 and ~5 Mt, respectively). Estimates should be considered with caution, as abatement in agriculture could vary considerably depending on the soil type, exploitation history, and climate. The remaining potential is split between transportation and industry. In the former, biofuel blends could reduce emissions by ~2 $MtCO_2e$ in 2030. In industry, the most significant opportunity exists in chemical plants, where a range of process modifications (e.g. optimization of catalyst use or process intensification) could reduce emissions by ~4 $MtCO_2e$. Finally, increasing the share of fuels such as biomass, waste, or gas in industry could abate ~3 $MtCO_2e$.

The size of abatement opportunities in energy efficiency and the power sector suggests that these two areas could be the focus of future abatement measures in Poland. A promising but as yet unproven new technology, CCS, could have significant impact on the country's future emissions. Among other opportunities, waste management and agriculture offer considerable abatement, which should not be overlooked.

A different way to look at potential is to look at the sector split of abatement (Exhibit 9) Approximately 52% of the total reduction potential is in energy supply sectors (electricity, petroleum and gas), 12% in the industrial sector, 31% in sectors with significant consumer influence (transportation, buildings, waste), and the remaining 5% in land-use related sectors (forestry and agriculture).

Exhibit 9

Split of abatement potential among different sectors

	Sector	Abatement potential 2030, $MtCO_2e$	Reduction as share of BAU emissions 2030, %	Average abatement cost EUR/tCO_2e
Power and industry	Power	120	66	22
	Chemicals	15	47	22
	Iron & steel	12	39	31
	Petroleum & gas	6	38	13
	Cement	3	13	-2
Consumer	Buildings	44	34	-18
	Transport	17	22	-5
	Waste	11	141	-18
Land use	Agriculture	9	30	1
	Forestry	1	3	13
	Total	236		

SOURCE: Poland GHG Abatement Cost Curve

Required additional investment by 2030 is estimated at 0.9% of annual GDP, while the average cost is estimated at EUR ~10/tCO_2e, with significant differences between sectors

If Poland were to implement all of the measures on the cost curve, the theoretical average abatement cost would be EUR ~10 per tCO_2e in 2030. Transaction and program costs, which have not been factored into the curve, are often estimated at between EUR 1 and 5 per tCO_2e, on average, and would need to be added to the cost of some measures.

This estimate should be considered with caution for two reasons: firstly, the assumption that opportunities would be addressed from left to right on our curve is highly optimistic; secondly, significant dynamic effects would affect the economy from a program of this magnitude. Such effects could work either to increase or to decrease costs, depending on how abatement measures were implemented, and have not been factored into the analysis.

Many of the abatement opportunities involve investing additional resources upfront to make existing or new infrastructure more carbon efficient and recouping that investment in part or in full through lower energy or fuel spending. Although it makes economic sense to pursue such opportunities, unlocking the potential could be challenging. The required additional upfront investment could discourage consumers from opting for the more efficient product, even if it did save money over time.

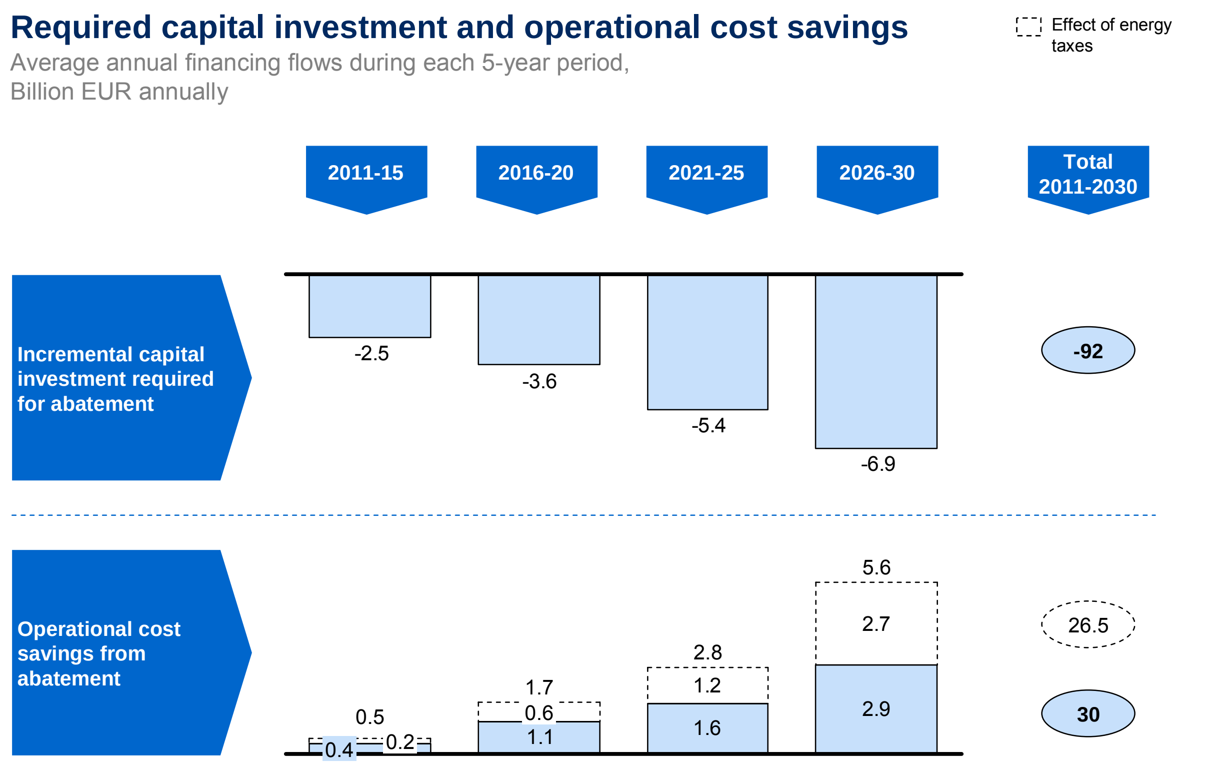
Analysis of the capex and opex cost savings (Exhibit 10) reveals that the required annual incremental investment would grow as more abatement opportunities were implemented. Similarly, the operational cost savings would increase as the energy efficiency potential is captured.[12] The total required additional investment from 2011 to 2030 is estimated at EUR 92 bn. On annual basis the additional investment is estimated at ~1% of GDP.[13] For comparison, total direct investment in Poland in 2008 was 18% of GDP. These costs and the required capital would be split somewhat unevenly among sectors and would vary over time.

It should also be kept in mind that energy taxes effectively mean that for every MWh saved, investors also save in terms of the taxes they would otherwise have to pay. At the same time, since these taxes represent government revenue, a reduction in energy demand lowers government income. Thus, whereas the total savings for consumers would amount to EUR 5.6 bn per annum in 2026-2030, savings for the whole economy would only be EUR 2.9 bn per annum.

[12] The value of savings is highly dependent on the assumed fuel prices. We assume that current prices (paid currently by power companies in Poland) would develop in line with IEA's Global Energy Outlook 2007 trends. Thus, fuel prices in 2030 reach the following levels: hard coal – 101 USD/ton; oil – 62 USD/bbl; gas 13 USD/mbtu.

[13] Throughout the period we have assumed a fixed exchange rate of 1.50 USD for 1 EUR.

Exhibit 10



SOURCE: Poland GHG Abatement Cost Curve

Cost of financing, fuel prices, and technology costs significantly affect the cost of abatement

In addition to the uncertainties surrounding the costs of fuels and the costs and feasibility of early development technologies (e.g. CCS, off-shore wind), financing costs also significantly influence the cost of abatement.

Increasing energy prices primarily affects the costs of energy efficiency measures. Assuming a 50% oil price rise (and proportional rise in the prices of other fuels), the average cost of abatement is reduced from 10 EUR/tCO_2e to 4 EUR/tCO_2e (as a rough rule of thumb, a rise in oil prices of about USD 10 /bbl decreases the average cost of abatement by 2 EUR/tCO_2e).

The assumptions on capital investment required to implement various technologies also influence cost of abatement. For example, increasing total capital investment required for installing 1 GW of nuclear capacity by EUR 500 mln increases abatement cost of nuclear by about 4 EUR/tCO_2e. For off-shore wind this change leads to a 15 EUR/tCO_2e increase.

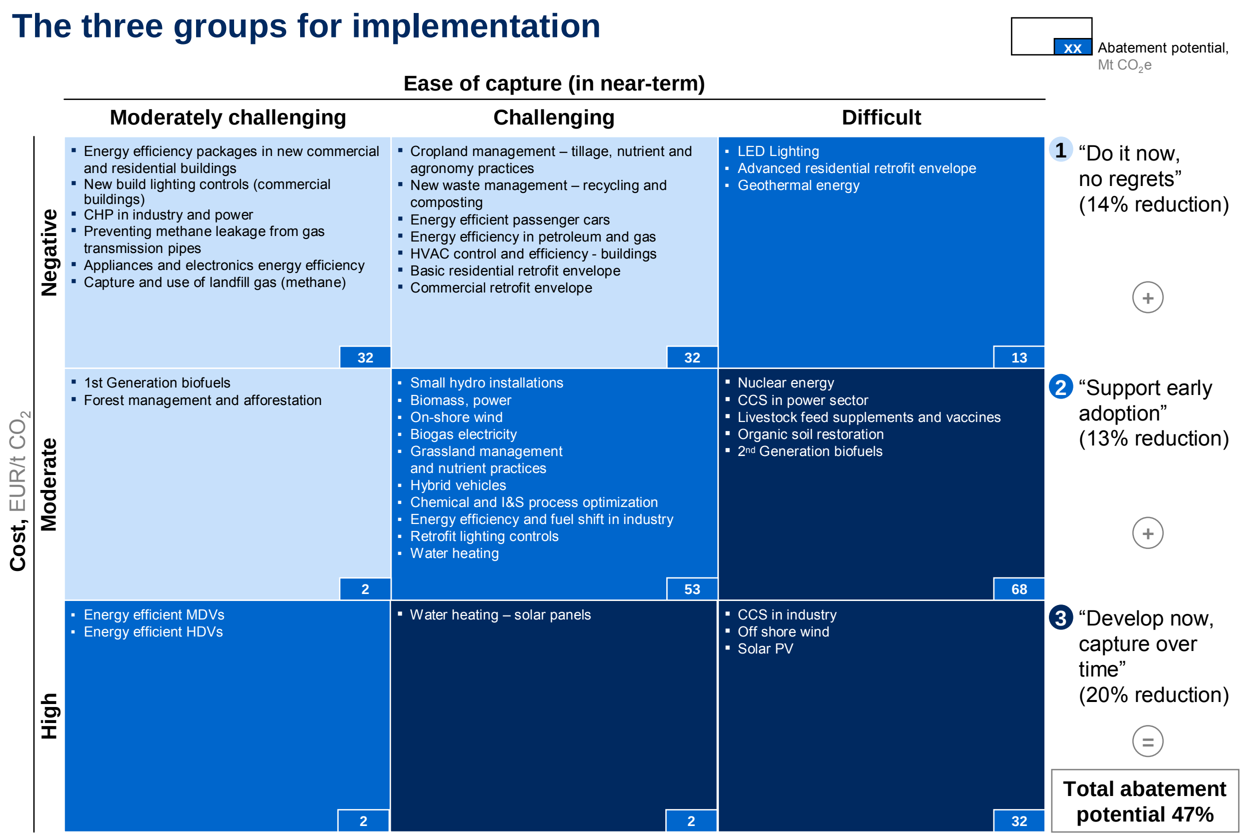
So far, we have assumed a risk-free financial rate of 4% for the required investments, excluding the mechanisms that government has at its disposal to influence investment decisions: energy taxes or subsidies, feed-in tariffs, and free-market mechanisms such as certificates and carbon allowances. Such mechanisms could be applied to favour GHG abatement investments and to reduce some of the risk for investors. Applying the higher interest rate (8%) increases the cost of capital-intensive technologies with relatively shorter lifetimes, such as wind turbines and hybrid vehicles, increasing total abatement cost from 10 to 19 EUR/tCO_2e.

If emissions reduction is to be maximized, urgent action is needed in Poland

The Polish economy could be steered towards a low-carbon growth path at an acceptable cost, but it would require that policy makers, businesses, and society start thinking about implementing abatement actions now. Two types of considerations would influence the sequencing and effectiveness of abatement actions.

The first consideration involves the practical timing of capturing each opportunity, which would be influenced by the current cost of the measure and its ease of capture. With this in mind, each group of measures has been assigned to one of three implementation groups (Exhibit 11). Such a classification necessarily simplifies the abatement process. The purpose of the matrix is to map the opportunities and the costs on a timescale.

Exhibit 11



SOURCE: Poland GHG Abatement Cost Curve

The first group consists of measures which are relatively easy to implement and result in net economic benefit or have moderate abatement cost (up to EUR 40 per tCO_2e). For example, increasing the share of recycled waste would reduce both emissions and the cost to society. Moreover, proven mechanisms to achieve it exist. Measures in the second group either have higher abatement costs or would require some build-up of regulatory or institutional capabilities. These measures would entail adopting innovative technology, such as hybrid vehicles, or innovative processes and techniques, especially in agriculture, as well as efficiency opportunities in industry. Opportunities in this group should be addressed by measures which support early adoption and create a favourable environment for scaling up implementation in the future. Finally, the third group consists of measures with significant implementation barriers in terms of cost and existing mechanisms for effective capture. They require either technology to mature significantly (e.g., CCS, off-shore wind) or very high capital expenditure and overcoming regulatory challenges, as with nuclear. For Poland, measures in the third group not only represent a significant part of the abatement potential, but also determine the country's future carbon development path. These opportunities could be seized over time by taking the necessary steps today.

The second consideration involves issues related to the timing and scope of implementing each opportunity. While implementing all of the opportunities from 2010 onwards would be ideal from the point of view of GHG abatement, we have analyzed the impact of delay and incomplete implementation. Exhibit 12 summarizes the four theoretical scenarios we have analyzed to illustrate what is at stake.

Exhibit 12

Potential implementation scenarios

	Description	Assumptions
A Full implementation	▪ **Climate change mitigation becomes top priority** ▪ Timely and decisive action is taken to capture abatement	▪ Full abatement potential is captured in time
B Implementation difficulties	▪ **Steps are taken to tackle climate change** ▪ Implementation difficulties prevent full potential capture	▪ Most measures in group one are successfully implemented ▪ More difficult opportunities in industry and power (efficiency, CCS, off-shore wind) are not captured in full
C Delayed action	▪ **"Wait and see" attitude** ▪ As pressure to reduce emissions grows, action is taken	▪ Abatement actions do not start until 2015 ▪ After that, full abatement potential is captured in all three horizons
D Delayed difficult decisions	▪ Climate change is treated with some urgency, but other matters get higher priority ▪ **Difficult measures are avoided**	▪ Abatement action begins in 2010 ▪ Abatement measures in Groups 1 and 2 are captured in full, but nuclear and off-shore wind power, and CCS are not implemented

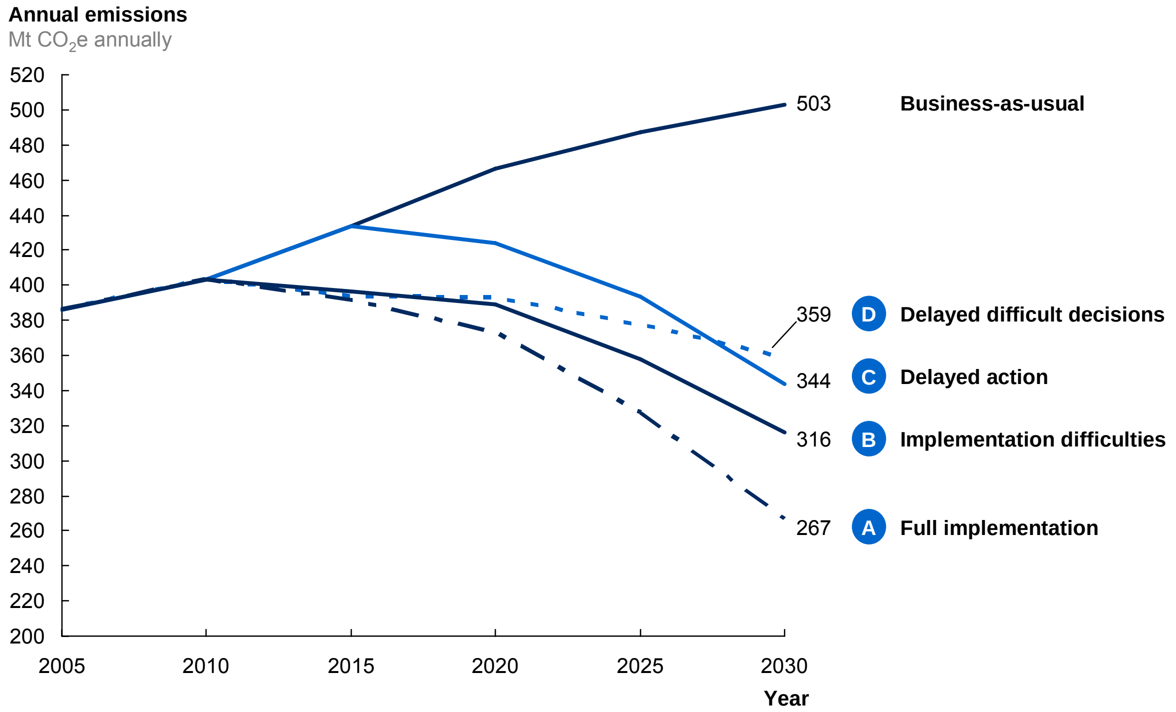
SOURCE: Poland GHG Abatement Cost Curve

Our analysis concludes that if Poland delays crucial decisions about power supply by five years, its ability to realize the full identified abatement potential would be significantly inhibited (Exhibit 13).

Delaying decisions on CCS, nuclear, and off-shore wind power would considerably limit abatement potential in 2020 and 2030 (Exhibit 14), and would likely lock Poland into carbon intensive infrastructure for years to come. Delaying action by only five years could reduce abatement potential by over 30% and impact the country's competitiveness.

Exhibit 13

Scenarios' impact on abatement potential



SOURCE: Poland GHG Abatement Cost Curve

Without suggesting what specific measures policy makers should take, we highlight three main policy areas, where we believe actions are required to reduce emissions, while maximizing the economic benefit for Poland:

1. Addressing the market imperfections (e.g., subpar technical norms and standards) that limit energy efficiency and prevent other measures that have net economic benefits (e.g., waste recycling) from being implemented.

2. Establishing stable long-term incentives (e.g., CO_2 prices or taxes) to encourage power producers and industrial companies to develop and deploy GHG-efficient technologies.

3. Providing support, including sufficient incentives, for the adoption of relatively new technologies, such as hybrid vehicles, second generation biofuels, and LED lighting.

Exhibit 14

Scenarios' impact on overall reduction potential in 2020

Poland 2020

Scenario	Annual emissions $MtCO_2e$	Change vs. 1988 %	Change vs. 1990 %	Change vs. 2005 %
Business-as-usual	466	-18	2	21
Delayed difficult decisions	393	-31	-14	2
Delayed action	424	-25	-8	10
Implementation difficulties	389	-32	-15	1
Full implementation	373	-34	-19	-3

SOURCE: KASHUE, National Inventory Report; Poland GHG Abatement Cost Curve

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This report does not express a viewpoint on the existing scientific explanation of the causes of climate change. Rather, it focuses on providing objective, consistent data on opportunities to reduce GHG emissions and their expected costs. It is intended to serve as a starting point for discussions among companies, policy makers, academics, and other stakeholders on how best to manage the transition in Poland to a low-carbon economy.

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