Resource Efficiency Gains and Green Growth Perspectives in Poland

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- Poland's energy sector is mainly based on fossil sources; the power sector depends almost entirely on coal. Only 9 per cent of Poland's energy production is based on renewable energies. Despite its wealth in natural resources, energy efficiency is crucial for a balanced and sustainable development in Poland.

- Energy intensity in Poland is almost twice as high as the EU average; greenhouse gas emissions are also high (8 per cent of total EU greenhouse gas emissions). Over 75 per cent of greenhouse gas emissions are caused by the combustion of fossil fuels (mainly coal and oil). Therefore, the main potential for emissions reduction lies in the energy sector.

- Some legal, financial and organizational mechanisms have already or are currently being implemented in order to encourage the reduction of emissions. However, political measures to support eco-innovation remain only on a medium level.

- The potential for green jobs in Poland is significant. In most regions there are strong academic centres capable of conducting educational projects for the sake of green growth. The environmental awareness among the young generation increases. The main constraints for green growth are administrative barriers, the absence of a clear political strategy to modernise the energy sector, and mechanisms for using environmental charges for new investments.

Content

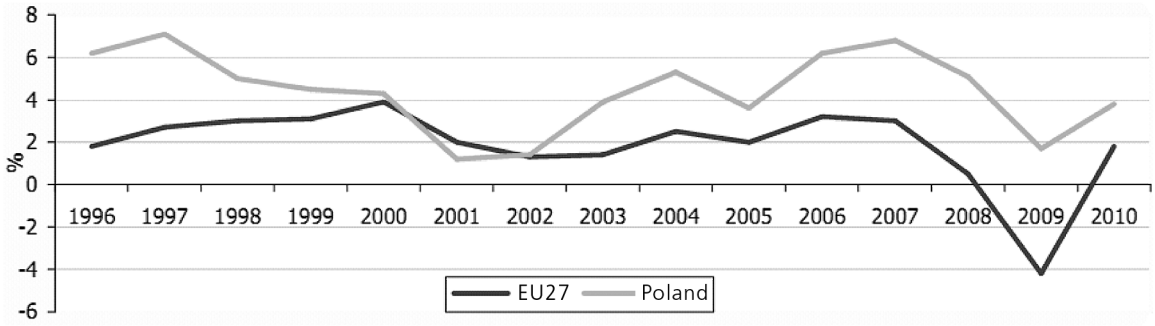
The aim of this chapter is to present current knowledge on the economic, political and social conditions for sustainable development, with particular reference to the state of the environment and Poland's natural resources. It also presents a number of critical remarks and reflections on the possibilities for implementing the concept of green growth in Poland.

1. Economic Policy in Poland

Soon after the announcement of the parliamentary election results in 2011, Donald Tusk promised the voters that »the next four years will be better, faster … we must work twice as fast and twice as hard because Poles deserve a higher quality of life and a higher quality of politics«.[1] In the October elections, his victorious *Platforma Obywatelska* (PO) (Civic Platform) party obtained 39.18 per cent of the votes. Donald Tusk – starting as »number one« in Warsaw – achieved the best result in Poland, with 375,000 votes. He is the first freely-elected prime minister in Polish history to serve two successive terms of office. The new government's economic programme was published in November last year, soon after the prime minister's parliamentary address.[2] It envisages a series of reforms of the pension and tax systems. Their purpose is to promote rapid development and to improve competitiveness in relation to other European countries. The current government's economic policy is based on the principles of solidarity and social justice. According to Finance Minister Jacek Rostowski, implementation of the reforms would be a »breakthrough without shock therapy«: in other words, a »long-march strategy«. According to PO's leaders, the party's political programme has always been designed for at least two parliamentary terms of office. It is meant to be an effective alternative to the »myth of a great reform leap forward«. Rostowski assumes that Poland needs a calm and gradual, though steadfast, reform effort in the style of Margaret Thatcher, which may last decades.[3]

Tusk's first term of office coincided with the greatest economic crisis since the Second World War. The political declarations of PO leaders, according to whom this would be a time of calm and gradual structural reforms, were quickly invalidated by social and economic reality. It now became more important to neutralise the effects of the world crisis in order to maintain economic growth, halt rising debt and reduce the excessive budget deficit. During its previous term of office, the government had carried out a few structural changes, such as raising the effective retirement age by five years for people previously eligible for earlier retirement; adopting a spending rule; and reforming teaching and higher education. According to government reports, Poland's strategy of reducing the negative impact of the crisis in 2008–2011 was the most effective in Europe. Poland recorded the fastest economic growth in the entire EU. GDP during this period rose by 15.5 per cent in contrast to the EU average, which fell by 0.5 per cent. In 2009, Poland's

Figure 1: GDP growth in Poland and the EU27, 1996–2010 (previous year =100; fixed prices)



Source: Eurostat, »Poland 2011. Economy-Society-Regions«.

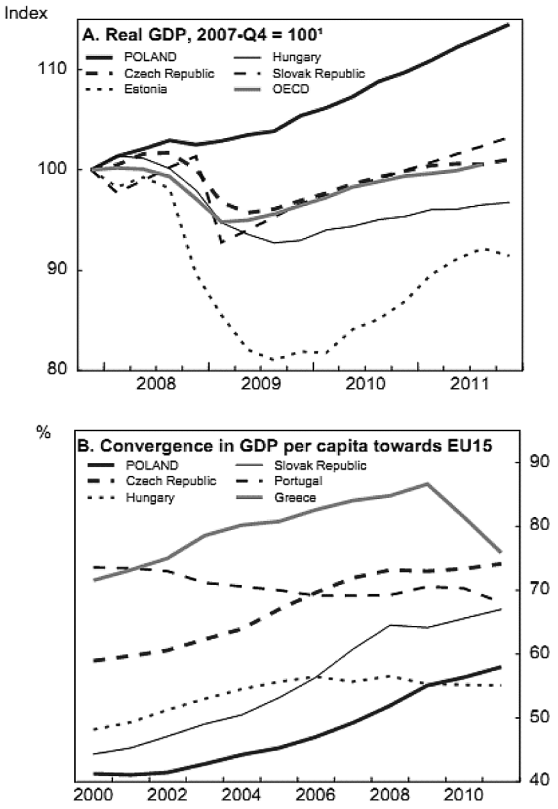
1. PAP (Polish Press Agency) report, 17 November 2011.

2. Chancellery of the Prime Minister, *Program gospodarczy nowego rządu – dokument* (the new government's economic programme – document), 18 November 2011.

3. Jacek Rostowski, *Do przyjaciół ekonomistów* (To my friends the economists), *Rzeczpospolita* 2 February 2012.

GDP rose by 1.6 per cent, the highest increase in the EU.[4] In *OECD Economic Surveys: Poland 2012*, experts show that during the economic crisis, Poland has displayed the fastest growth in GDP of all OECD member states. Assessing GDP in per capita terms, the report says that »since 2005, Poland has been catching up with the EU15 countries twice as fast as at the start of this decade. However, one notes that despite the strong economic growth in the period 2010–2011, unemployment has gradually risen to almost 10 per cent«.[5] Economic policy hitherto has exploited the development opportunities offered by access to EU funds. According to its leader, the second PO term of office is to be a period of profound structural reforms. The first half of 2012 will be crucial to the success of the entire reform plan.

Figure 2: GDP growth in Poland compared to other OECD countries



Source: OECD Economic Surveys: Poland 2012.

The new government's economic programme calls for the elimination of the excessive budget deficit, with a reduction to 1 per cent of GDP by the end of its term of office (the plan is to reduce the public finance deficit to 2.97 per cent of GDP in 2012). The ratio of public debt to GDP is also to be reduced steadily. According to the government's »Strategy for managing the public debt in 2012–2015«, in 2012 the public debt will amount to PLN 832.5 billion (52.4 per cent of GDP), in 2013 PLN 846.9 billion (50.3 per cent of GDP), in 2014 PLN 864.8 billion (48.3 per cent of GDP) and in 2015 PLN 902.2 billion (47.4 per cent of GDP). The government will continue to reform the pension system and social security system for farmers. From 2013, the retirement age for women and men will be gradually equalised and also raised to 67. The gradual introduction of a new retirement age is supposed to encourage an energetic state policy in support of the employment of older persons. The government economic programme also calls for pension reforms in the uniformed services and fairer pensions for miners. Unjustified tax concessions and loopholes are to be eliminated. Tax concessions are to be used to improve support for child rearing and to encourage families to have more children. The tax concession for internet connections will be abolished. The justification for this is that telecommunications services are becoming cheaper and the state is supporting the creation of a modern information network. According to the European Statistical Office, the fiscal burden of Poles in 2010 was almost 8 per cent of GDP below the EU average. The government regards low taxation as a permanent aspiration. A tax increase would be justifiable only by a need to ensure stable public finances in the short term. The government has adopted a straightforward macroeconomic policy: to permanently reduce public spending in the medium term (this does not apply to research and development and public investments), so that when the deficit in the public finance sector has fallen below 1 per cent, taxes can gradually be reduced (provisionally, as of 2015). An important element of government economic policy is new mechanisms of taxing revenues from agricultural production. From 2013, farms will have to maintain accounting records and their incomes will be taxed under the general rules. Income tax from farms will permit the reduction of other burdens, especially agrarian tax. Settlement of the question of accounting will also enable the creation of a modern system of social security for farmers.

4. Ministry of Regional Development, Report, *Poland 2011 Economy-Society-Regions*.

5. OECD (2012), OECD Economic Surveys: Poland 2012, OECD.

The government also reckons that the state should reap greater profits from Poland's natural resources. The economic programme envisages greater public dues levied on the extraction of resources, such as copper and silver. The exploitation of shale gas deposits in Poland holds out the prospect of considerable revenues. The government's priorities include: deregulation; improving and modernising public administration; simplifying building procedures; freeing up controlled professions; completing the disbursement of EU funds for 2007–2013; obtaining a minimum of PLN 300 billion from the EU budget for 2014–2020; continuing the expansion of infrastructure, such as roads, railways and airports; increasing spending on education and science; and reforming the health care system.

2. State of the Environment in Poland

Poland's socio-economic transformation in the 1990s, recognition of the principles of sustainable development and membership of the European Union, resulting in a duty to introduce restrictive environmental regulations, have brought visible and tangible environmental results.

In recent years one has observed a steady reduction in anthropogenic pressure on the environment. But despite a series of positive changes, there are still major environmental problems requiring solutions and appropriate regulations. At present, the biggest noticeable impact on the quality of the environment in Poland can be seen in energy (consumption of fossil fuels and the consequent atmospheric emissions); agriculture (broad negative impact on soil, water and biological diversity); the communal economy (creation and neutralisation of waste and waste disposal); uncontrolled urbanisation and expansion of infrastructure (urban sprawl, soil sealing, fragmentation of habitats and increased levels of emissions) and industry, services and unbalanced patterns of consumption.[6]

2.1 Natural Resources

Poland enjoys great biological and landscape diversity. It has been shaped by a transitional climate (between maritime and continental); a diversified terrain and geological structure; its soil resources; an absence of natural ecological barriers; uneven industrialisation and urbanisation; the widespread preservation of traditional extensive farming; and extensive afforestation.[7] Some 485 families of plants and 47,000 species of wild animals have been identified in Poland. At the end of 2009, 32.3 per cent of Poland's territory was protected by domestic forms of nature conservation.[8] Part of the areas under nature conservation (all national parks and some landscape parks) forms the Natura 2000 system. The Natura 2000 network now embraces 19.8 per cent of Poland's territory and comprises 823 habitats, constituting 11 per cent of Poland's territory, and 144 special protection areas for birds, constituting 15.8 per cent of Poland's territory.[9] Forests are an important part of the country's ecological system, accommodating 65 per cent of all animal species. Poland has around 9.1 million hectares of forest, 29.2 per cent of the country's surface. The country's policy of afforestation calls for an increase in the forest area to 30 per cent by 2020, and to 33 per cent by 2050.[10]

2.2 Water Resources

The quantity of water available per head of population in Poland is about 1,500 m^3 per year. This is one of the lowest figures in Europe (36 per cent of the European average). Surface waters are very variable and unevenly distributed over the country. Total flowing water resources in Poland are about 61.9 billion m^3 per year on average. Specific runoff is 5.0 l/s km^2, almost half the European average. Underground water resources (included among partly renewable resources) are estimated at 37.7 million m^3 per day, equivalent to 1 m^3 of water per day per head of population. They are not much used for commercial purposes. Poland's greatest challenge in water management is the promotion of balanced water consumption and rational satisfaction of water demand from the population, agriculture and industry. In recent years, water consumption broken down into sectors has been as follows: about 70 per cent of water is consumed

6. OECD (2012), ibid.

7. Forecast of the environmental impact of the draft strategy »Energy Security and the Environment«, FUNDEKO, Wrocław (2011).

8. Report on the state of the environment in Poland 2008, Environmental Monitoring Library, Warsaw (2010).

9. *Natura 2000 in Poland*, report available at http://natura2000.gdos.gov.pl, dated12-04-2012.

10. Ministry of the Environment, National Programme of Increased Afforestation, Warsaw (2003).

by industry (over 80 per cent of which by the power sector), 20 per cent by the communal economy and 10 per cent by agriculture (9 per cent for fish ponds and 1 per cent for irrigation).[11] For several years, overall water consumption for the needs of the national economy and population has remained at a relatively constant level, at about 10,550 hm^3. Overall water consumption has fallen by 0.8 per cent compared to 2004. In the communal sector, water consumption has fallen by about 3.7 per cent. The highest amount of water consumption of 7606.1 hm^3 (73.8%) has been noted in industry (information as of 2009). However, industrial use of water resources has fallen by 2.1 per cent since 2004. In 2004–2009 a gradual decline was observed in the industrial water consumption index, taken to mean the amount of water consumed for industrial purposes in relation to the value of sold industrial output. The industrial water consumption index fell from 11.5 m^3 per thousand zlotys in 2004, to 8.5 m^3 per thousand zlotys in 2009.[12]

Table 1: Water consumption to satisfy the needs of the national economy and population, Poland (hm^3)

2004	2005	2006	2007	2008	2009	2010
10441.5	10382.0	11253.8	10864.0	10233.6	10309.5	10356.5

Source: Indicators of Poland's sustainable development.

For several decades, the quality of Poland's surface waters has been adversely affected by discharges of communal and industrial waste, either untreated or insufficiently treated. In 2010, the quantity of waste discharged into surface waters was 9,216.8 hm^3, most of which (7,919 hm^3) was industrial waste. Proper development of the water-sanitary infrastructure (including the construction of new waste treatment plants) in recent years has served to reduce water contamination. In 2007–2010, the water distribution network in the whole of Poland increased by about 8.6 per cent to 272,888 km at the end of 2010. The total length of the drainage network in Poland in 2010 was 107,509.1 km, 22,652.9 km (26.7 per cent) more than in 2006. The most important indicator is the percentage of the population using waste treatment plants. In 2010, 65.2 per cent of the population were covered by waste treatment plants (3.8 per cent more than in 2006). The above figures illustrate positive changes to infrastructure, beneficial to the environment. Thanks to these changes, the quality of Poland's waters is improving steadily. Nevertheless, most flowing surface water is still sub-standard, mainly due to its sanitary condition.[13]

2.3 Mineral Resources

The most important mineral resources in Poland, exploited with varying degrees of intensity, are bituminous coal and brown coal, natural gas, oil, copper ore (around 3.3 per cent of the world's output), zinc and lead ore, silver, sulphur, rock salt and common minerals (for example, those used in construction, such as sand, gravel and clay for construction ceramics).

Coal

Poland has considerable reserves of bituminous and brown coal compared to other European countries. Bituminous coal reserves of some 44.3 billion tonnes (about 16.9 billion tonnes of which are exploited) are located in 139 deposits (48 of which are mined). Brown coal resources of some 19.8 billion tonnes (over 1.7 billion tonnes of which are exploited) are located in 86 deposits (11 of which are mined).[14] Even though Poland is still the world's ninth biggest producer of bituminous coal, extraction has been falling steadily. In 1979, bituminous coal extraction was estimated to be 201 million tonnes, but in 2009, only 77.4 million tonnes were extracted, 62 per cent of the entire output in the EU.[15] Coal mines have been undergoing successive restructuring since the beginning of the 1990s. The coal balance is falling due to extraction, losses during mining and verification and reclassification attributable to the specific nature of the market economy.[16] In 2008, domestic extraction of bituminous coal was not enough to satisfy demand, and for the first time Poland imported it, mainly from Russia.

11. National Water Economy Board, Diagnosis of the current condition of water management. Annex 1 to Draft State Water Policy up to 2030 (taking into account stage 2016), Warsaw (2010).

12. Central Statistical Office/Statistical Office of Katowice, Indicators of Poland's sustainable development, Katowice (2011).

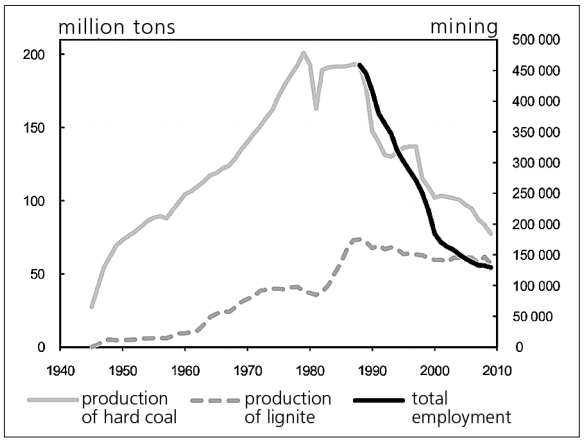
13. Environmental impact forecast… op. cit.

14. Ministry of Regional Development: Report Poland 2011.

15. OECD/IEA (2011), Energy Policies of IEA Countries: Poland 2011 Review.

16. Environmental impact forecast.

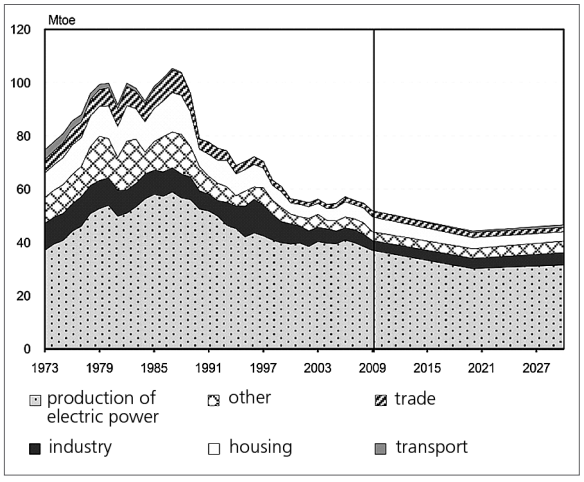
Figure 3: Bituminous and brown coal output in Poland and total employment in the mining sector , 1945–2009



Source: OECD/IEA (2011).

Over the past 20 years, the extraction and production of brown coal has not decreased significantly, amounting to some 60 million tonnes per year. In 2009, brown coal extraction was estimated at 57.1 million tonnes per year, which means that Poland is still the third biggest producer of brown coal in the EU. Poland's per capita coal reserves are among the biggest in the world. At the current production level, coal resources may suffice for a further 200 years of development.

Figure 4: Coal supply by economic sector



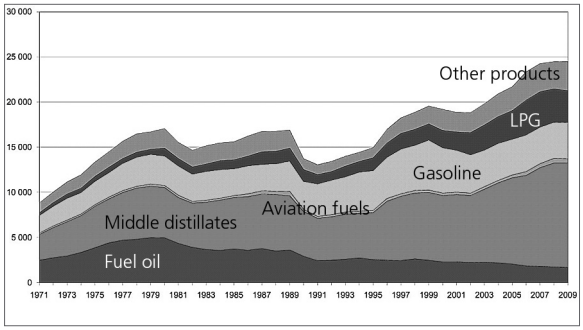
Source: OECD/IEA (2011).

The problem is the economic feasibility of extraction. Coal reserves whose extraction is viable may be much lower than the statistics suggest. The chief consumer of bituminous and brown coal in Poland is the power industry. Over 70 per cent of coal is used to produce electricity. Over 99 per cent of the brown coal produced is used by electricity and heat generating plants. The industrial sector consumes 8 per cent of the coal. The housing sector uses another 9 per cent. The biggest industrial consumers include coking plants, steelworks and metallurgical plants, chemical and petrochemical plants, non-metal processing enterprises and the agricultural and food sector, including tobacco and beverage production.[17]

Oil

Oil is Poland's second largest energy source; 84 oil deposits were recorded in 2009. Extractable reserves of oil and condensate amounted to 26.29 million tonnes. Annual oil output reached about 1.6 million tonnes. This is equivalent to 25,000 barrels of oil products per day (kb/d). This level of output satisfied 5 per cent of domestic demand. The remainder of domestic demand (26.7 million tonnes, 558 kb/d) is covered by imports (94 per cent from Russia, 2 per cent from Algeria and 1 per cent from the United Kingdom and Norway). For several years, demand for oil has been rising at about 3 per cent per year. In 2009, demand was estimated to be 24.5 million tonnes (533 kb/d).

Figure 5: Overall consumption of oil products by category, in thousands of tonnes



Source: IEA Energy Statistics.

The biggest demand for oil derivatives comes from the transport sector, which accounts for 60 per cent of overall consumption. The share of transport in the oil market has

17. OECD/IEA (2011).

increased by 10 per cent over the past decade. This has been at the expense of industry, trade and agriculture. Fuel oil and heating oil are the most sought-after products on the oil market. The demand for these distillates accounts for almost 50 per cent of total oil demand (an increase of 65 per cent since 2000). Today, transport uses twice as much fuel oil as ten years ago.[18] In 2010, 1,551.8 million tonnes of goods were delivered by road transport, 39.3 per cent more than in 2006.[19] In 2000 there were over 14 million registered vehicles in Poland, whereas in 2009 there were already more than 22 million.[20]

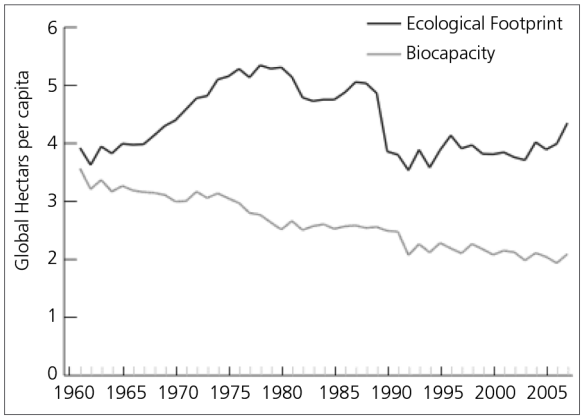
Natural Gas

Reserves of natural gas are significantly smaller than those of oil and coal. At the end of 2010 Poland had 280 natural gas deposits (190 of them exploited), and their total balance amounted to 145.15 billion m^3 (including 120.89 billion m^3 in exploitation). In 2009, industrial deposits of natural gas amounted to 64.90 billion m^3. In 2009, extraction of natural gas from deposits with a recorded capacity reached 5.8 billion m^3. Intense research into and exploration of shale gas deposits took place in 2011. The discovery of major deposits of shale gas could create new prospects for the country's energy balance.[21] Average daily natural gas consumption in Poland in 2009 fluctuated between 30.2 million m^3 (in summer) and 62.2 million m^3 (in winter). Current forecasts for domestic demand for this resource are about 16.4 billion m^3 and are constantly rising.[22] Forecasts suggest that the demand for gas (in relation to 2009) will rise by 28 per cent in 2020 and by 52 per cent in 2030.[23] About one-third of the overall gas supply comes from domestic resources and the remainder is imported: Russia accounts for 82 per cent and Germany accounts for 11 per cent of Poland's gas imports. The main recipient of natural gas in Poland is industry, with a share of 37 per cent of the total supply. The housing sector uses 26 per cent and the services sector 13 per cent of natural gas resources. Only 10 per cent of Poland's natural gas is used for electricity and heat generation. Natural gas had only a 2 per cent share of energy output in 2009.[24]

2.4 Use of Resources

The economic growth trends observable in Poland over the past decade have translated into a gradual improvement in the standard of living. The human development index (HDI), which takes into account, among other things, incomes, health, education and poverty, stood at 0.813 in 2011, putting Poland in 39th place among the most developed countries.[25] At the same time, Poland's ecological footprint was 4.3 so-called global hectares (gha) per person (figures for 2007, European average 4.7 gha per person). If we note that the production capacity of Poland's environment is 2.1 gha per person, we see that Poland consumes twice the quantity of resources available on its territory.[26]

Figure 6: Resource demand per capita (ecological footprint) and resource supply (biocapacity), Poland 1961–Present



Source: Global Footprint Network.

In the long term, more efficient use of natural resources is crucial for balanced and stable development, guaranteeing a better quality of life and the prosperity of the population. Domestic materials consumption (DMC) – total materials directly consumed in economic processes

18. OECD/IEA (2011).

19. Ministry of Regional Development: Report Poland 2011.

20. PZPM (2011), Report by the motoring branch, 2011.

21. Ibid.

22. OECD/IEA (2011).

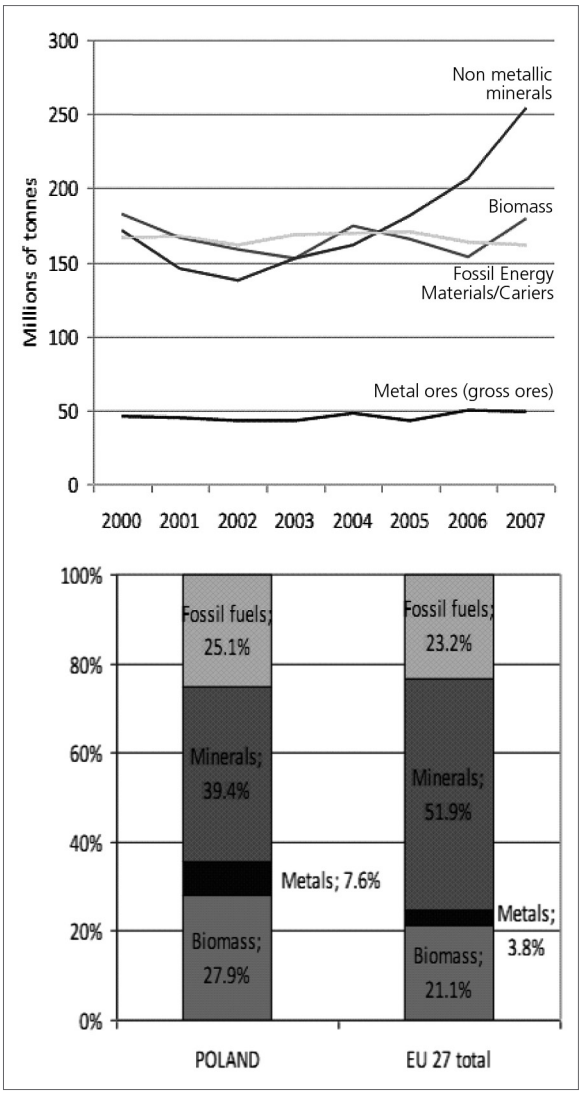
23. Ministry of the Economy (2009), Poland's energy policy up to 2030, Warsaw.

24. OECD/IEA (2011).

25. UNDP (2011), Human Development Report 2011. Sustainability and Equity: A Better Future for All.

26. Chief Environmental Protection Inspectorate (2011), The State of the Environment in Poland. Signals 2011. Environmental Monitoring Library.

Figure 7: Domestic material consumption (DMC) by category over time and breakdown of DMC by type of materials, Poland



Source: Eurostat (EEA 2011 Survey of resource efficiency policies in EEA member and cooperating countries - POLAND)

for the needs of the national economy – rose by 13 per cent between 2000 and 2007. During the same period, GDP increased by 30 per cent in relative terms. In 2007, DMC was 642,107,000 tonnes. In terms of materials consumption, Poland occupies sixth place in Europe. Almost 40 per cent of all consumed resources are non-metallic raw materials, for example, mineral construction materials. Biomass accounts for 28 per cent and fossil fuels for 25 per cent of domestic consumption. Metal ores account for almost 4 per cent of DMC.[27] The drastic increase in the consumption of minerals is attributable to the realisation of infrastructural projects and the development of the construction sector since 2004.

One yardstick of the economy's materials intensiveness is the material productivity index, measured as the ratio of GDP to DMC. The lower this index, the more materials are needed to create one unit of GDP. According to Eurostat figures, in 2000–2005 Poland's material productivity index rose from USD 500 ppp/tonnes DMC to USD 581 ppp/tonnes DMC. During the same period, the EU27 average rose from USD 1052 ppp/tonnes DMC to USD 1,144 ppp/tonnes DMC. This means that Poland's economy is highly materials-intensive, twice as high as the EU27 average.

The intensiveness of resource consumption is an important gauge of an economy's environmental efficiency. Extraction, processing and consumption of resources involve the emission of pollutants and the creation of waste. Over 90 per cent of all waste from the exploitation of natural resources is industrial waste. The structure of industrial waste is as follows: processing is responsible for over 45 per cent of all waste, metals production for over 30 per cent, mining for around 29 per cent (of which including bituminous coal mining accounts for 26 per cent) and electricity generation and distribution for around 14 per cent). Most industrial waste comprises sediment left from the enrichment of non-metallic ores by means of flotation (27 per cent), waste from the rinsing and cleansing of minerals (25 per cent) and ash-gravel mixtures from the wet disposal of combustion waste (8 per cent).[28] A total of 113.5 million tonnes of industrial waste were produced in 2010. The amount of waste produced annually has stabilised in recent years. There is also a negative relationship between economic growth and increased waste (GDP is increasing while overall waste production is decreasing).[29] Most industrial waste (around 73.4 per cent) is recycled. About 19.2 per cent of all waste is still neutralised through disposal. Communal waste accounts for about 10 per cent of all waste produced annually. The quantity of waste produced by households is linked to individual consumption levels and patterns. Over the past decade the private consumption index has risen by 34 per

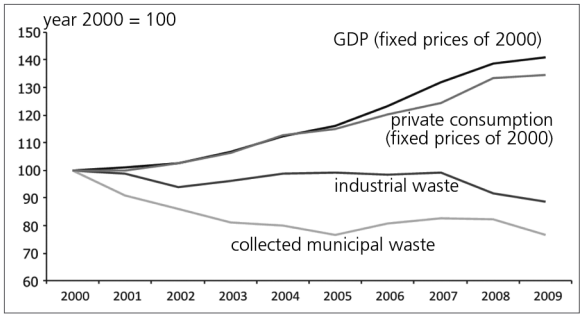
27. Chief Environmental Protection Inspectorate 2011, op. cit.

28. Chief Environmental Protection Inspectorate (2011).

29. Ministry of Regional Development: Report Poland (2011).

cent, while the quantity of collected waste has fallen by almost 23 per cent. Some 12 million tonnes of communal waste were produced in 2009, 316 kg per capita (the European average is 512 kg of communal waste per capita). The chief method of managing communal waste is disposal. The number and size of waste disposal sites has been falling steadily from one year to the next. In 2009, there were 803 waste disposal sites in Poland, occupying an area of 2,820.7 hectares. Some 78 per cent of all collected communal waste was deposited in waste disposal sites in 2009. The per capita quantity of waste neutralised through disposal was 206 kg, compared to an EU average of 192 kg per capita.[30]

Figure 8: Changes in the production of industrial and communal waste against changes in GDP and private consumption

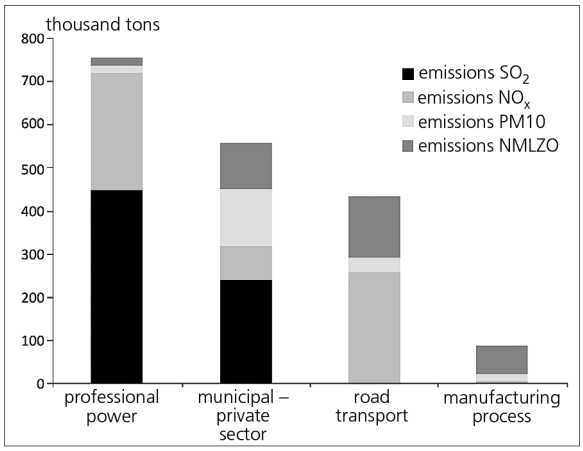


Source: Central Statistical Office via: the Chief Environmental Protection Inspectorate (2011).

3. Atmospheric Pollution

Pollution of the atmosphere in Poland is determined by annual measurements of the presence of sulphur dioxide, nitrogen dioxide, carbon monoxide, benzene, ozone and PM10 suspended dust. Lead, arsenic, cadmium, nickel and benzopyrene pollution are also tested. Air quality in Poland has improved in recent years. The common air quality index CAQI is falling steadily. The CAQI for four pollutants (SO2, NO2, O3, PM10) fell by 40 percentage points during the period 1997–2009.[31] Given that the fall in the emission of primary pollutants has been accompanied by steady economic growth, one can say that a decoupling of economic growth from emissions is occurring in Poland.[32] Despite the improved air quality, excessive concentrations of ozone in the troposphere, suspended dust PM10 and benzopyrene remain a problem. The main sources of dust pollution are the heating systems of buildings, exhaust gases from vehicles and emissions from industrial installations and power and heating plants. The amount and type of pollution emitted reflects the unimproved structure of energy carriers. The quality and quantity of emitted dust has a major impact on pollution. Key factors in the magnitude of emissions in Poland are the technologies for producing energy, the efficiency of exhaust treatment systems and the fuels used by the communal and housing sector.

Figure 9: Emission of chief pollutants in Poland in 2009 by sectors of the economy



Source: Ministry of the Environment, Chief Environmental Protection Inspectorate (2011).

3.1 Emissions of Greenhouse Gases

In 2009, Poland was in fifth place in terms of the quantity of greenhouse gas emissions in Europe. Poland is responsible for 8 per cent of total EU greenhouse gas emissions. Greenhouse gas emissions have fallen by 16.8 per cent since 1990; in fact, compared to the base year 1988, after which the political and economic transition commenced, emissions have fallen by 33.2 per cent.

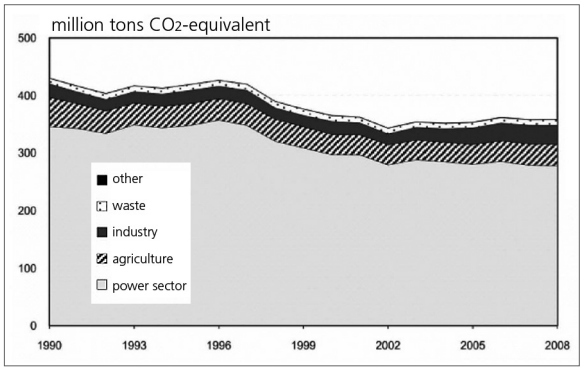
30. Central Statistical Office/Katowice Statistical Office, Indicators of sustainable development.

31. Kobus D. Ocena zmian zanieczyszczenia powietrza w Polsce w latach 1997–2009 z wykorzystaniem *indeksu jakości powietrza* (An assessment of air pollution in Poland in 1997–2009 with the use of the air quality index) in: *Przemysł Chemiczny* 90/2(2011), Warsaw (2011).

32. Chief Environmental Protection Inspectorate (2011).

A major fall in emissions of 19 per cent in the period 1988–1990 is attributable to the abrupt economic transformation and the collapse of many energy-intensive and highly polluting branches of industry. Despite economic growth, over the past twenty years greenhouse gas emissions have remained relatively stable at about 30 per cent below their 1988 level. An annual increase in emissions of 1.4 per cent has been noted in recent years.[33] In 2008, greenhouse gas emissions in Poland reached 397 Mt of CO_2 equivalent, 80 per cent of which was attributable to the energy sector.[34]

Figure 10: Greenhouse gas emissions by origin, 1990–2008



Source: OECD/IEA (2011).

Over 75 per cent of greenhouse gas emissions is caused by the combustion of fossil fuels. The main greenhouse gas is carbon dioxide, with an 82 per cent share of total emissions. It derives mainly from the combustion of coal: in 2009, 193.9 million tonnes of CO_2 were discharged into the air in this way. The combustion of oil discharged 63.8 million tonnes and that of natural gas 25.8 million tonnes of CO_2. Remaining sources of emissions are negligible. At the same time, CO_2 emissions from coal combustion fell by 32.1 per cent in the period 1990–2009. Emissions from oil combustion rose by 84.9 per cent and emissions from gas combustion rose by 39.8 per cent.[35] Increased emissions caused by oil combustion can be attributed to the dramatic growth of the transport sector in Poland.

33. McKinsey and Company (2009), An Assessment of the Potential for Reducing Greenhouse Gas Emissions in Poland by the Year 2030.

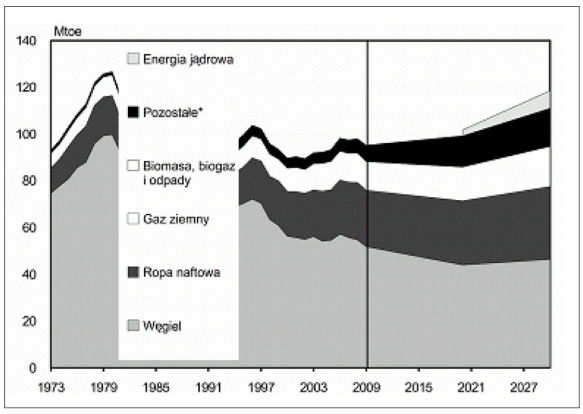
34. OECD/IEA (2011).

35. IEA/OECD (2009), CO_2 Emissions from Fuel Combustion, Paris.

3.2 Energy Production

In 2009, primary energy output in Poland reached almost 95 million tonnes of oil equivalent (Mtoe). This is markedly below the record level of 1987, when domestic energy output reached 133 Mtoe. Most of Poland's energy is from non-renewable sources, while the power sector depends mainly on coal-fired power stations. Bituminous coal accounts for 45 per cent of total primary energy consumption (as of 2009). Dependence on coal can be seen particularly in electricity production, in which 59 per cent of electricity is produced from bituminous coal and 31 per cent from brown coal. The use of coal to produce electricity is diminishing very slowly (by 0.6 per cent over the past five years); furthermore, electricity is produced in antiquated power and heating plants with low-efficiency condensation blocks.[36] Power stations are located mainly in the south and centre of the country. There are only two power stations in the north. Because of the uneven distribution of power stations in Poland, the energy has to be transported over long distances. The electricity grid is being used to high capacity, while the fixed assets are in a serious state of dilapidation. This not only results in losses during transmission, but also reduces the reliability of electricity supply to consumers in the north and east of the country. In 2009, 93 per cent of primary energy was produced from fossil fuels (25 per cent from oil and 13 per cent from gas).[37]

Figure 11: Total primary energy output by origin, 1973–2030 (remainder: water, wind, geothermal and solar energy)



Source: OECD/IEA (2011).

36. Environmental impact forecast.

37. OECD/IEA (2011).

In 2009, 9 per cent of overall energy production was from renewable energy sources (RES).[38] According to the IEA, this percentage was 7.3 per cent, equivalent to 6.95 Mtoe. RES energy in the EU27 countries is estimated to be 18.3 per cent of all energy. Poland is in 16th place among the 28 member states of the IEA in terms of the intensive use of RES.

In 2009, 95.7 per cent of the RES supply came from biomass and waste. Almost 3 per cent of energy was produced in water power stations. Some 1.3 per cent came from wind farms. Geothermal and solar energy had a marginal share in energy output.[39] According to domestic sources, 86.1 per cent of the energy produced in 2009 came from biomass, 7.1 per cent from biofuels, 3.4 per cent from water power and 1.6 per cent from biogas. Wind energy accounted for 1.5 per cent and geothermal energy accounted for 0.2 per cent of the total RES energy produced.[40]

Table 2: Generation of primary energy from renewable sources in Poland in 2001–2009[41]

2001	2002	2003	2004	2005	2006	2007	2008	2009
5.1	5.2	5.2	5.5	5.8	6.1	6.7	7.6	9.0

In terms of electricity production from renewable sources, Poland is third from the bottom among the IEA member states. In 2010, total RES energy output was 10,888.8 GWh; a decade earlier, this figure was 2,783.0 GWh. Most electricity is obtained from biomass (56.5 per cent), followed by water power (27.4 per cent) and wind energy (12.4 per cent). Biogas accounts for 3.7 per cent of electricity generation. Wind energy is the most dynamically developing sector of electricity production. The average annual power capacity increase in this sector in 2000–2008 was 107.7 per cent; in the case of biogas, this increase is estimated to be 24.9 per cent per year. The processing of biomass has risen at a rate of 11.5 per cent per year.[42]

38. Chief Environmental Protection Inspectorate (2011).

39. OECD/IEA (2011).

40. Central Statistical Office 2011, Energy from renewable sources in 2010, Warsaw.

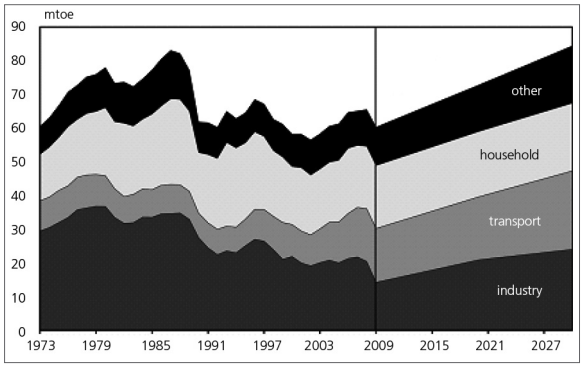
41. Ibid.

42. OECD/IEA (2011).

4. Potential for Reducing Emissions

Political changes, economic restructuring and the conditions governing management of resources have caused constant changes in energy demand. A fall in energy demand by an average of 1.2 per cent per year was observed in the period 1990–2002. Afterwards, consumption began to increase slowly (by about 2.4 per cent per year) until 2008. In 2009, energy consumption fell by 3 per cent against the period 2006–2008,[43] which can be attributed to the global crisis. But in 2010 electricity consumption rose again, reaching its highest level in history at 156 TWh.[44] The structure of final energy consumption illustrates the main directions in which economic development is heading. On the one hand, less energy is being used in the industrial and private household sectors, while more is being used in transport and services.

Figure 12: Final total energy consumption by sectors, 1973–2030 (others include the commercial sector, public services, agriculture and fishing)



Source: OECD/IEA (2011).

In 2009, final energy consumption in individual sectors of the Polish economy was as follows: industry 24 per cent, transport 27 per cent, domestic households 31 per cent, agriculture 6 per cent and services 12 per cent.[45] The structure of consumption broken down by energy carriers in 2009 was: coal 18 per cent, liquid fuels 33 per cent, gas 14 per cent, heat energy 11 per cent, electricity 16 per cent and others 8 per cent.[46] The share of RES en-

43. Central Statistical Office (2011), Efficiency of Energy Use in 1999–2009, Warsaw.

44. Environmental impact forecast.

45. Chief Environmental Protection Inspectorate (2011).

46. Central Statistical Office (2011).

ergy in total energy consumption was 7.9 per cent. Current government policy calls for an 15 per cent increase of RES energy in the final energy balance by 2020, and a 20 per cent increase by 2030.[47]

Even though the demand for energy is rising more slowly than economic growth, Poland has one of the highest levels of energy-intensiveness in Europe. Energy-intensiveness, taken to mean the relationship of energy consumption to GDP, is almost twice the EU average (Poland is in eighth place in the energy-intensiveness rankings). In 2008, the Polish economy's energy-intensiveness was 383.54 kgoe/EUR 1,000. The EU27 average at the same time was 167.11 kgoe/EUR 1,000. The above figures show that there is strong potential for reducing energy consumption in Poland. The Polish economy's energy-intensiveness has fallen by almost 30 per cent since 1998, while at the same time average energy-intensiveness in the EU has fallen by about 17 per cent.[48] In 2008, Poland's energy-intensiveness was 30 per cent higher than the average among IEA member states. An examination of the evolution of the energy consumption index shows that there is a long-term trend towards the level of energy-intensiveness of the OECD and EU countries. The present decline in the Polish economy's energy-intensiveness is estimated to be around 3 to 5 per cent per year.

4.1 Energy Saving and Emissions Reduction

Under the adopted climate-energy package and ratified Kyoto Protocol, Poland has committed itself to:

- reducing greenhouse gas emissions by 20 per cent of their 1990 level by 2020;
- increasing the share of RES energy in total energy consumption by 20 per cent by 2020;
- increasing energy efficiency by 20 per cent in relation to forecasts by 2020;
- increasing the share of RES energy (biofuels) used in transport by 10 per cent.[49]

Reductions in greenhouse gas emissions during the period 1988–2009 were as follows: overall energy combustion –34 per cent; energy industry –36 per cent; processing and construction industry –45.1 per cent; aircraft exhaust fumes –40.9 per cent; industrial processes –25.0 per cent; use of solvents –26.2 per cent; waste matter –5.3 per cent; and farming –30.6 per cent. The biggest increase in level of emissions was noted in the transport sector, at 99.6 per cent, and in connection with changes to land usufruct (LULUCF), at 248.7 per cent.[50] However, this does not alter the fact that the Polish economy has one of the highest emissions levels in the EU; per capita greenhouse gas emissions in Poland are higher than in the 11 other EU member states whose the per capita incomes are higher than in Poland.

As shown above, the high level of emissions in Poland is attributable mainly to the fact that energy production is based mainly on coal. This means that Poland has great potential to further reduce greenhouse gas emissions at relatively low final cost. However, the government fears that the high costs of investing in low-emission technologies may weaken the economy's price competitiveness, reduce energy security and diminish production in real terms.[51]

Official government forecasts produced for the needs of state energy policy envisage a 21 per cent increase in the demand for primary energy by 2030. Overall demand will reach 118.5 Mtoe in 2030. The greatest increase in energy demand will occur after 2020. Regarding primary energy carriers, consumption of bituminous coal will fall by about 16.5 per cent and that of brown coal by 23 per cent, while gas consumption will rise by about 40 per cent. The share of RES energy in total primary energy consumption will rise to 12.4 per cent in 2030. The government's forecasts still take into account a 6.5 per cent share of nuclear energy in primary energy consumption. CO_2 emissions are to gradually decrease to about 280 million tonnes in 2020. In 2030, emissions will exceed 300 million tonnes.[52]

47. Ministry of the Economy (2009).

48. Chief Environmental Protection Inspectorate (2011).

49. Kyoto Protocol to the UN Framework Convention on Climate Change, drawn up in Kyoto on 11 December 1997 (OJ 17 October 2005).

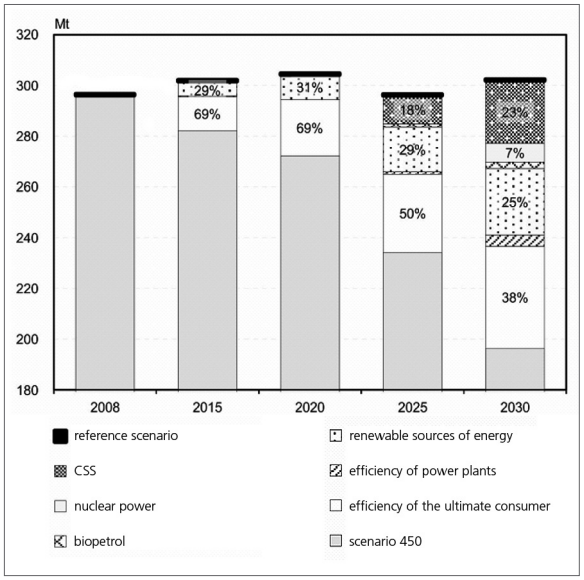
50. UNFCCC, National greenhouse gas inventory data for the period 1990–2009.

51. OECD (2012).

52. Ministry of the Economy/Energy Market Agency (2009), Forecast of fuel and energy demands by 2030, Warsaw.

According to the IEA[53], the demand for primary energy in Poland will reach about 115 Mtoe by 2030. This is an estimate based on the so-called reference scenario which envisages no changes to energy policy at all and the continuation of current market trends. If Poland adopts the package of solutions to restrict atmospheric greenhouse gas concentrations to 450 ppm in the long term – the so-called Scenario 450 – the demand for energy will be 104 Mtoe. The scenarios of energy demand are accompanied by the relevant emissions scenarios. According to the reference scenario, CO_2 emissions in 2030 will reach 302 $MtCO_2$.

Figure 13: Reduction of CO_2 emissions from fuel combustion in Poland, by type of fuel, 2008–2030



Source: IEA (2010), Energy and CO2 Emissions Scenarios, Poland.

If integrated modernisation solutions are introduced (Scenario 450), emissions could be reduced by 35 per cent to 196 $MtCO_2$. The IEA calculates that the cost of reducing greenhouse gas emissions will reach EUR 113 billion by 2030. About 70 per cent of this is to be spent on modernising the transport sector. Electric power stations will require some EUR 16 billion in investments. Housing will swallow up about EUR 12 billion. The annual increase in spending on reducing emissions is expected to reach 1.2 per cent of GDP.

53. IEA (2010), Energy and CO2 Emissions Scenarios of Poland, IEA working paper, Paris.

A comprehensive report by McKinsey & Co. on the possibilities of reducing greenhouse gas emissions in Poland by 2030 shows that, in the reference scenario, annual emissions of greenhouse gases in the target timeframe may reach 503 $MtCO_2$. Analyses indicate that full use of current technological potential will allow emissions to be reduced to 20 per cent of the reference level by 2020. Further reductions in emissions by 2030 will require a thorough change of lifestyle and investment in more expensive technologies. Buildings and vehicles will have to be more economical with energy. The share of low-emission energy in total electricity output would have to be over 50 per cent and the emission-intensiveness of GDP would have to fall by 70 per cent of the present value. Determined and comprehensive action to improve energy efficiency and guarantee low-emission energy sources, carbon capture and storage (CCS) and modernisation of industry, waste management systems and agriculture could enable a 47 per cent reduction in emissions by 2030 (in relation to the reference level). Annual emissions would then amount to 267 $MtCO_2$ at an average cost of reduction of 10 euro/$MtCO_2$. It is worth noting that an increase in energy efficiency and the use of low-emission sources of energy account for 70 per cent of the entire potential for reducing emissions. A possible reduction of emissions by 68 $MtCO_2$ (29 per cent) could be achieved by introducing more economical vehicles, insulating buildings and introducing systems to control the energy efficiency of industrial machinery and equipment. The greatest possibilities for improving energy efficiency are in the construction and housing sector. Replacing coal with low-emission electricity, electricity generation by wind farms and nuclear power stations and the use of biomass will bring savings in the region of 100 $MtCO_2$ (42 per cent). The cost of implementing low-emission solutions has been estimated at EUR 21/$MtCO_2$. Almost twice as expensive (EUR 38/$MtCO_2$.) are carbon capture and storage (CCS) systems. These could reduce emissions by about 36 MtCO2e (15 per cent) per year. Emissions could be reduced by over 7 per cent of the entire reduction potential by reducing methane and nitrogen peroxide waste in agriculture and the economy. The most important tasks in this domain include the capture of waste gases, intensification of recycling and application of best practices in agriculture. The use of biofuels in transport alone will reduce emissions by about 2 MtCO2e in 2030. An examination of the possibility of reducing greenhouse gas emissions in Poland by sector has shown that over half of the possible reduction can be achieved in the energy sector, comprising the

electricity, oil and gas industries. Industry can attain some 12 per cent of the possible reduction. Transport, construction and waste management have a 31 per cent share in possible greenhouse gas reductions. The remaining possible 5 per cent reduction can be achieved in forestry and agriculture.[54]

According to the Institute for Eco-Development,[55] development scenarios envisaging a reduction in CO_2 emissions by 48 by 2020 and by 57 per cent by 2030 compared to 1996 are feasible. The ambitious programme of reducing energy-intensiveness is expected to cost some EUR 103 billion by 2030. The proposals for strategic solutions underline the economic unfeasibility of developing nuclear energy, the significance of dispersed energy and the need for fundamental changes in transport policy.

The forecasts and scenarios presented above exemplify the more or less probable future shape of energy production and consumption. The pollution simulations are presented in a long-term horizon up to 2030. An even more distant prospect, up to 2050, has been presented by Greenpeace Poland in conjunction with the Institute of Renewable Energy.[56] Assuming that the economy will be low energy-intensive and that there will be a major stimulus to local investments in RES, greenhouse gas emissions in Poland could be reduced to 210 $MtCO_2$ by 2050, a per capita reduction of 36 per cent. According to the authors of the report, renewable energy sources could cover 48 per cent of the demand for primary energy, while demand itself will fall by 13 per cent. Renewable energy sources could provide 80 per cent of electricity, 50 per cent of heat and 36 per cent of transport fuels and energy.

These are just a small selection of publications devoted to the future of energy in Poland. Over a dozen similar analyses have been produced since 2008. A review and assessment of these analyses is the subject of separate surveys and studies, which should result in conclusions and recommendations for a national programme for reducing emissions.[57]

54. McKinsey & Company (2009).

55. Institute for Eco-Development (2009), extract from Poland's Alternative Energy Policy up to 2030, Technical-methodological report, Warsaw.

56. Greenpeace Poland (2008), *Energy (R)evolution for Poland. Scenario for Poland's Supply of Clean Energy Carriers in the Long Term*.

57. Ministry of the Economy (2011), Energy Mix 2050, An Examination of Scenarios for Poland, Warsaw.

The March meeting of the EU Council for the Environment was devoted to discussing the concept of so-called milestones along the road to CO_2 reductions in the EU by 2050. The Danish presidency has proposed that the EU reduce emissions by 40 per cent by 2030, by 60 per cent by 2040 and by 80 per cent by 2050, compared to 1990. Poland has not yet approved this proposal. It is the only EU country not to have agreed to the ambitious new reduction plans. The Polish government believes it is too soon to define new political challenges if the energy-climate package does not come into force by 2013. Poland does not question the viability of climate policy, but the tools for implementing it should be adapted to the capabilities of individual member states.[58]

4.2 Economic Innovation

According to the latest Innovation Union Scoreboard 2011[59] Poland occupies last place in the group of »moderate innovators« and is 23rd in the EU27. Poland's strong points are human resources, investments in enterprises and economic performance. Areas requiring intervention are the interface between the public and private sectors, the protection of intellectual property and the quantity of innovative enterprises, which should be higher. Public support for innovation is gradually increasing. Spending on science has risen slightly: outlay in the 2012 budget totals PLN 6.37 billion, 18.36 per cent more than in 2011. This is a 70 per cent increase compared to 2007; the government presently allocates 0.75 per cent of GDP to science. The increased outlay is accompanied by essential reforms to science and higher education. The funding of primary research has been separated from funding of applied research and development. A National Science Centre and National Centre for Research and Development have been formed. The standard of education is still disturbing. Spending per pupil (student) in relation to GDP is very low. According to the OECD's report on Poland, in this respect Poland is ahead only of Brazil, Argentina, Chile and Mexico. Education spending as a whole is about 5.7 per cent of GDP, close to the OECD average.[60]

58. Marcin Korolec, *Ochrona klimatu – globalnie, a nie lokalnie* (Global, not local, climate protection), interview conducted by Małgorzata Masłowska-Bandosz, *Ecomanager* 4/2012, pp. 17–19.

59. European Commission (2012), Innovation Union Scoreboard 2011.

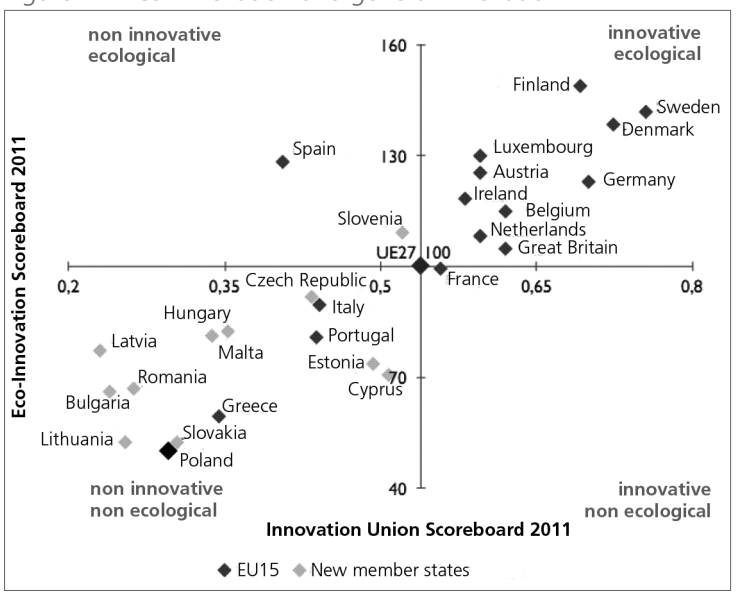
60. OECD (2011), Education at a Glance 2011: OECD Indicators, OECD Publishing.

The results of the Sixth Community Innovation Survey[61] reveal that Polish enterprises are very inactive regarding innovation. Innovation (taken to mean the number of enterprises concerned with innovative products, processes, organisation or marketing) is half that of the EU27 average. This is a disturbing sign of diminishing interest in product or process innovation in industry and services. During the period 2008–2010, 7.9 per cent of industrial enterprises and 5.1 per cent of service enterprises introduced innovative products and processes; product innovations were introduced in 12.1 per cent of industrial enterprises and in 7.9 per cent of service enterprises; and process innovations were introduced in 12.9 per cent of industrial enterprises and 10 per cent of service enterprises.[62] From the figures quoted, it can be seen that Poland is clearly behind in creating a **»**green economy**«**. This affects its international economic position. In contrast with more developed countries, Poland sends about 3 per cent of its exports of environmental goods to developing countries, while virtually all imports of these goods (about 97 per cent) come from these countries. This means that we have no suitable competitive edge against the OECD countries in the trade of environmental products.[63]

If we are to attain the objectives of sustainable development and green growth, it is particularly desirable to take action to encourage eco-innovation, in the sense of »actions involving the development or introduction of new ideas, conduct, products or production processes by all parties concerned, having a favourable impact on the environment or on its survival**«.**[64]

The Eco-Innovation Index illustrates five problem areas: outlay, action, results, environmental impact and socio-economic effects. Poland, with an index of 50 points, was in last place in a ranking on eco-innovation in 2012. Poland scored the least for outlay (government spending, green investments) and for results (patents, publications). The country scored most points for economic effects.[65] Most innovation in Poland is introduced by industrial public sector enterprises (35.6 per cent in 2006–2008) and service enterprises (23.3 per cent); in the private sector, the figures are 26.1 per cent and 16.0 per cent, respectively. Product eco-innovation includes: improved possibilities for product reutilisation (services 5 per cent; industry 8 per cent); minimisation of pollution (services 7 per cent; industry 12 per cent) and reduced energy consumption (services 7 per cent; industry 11 per cent). Eco-innovative processes include: recycling of waste, water and materials (services 6 per cent; industry 11 per cent); reduced emission of pollutants (services 6 per cent; industry 14 per cent); reduction of CO_2 emissions (services 5 per cent; industry 8 per cent); reduction in energy-intensiveness (services 4 per cent; industry 12 per cent); and a reduction in materials-intensiveness (services 4 per cent; industry 11 per cent).

Figure 14: Eco-Innovation and general innovation[66]



Source: Eco-Innovation Observatory, Pro Inno Europe.

The chief prerequisite for eco-innovation is a desire to reduce production costs. A desire to improve the condition of the local environment is mentioned in second place,

61. Sixth Community Innovation Survey, More than half of EU27 enterprises are innovative, Eurostat Newsrelease 166/2010, via: Ministry of Regional Development, Poland 2011.

62. Central Statistical Office/Voivodship Statistical Office Szczecin (2011), Innovations in Enterprises in 2008–2010, Warsaw.

63. Strategic Research Laboratory, Institute of Mineral Resources and Energy of the Polish Academy of Sciences, 2009: Opportunities and Dangers to Industry in Connection with the Development of a Green Economy, Expert Analysis.

64. Kistowski, M. (2002), Wybrane aspekty metodyczne sporządzania strategicznych ocen oddziaływania na środowisko przyrodnicze, Człowiek i Środowisko, Vol. 26, No. 3–4, pp. 55–72.

65. EIO (2012), The Eco-Innovation Gap: An Economic Opportunity for Business, Eco-Innovation Observatory, funded by the European Commission, DG Environment, Brussels.

66. Szpor, A. and Śniegocki A. (2012), Eco-innovation in Poland; Current Status, Barriers to Development, Possibilities of Support, IBS.

followed by a desire to improve an enterprise's image. Entrepreneurs consider a lack of funds and the high cost of innovation to be the greatest obstacles to modernisation. The problems include finding a partner, establishing contact with a research and development establishment and access to information on new technologies.[67] The assumptions of government policy on ecological innovation have been defined in the Executive Programme of the National Action Plan on Environmental Technologies and in the Strategy for altering Production and Consumption Patterns for the Sake of Permanent, Sustainable Development.[68] Priority areas for environmental technologies of the greatest economic importance are: finding energy sources/carriers (26 per cent), balanced consumption (16 per cent) and production (13 per cent), balanced neutralisation of waste (16 per cent) and sustainable logistics systems (10 per cent).[69]

Instruments supporting eco-innovation in Poland can be divided into five categories: support for R&D and technological development; support for the promotion, sale and diffusion of technologies; financial tools in support of innovation; instruments for green technology enterprises; and the instruments available under Regional Operational Programmes. Among the first category one can mention tenders for such research programmes as BroTech, INNOTECH, Patent PLUS and Kadtech, financed by the aforementioned National Scientific Centre and National Centre for Research. Important here are the instruments offered by the Polish Agency for Enterprise Development PAED, such as vouchers for innovation and support for R&D.[70] The promotion, sale and transfer of technology is covered by the appropriate programmes. Among the Polish instruments in support of eco-innovation, the GreenEvo green technology accelerator deserves mention. This initiative supports Polish eco-innovators in entering the global market. Of particular interest is the Database on New Technologies maintained by the Ministry of the Economy. The Polish Agency for Enterprise Development fulfils the important task of promoting knowledge of eco-innovation and realising the Innovative Enterprise Club project. Each year, the Minister of the Environment holds a »Leader of Polish Ecology« competition. The work of NGOs is invaluable, for example, the »Clean Business« (Czysty Biznes) programme led by the Environmental Partnership Foundation[71] or projects by the Institute for Eco-Development under the title »Protect the Climate« (Chrońmy Klimat).[72] Eco-innovation should be backed by an appropriate system of public procurement. In 2007 the government adopted a national plan of action for green public procurement for 2007–2009. Subsequently, the Office of Public Procurement produced a national plan of action for sustainable public procurement for the period 2010–2012. In 2010, green public procurement accounted for 10.5 per cent of all public procurement. Among the instruments of financial support for modernisation, the following might be mentioned: a tax concession for innovation (expenditure on the acquisition of new technologies is tax deductible); the possibility of acquiring the status of a Research Development Centre (whereupon exemption from property tax is granted and the funds allocated to an innovation fund can be deducted from tax), the PAED »Loan for Innovation« (*Pożyczka na innowacje*) programme; credits for technologies; the »Angels of Business« (*Aniołowie Biznesu*) project, or the Venture Capital/Private Equity funds financed by private capital.

4.3 Green Jobs

Knowledge of the changes taking place in the structure of employment is essential in order to properly plan the development of so-called green jobs.[73] One of the signs of increased development and economic innovation is a decrease in the number of people employed in agriculture and an increase in the number employed in services. In 2010, the shares of people employed in agriculture, industry and services out of the working population were 12.9 per cent, 30.2 per cent and 56.9 per cent, respectively. Most were in the 25–54 age bracket (77.1 per cent), and the least were in the 15–24 age bracket (26.3 per cent) and the 55–64 age bracket (34 per cent). People with higher education account for 82.7 per cent, those with secondary education 62 per cent and those

67. Szpor and Śniegocki A. (2012).

68. PAED (2010), Environmental Protection and Eco-innovation, Concluding Report, Warsaw.

69. Strategic Research Laboratory (2009).

70. Alwast, Ł. and Liwiński, A., Instruments of Support for Polish Enterprises in the Sphere of Green Technologies, GreenEvo – Foreign Markets and Prospects of a Green Evolution of Polish Technologies, Part III.

71. Thematic gateway: http://czystybiznes.pl.

72. Thematic gateway: http://www.chronmyklimat.pl

73. In Poland, there is no official definition of a »green economy«, »green jobs« or »green sectors of the economy« (see OECD 2011, Employment and Local Development in Poland in the Context of Climate Change, concluding Report).

with lower education 23.6 per cent of the working population.[74] Unfortunately, the number of unemployed people with higher education has grown in recent years. Such people are usually specialists in economic affairs and management, education, physics, mathematics, technology and the natural sciences and environment (10 per cent of graduates are without work), as well as specialists in social sciences and related subjects. According to the Foundation of Economists of the Environment and Natural Resources, in 2007, 373,607 people were employed in environmental conservation in Poland, about 2.5 per cent of the working population. The largest number (75 per cent) were employed in the circumenvironmental sector. Some 13 per cent were employed in the primary environmental sector (environmental conservation services) and 12 per cent in the public sector. The largest number of people were associated with the economy and environmental management. A second group (20 per cent) comprised people employed in waste management. The air and climate conservation sector employed 12.5 per cent and the internal water management sector about 10 per cent. The people most sought after on the labour market are technical workers (most job vacancies are for sorters of recycled materials, while the largest group of unemployed are plumbers).[75]

The following can be regarded as the strong points and advantages along the road to new green jobs in Poland: the results of the energy savings programmes so far; the existence in most regions of strong academic centres capable of conducting educational projects for the sake of green growth; increasing environmental awareness among the young generation and the appearance of responsible new patterns of consumption; and great interest in investing in wind power. Regarding weak points, one might mention the following: administrative barriers; the absence of a clear strategy to reduce emissions and modernise the power sector; poor cooperation between institutions; no mechanisms for using environmental charges for new investments; and no training programmes on the practical aspects of creating and running a »green business«. The possibility of a new tax and charges to encourage reduced consumption of high-carbon products, the use of auxiliary funds and the engagement of vacant human resources in building a green economy are mentioned as opportunities for the development of green jobs. The greatest dangers include: failure to attain target figures on emissions reductions; an increased dependence on gas imports; a slowdown in the improvement of living standards in Poland; insufficient use of technological and innovative opportunities; increased costs of manufacturing ecological products; and enhancement of the negative effects of the economic crisis. The emergence of new sectors of the economy and the creation of green jobs depend on the following conditions: an increase in the level of awareness and professional know-how; the development of a system of co-production and of a pattern of exchange of information between small firms; a change of attitude in the administration; stimulus of the demand for green products and services; and increased cooperation between enterprises and the scientific sector in order to create innovative solutions.[76] According to optimistic development scenarios, 350,000 green jobs could be created in Poland by 2020 and400,000 green jobs could appear by 2030. Between 30,000 and 45,000 people could find employment in the wind energy sector (in 2020 and 2030, respectively). In the transport sector, these figures are 75,000 and 60,000, respectively. Energy production from biomass will require the creation of up to 60,000 new jobs by 2020. This figure will rise to over 90,000 by 2030.[77]

5. Environmental Awareness and Society's Expectations

The latest surveys on environmental awareness and environmental protection and climate-energy issues reveal that only 16 per cent of Poles think that environmental pollution is a serious social problem. Only 7 per cent perceive the problem of the exhaustion of natural resources; 39 per cent of respondents saw a danger of natural disasters, but only 5 per cent acknowledged the danger of a breakdown in a nuclear power station. The condition of the environment and climate change are affected by industry (said 61 per cent of respondents), large-scale forest clearance (55 per cent), energy (26 per cent) and transport (18 per cent). The surveys revealed that the higher a respondent's education, the higher his envi-

74. Ministry of Regional Development: Report Poland (2011).

75. Foundation of Economists of the Environment and Natural Resources (2008), The Labour Markt in the Sphere of Environmental Protection in Poland, Białystok.

76. OECD (2011), Employment and Local Development in Poland in the Context of Climate Change, Concluding Report.

77. Greenpeace Poland (2011), Working for the Climate – Green Jobs in Poland.

ronmental awareness. The opinion of respondents also depends on whether they live in a large city (the larger the city, the greater a respondent's sensitivity to environmental issues). Regarding the most important reasons for protecting the environment, most respondents (63 per cent) said a concern for one's own health and that of one's family and the conservation of the values of nature for future generations, and 22 per cent said an exhaustion of natural resources. Some 41 per cent of respondents said that daily conduct has the greatest impact on environmental conservation, one-third said that the government's actions are important in this matter and one-quarter pointed to the need to formulate stricter legal regulations.

Fewer and fewer Poles support traditional forms of energy output based on coal, oil and gas**.** Over 50 per cent of the respondents said that government policy on raw materials and renewable energy sources should be expanded over the next 20 years. Wind, water, solar and geothermal sources were regarded as the environmentally friendliest methods of energy production. Half of Poles regard these as cheap energy. However, one-third are convinced that only the richest countries can afford RES energy. On the other hand, biogas, biofuels and heat pumps are considered to have a low environmental friendliness. Some 16 per cent of the respondents were in favour of the expansion of nuclear energy, but as many as three-quarters would not want a nuclear power station near their homes. Only 10 per cent of respondents believed that energy savings are an important part of energy policy. On the other hand, many respondents named practical actions for saving energy: 79 per cent mentioned the replacement of doors and windows with ones that save more energy, over 70 per cent had decided on insulating doors and walls and 44 per cent had improved the operation of their ventilation system or had upgraded the heating system. About 16 per cent of the respondents admitted that they know too little about saving energy in households. As many as 70 per cent of the respondents did not know what an **»**energy certificate for a building**«** is. Most of the respondents agreed on the correctness of climate change policy, saying it should be realised, regardless of the initial costs. Only 14 per cent said that the costs of investing in RES could be so high that they might harm the economy.[78]

78. Stanaszek A., and Tędziagolska M. (2011), A Survey of the Environmental Awareness of Poles, 2010, with Particular Regard to Environmentally Friendly Energy.

6. Prospects for Growth

Since 2009 the government has been putting out strategic documents, strategies and development programmes, including long-term programmes. The system of management of development that is being formed in this way will fundamentally alter the framework of policy strategy in Poland. Below we discuss the most important present mechanisms and tools for realising energy policy, supporting green technologies and innovation and boosting materials and energy efficiency and present an outline of planned development strategies.

»Poland's Energy Policy up to 2030« is the document that lays down the main goals and means of reducing the energy sector's impact on the environment, raising energy efficiency, introducing nuclear energy and developing energy from renewable sources and biofuels. Its main objectives are »zero-energy« economic growth, reducing the energy-intensiveness of the Polish economy, building high-efficiency electricity generating plants, boosting the production of electricity in cogeneration, reducing losses during transmission and improving the final efficiency of energy consumption. »State ecological policy for 2009–2012, with an outlook towards 2016« lays down the framework and principles for realising a modern ecological policy. It introduces mechanisms for taking into account environmental protection in sectoral strategies, serves to animate the market for the sake of environmental protection, ensures society's participation in activities to protect the environment, and supports technical research and progress. It deals with the question of environmental management and liability for damage to the environment, takes into account ecological aspects of spatial planning and emphasises the protection of natural resources.

National legal, financial and organisational mechanisms that have already been or are due to be implemented and which directly or indirectly encourage the reduction of emissions include systems of disposable certificates promoting renewable energy and cogeneration;[79] the

79. The market mechanism of *white certificates* (certificates of energy efficiency) is an integral part of the Energy Efficiency Act. Firms selling energy to end consumers will be obliged to obtain a white certificate so that it can be submitted to the appropriate supervisory authority for redemption. The quantity of certificates depends on the volume of energy sold. A suitable number of certificates is obtained in a government tender. It is possible to purchase certificates on commodity exchanges or on regulated markets.

promotion of biofuels by means of excise tax and corporate income tax concessions; supporting the cultivation of plants for energy production; backing investments; and preferential treatment for vehicles using biofuel. Regarding RES, such mechanisms include excise tax exemptions, reducing grid connection charges and an obligation to buy electricity produced from renewable sources. Actions for the sake of energy efficiency include energy audits of buildings, a fund mechanism for thermo-modernisation, a programme concerning economical energy consumption in the public sector and the promotion of sustainable transport systems. The National Fund for Environmental Protection and Water Management supports investments in RES and an increase in energy efficiency, as well as cogeneration. On 17 April 2012 the Council of Ministers adopted the Second National Action Plan on Raising Energy Efficiency in Poland 2012. The tasks mentioned in it and already being realised include: the introduction of compulsory certificates of energy efficiency for buildings and apartments when they are sold or rented; affixing labels to energy-consuming equipment and products showing their energy efficiency and introducing minimum standards for such products; the introduction of preferential loans and subsidies out of domestic and European funds, including under the terms of the Act on Support for Thermo-modernisation and Repairs, support for R&D in the field of new energy-saving solutions and technologies and the application of demand side management.[80]

As already mentioned, Poland is currently engaged in a programme to establish a new policy strategy. Long-term documents aimed at producing a new system of development management include the Long-Term National Development Strategy 2030 and the Concept of National Spatial Management 2030. The chief medium-term strategy is the Medium-Term National Development Strategy 2020, which will replace the National Development Strategy 2007–2015 currently in force. The development paths laid down in the Short-Term National Development Strategy are itemized in nine specific strategies: Economic Innovation And Efficiency Strategy; Human Resources Development Strategy; Transportation Development Strategy; Energy Security and Environment Strategy; Efficient State; Social Capital Development Strategy; National Regional Development Strategy – Regions, Cities, Rural Areas; and Sustainable Rural And Agricultural Development Strategy. These are the most important – from the point of view of green growth – thematic areas and action plans proposed in selected strategies.

The Long-Term National Development Strategy 2030 lays down the most important action plans to achieve economic development and improve living standards. Attainment of the development objectives depends on 23 key decisions, including improving environmental conditions and eliminating the risks of climate change. The strategic objectives and tasks of environmental conservation and climate policy include creating a system of incentives to accelerate the development of a green economy based on an efficient use of natural resources, the implementation of a comprehensive programme to develop innovative environmental technologies, firm action to conserve the atmosphere and protect the purity and availability of water, preservation of the country's natural and geological resources for future generations and adaptation to climate change. The Medium-Term National Development Strategy 2020 will be one of Poland's key strategic documents, closely linked to the strategic activities of Europa 2020. Under this Strategy, a series of activities have been undertaken to improve the condition of the environment against the need to ensure energy efficiency. It calls for, among other things, an improvement in energy efficiency, greater diversity of supply of fuels and energy and adaptation to climate change. Strategic development objectives until 2020 will be realised via integrated strategies. The Innovation and Economic Efficiency Strategy creates the conditions for a competitive economy which will be innovative, efficient and open to international and interregional know-how and cooperation. Intervention paths involve adapting the regulatory and financial environment to the needs of innovation, ensuring that the economy receives the appropriate resources in terms of know-how and labour and balanced consumption of resources.

Eco-efficiency is the subject of the whole of priority area 8: Increasing the efficient use of natural resources and raw materials, including intervention paths; 8.1. Conversion of the entire socioeconomic system to a so-called »greener path«, especially a reduction of the economy's energy and materials intensiveness; 8.2. Development of an industry that operates for the sake of environmental conservation and a corresponding sector of environmen-

80. Ministry of the Economy (2012), Second National Action Plan on Raising Energy Efficiency in Poland. Warsaw

tal services; 8.3. Support for the development of sustainable construction at the stage of planning, designing, erecting and managing the building throughout its life. The next strategy, that of Transport Development up to 2020 (with an outlook up to 2030), lays down the development paths of transport in Poland. Its purpose is to boost the availability of transport, improve traffic safety and raise the efficiency of the transport sector. The Strategy for the Sustainable Development of Rural Areas, Agriculture and Fisheries has five objectives: improving the quality of human resources and entrepreneurship in rural areas; improving the quality of life in rural areas and making them more easily accessible; food safety; an increase in the competiveness of the food sector; and environmental conservation and adaptation to climate change in rural areas. The Energy Safety and Environment Strategy is one of the most important integrated strategies, containing guidelines for energy policy and ecological policy. The chief development objectives are: sustainable management over environmental resources (including a rational and effective use of fossil fuel and water resources and a multifunctional forestry policy); assuring the economy a safe and competitive supply of energy (better use of national energy resources, greater energy efficiency, safety of energy deliveries, modernisation of the professional electricity sector, increased competition on the fuel and energy markets, a greater role for consumers, an increased share of dispersed renewable energy sources and the spread of energy in suburban and rural areas) and an improvement in the state of the environment. The final development objectives determine such paths of action as: guaranteeing access to pure water, rational waste management, reducing the impact of energy on the environment, supporting new and promoting Polish energy and environmental technologies, propagating ecological behaviour and creating the conditions for green jobs. Creating and developing a System of Verifying Environmental Technologies; producing a national system of monitoring environmental technologies; adapting the procedures in the National Fund for Environmental Protection and Water Management to the financing of innovative environmental technologies; research into clean carbon technologies; promoting Polish firms in the environmental sector in the GreenEvo project and an international transfer of innovative Polish technologies are just some of the proposed operational actions contained in the draft strategy.[81] In August 2011 the government adopted the Assumptions of a National Programme for the Development of a Low-Emission Economy. This Programme is being prepared because of the need for a low-emission economy and create by 2025 the best model of a modern economy that consumes less materials and energy and is geared to innovation. The draft Programme defines key areas of activity covering: the development of low-emission energy sources, improving energy efficiency, improving management of raw materials and resources, the development and use of low-emission technologies, preventing the emergence and improving management of waste, and promoting new patterns of consumption. The Programme is to be compatible with strategy up to 2030, the medium-term national development strategy and the nine horizontal strategies, and other programmes.

The modernisation of the Polish energy sector, a restructuring of the energy market, ecological innovations and investments in new technologies are the subject of research, analyses and expert assessments. The practical proposals and guidelines submitted in this regard are very diverse and their substantive contents are often the result of scientific evidence, political choice, lobbying and the expectations of interest groups. The multiplicity of opinions is also proof of a lively debate among experts on the future of Polish energy and climate policy.

The latest OECD assessments and recommendations for Poland regarding a policy of combating climate change[82] stress the need to find the cheapest possible ways of reducing pollution. A key prerequisite for modernisation is uniform carbon dioxide emission prices for all economic sectors. The tax exemptions on domestic coal and gas consumption should be abolished. External costs should be made fully international by introducing a suitable tax on fossil fuels. At the same time, protective mechanisms should be created for the poorest people because of the potential deterioration of their living standards. Further relaxation of the electricity market is called for. To make it easier for new enterprises to function on the market, it is essential to make a clearer and firmer demarcation between energy producers and energy distributors. It is im-

81. Ministry of the Environment/Ministry of the Economy (2011), Energy Safety and Environment Strategy, Draft document of 18 May 2011.

82. OECD (2012).

portant to reduce the administrative burden on connecting new electricity producers to the distribution system. The success of European climate policy requires greater integration of the Polish electrical energy market with the same markets in the neighbouring countries. Modernisation and expansion of the transmission network is essential. OECD experts claim there should be stronger incentives in Poland to invest in new energy sources. They say it is essential to preserve the cost advantages of uniform support for renewable energy sources based on green certificates. One of the more important challenges is to strengthen the mechanisms of cooperation and coordination between operators and the administrative bodies responsible for fulfilling the country's strategic goals in energy efficiency.

In November 2011, the Institute of Structural Research, together with demosEUROPA,[83] having considered over a dozen treatises containing forecasts and programmes, put forward guidelines on an optimum energy strategy by 2030 and 2050. Energy policy should most of all encourage the broadest possible technological diversification. In this connection it is essential to expand distribution networks and invest in smart grid solutions. The purpose of modernisation is to expand the group of energy providers and increase the independence of commercial partners. An important postulate is to encourage innovation by, among other things, specific support for research and development establishments. An improvement and stabilisation of the legal-organizational framework is of particular importance. The most urgent tasks to be realised (recommendation for 2012) include: creating a public database on the costs of introducing energy technologies; carrying out a review of legislation that hinders the development of new technologies; creating a forum for an exchange of know-how and cooperation for the reaching of decisions between the government, civic organisations and the scientific community; developing tools of information policy and the mechanisms of its functioning; and carrying out a review of Polish research establishments able to play an active part in initiatives on innovation in energy and transport.

In December 2011 the Social Council of the National Emissions Reduction Programme put forward a comprehensive proposal for systemic changes in Poland.[84] The Council is attached to the Ministry of the Economy and is engaged in improving the process of reducing emissions as a primary instrument of climate protection. Its role is to seek the best ways of protecting the climate without affecting energy security. The proposals in the white paper serve as the starting point for a debate on the final shape of the National Programme for the Development of a Low-Emission Economy (previously called the National Programme for Reducing Greenhouse Gas Emissions). The document examines the conditions for a domestic market and the degree of implementation of European legislation. It discusses essential spending on modernisation in sectors such as electrical energy, gas, heating and transport. It indicates the need to perform legislative work and seek sources and methods of finance. The numerous solutions mentioned in the document include a need to create a Polish Flag Programme of Clean Carbon Technologies; formulate a National Strategic Programme for 2012–20 to identify and prepare CO_2 disposal sites; create a Clean Energy Fund; support the development of electricity production in high-efficiency cogeneration; modernise mechanisms of support for dispersed energy and RES; abolish outdated generation systems; upgrade grids; and rationalise transportation. The inevitability of the energy development of eastern and northern Poland is indicated. The prime postulate is to eliminate the short-term and medium-term nature of the challenges to reduce emissions and introduce market-stabilising solutions and investment processes. The current public debate on the above proposals indicates that a change to the energy mix, an improvement in the quality of transmission and distribution networks, a full opening of the market and premeditated energy consumption, as well as a harmonisation of company development strategy with state policy, should be considered priorities.[85]

The current discussion taking place among business communities reveals a series of urgent tasks on which a greener Polish economy depends. The many postulates point to the need for a cohesive and reliable system of regulations and forecasts; analyses of the economic, ecological and social effects of the environ-

83. Ministry of the Economy (2011), Energy Mix 2050.

84. Social Council of the National Emissions Reduction Programme (2011), White Paper on the National Programme for Reducing Greenhouse Gas Emissions, Warsaw.

85. Report on the Debate: Poland's Energy Policy – Priorities of the Polish Energy Sector, Warsaw, 8 February 2012.

mental regulations introduced; and a curbing of administrative barriers. It is essential to formulate protective strategies for branches threatened with liquidation or profound restructuring. Support for the education system in boosting society's environmental awareness and an increase in the transfer of know-how, best practices and technical solutions are important. The need for legal regulations to provide customers with clear information on products and their environmental characteristics resulting from an assessment of their life cycle or carbon footprint is indicated. Increased financial support and better access to capital for investment in eco-innovation is postulated.[86] Among business postulates, the need for a cohesive, transparent and concentrated system of economic-financial (fiscal) instruments to support the implementation of sustainable production is indicated. The chief component of this system should be a catalogue of detailed investments receiving support.[87] For the Polish business community, balanced management of resources represents an opportunity to design and introduce new services and products, and consequently to create new jobs. More rational consumption of resources, taken to mean factors of production, means the minimisation of production costs, resulting in a rise in competitiveness. The application of environmental technologies and investment in green energy will reduce the scale of charges for using the environment and utilising waste. Proper concern for the environment entails confidence and credibility. Sustainable business requires educational and promotional activities leading to a change in priorities and in production and consumption patterns. Essential are long-term support for research and development, designs and new technologies, as well as the introduction of innovative management methods, reducing damage to the environment. It is crucial to raise the ecological awareness of consumers and the environmental and social responsibility of entrepreneurs.

86. PwC 2012. Vision of a sustainable development of Polish business 2050. Report-working version, February 2012.

87. Polish Agency for Enterprise Development, 2011, Instruments to support the implementation of patterns of sustainable production in the Ministry of Social Policy, Warsaw.

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