исследовательских проектов и их коммерциализации. Для реализации Соглашения в каждой из стран основаны совместные центры технологического сотрудничества, основной задачей которых является поиск партнеров и развитие проектов, представляющих взаимный интерес. Приоритетными направлениями взаимодействия в соответствии с Соглашением являются обмен сотрудниками для реализации проектов, инвестиции в научные разработки с целью создания, трансфера и внедрения технологий. Причем каждый год Республика Корея создает финансовый фонд для поддержки научного белорусско-корейского сотрудничества, объем которого зависит от потребностей промышленных предприятий Кореи в трансфере технологий из Республики Беларусь. На настоящий момент размер этого фонда составляет 1 млн долларов США.

Степень интенсивности международного сотрудничества по организациям НАН Беларуси существенно различается, наиболее значимыми результатами отмечаются следующие организации: Белорусский государственный научно-производственный концерн порошковой металлургии, Белорусский государственный научно-производственный концерн межотраслевого машиностроения и приборостроения «Белмашприбор», Институт физики им. Б.И. Степанова, Объединенный институт проблем информатики, Институт физики твердого тела и полупроводников, Институт молекулярной и атомной физики, Институт математики и некоторые другие.

Белорусским государственным научно-производственным концерном «Белмашприбор» заключен контракт на поставку оптических изделий фирме «АПС Оптикс» (США) на сумму 200 тыс. долларов США, а также договоры с организациями России, Литвы, Украины, Франции на экспорт дробильно-измельчительного оборудования и аттракционов. За 2004 г. данной продукции отправлено на общую сумму 1212,5 тыс. долларов США. В целом по концерну в 2004 г. экспортировано продукции на сумму 1,8 млн долларов США, что превышает объемы 2003 г. на 3%.

Таким образом, инновационный деятельность представляет собой практическое освоение результатов научных исследований и разработок. Но для разработки практических в этой области необходимо проанализировать организацию инновационной деятельности за рубежом.

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SELECTED ISSUES CONCERNING ENVIRONMENT PROTECTION AND POLISH ENERGY

Abstract: The main aim of the paper is to present the Polish energy policy. The structure of energy generation has been shown. The aspects of natural environment protection has been introduced.

Keywords: energy, environment protection,

Energy constitutes this branch of industry which has a particularly negative impact on the natural environment. Processes of fuel combustion used for generating energy are the main reason for pollution and emission of air pollutants, especially greenhouse gases. Economic and administrative instruments of the environment protection policy are the key to tackling the above mentioned issues. Current world energy problems are discussed at World Energy Councils.

Our government's documents on Energy Policy of Poland also account for the decisions made at the World Energy Council. At the 18th World Energy Council the key problems of energy were identified; they also included ecological aspects of the way the energy market operates:[1]

- Cleaner combustion technologies of coal as well as liquid and gaseous fuels – making clean technologies more commonly used in order to limit air pollution emissions,
- Gas and electricity convergence and multi-energy services – solving jointly the regulation problems of the energy and natural gas transport as well as aiming at mutual complementation of both sectors in regional energy systems in order to improve flexibility and efficiency of energy supply,
- Nuclear energy, large hydroelectric power stations and emission of greenhouse gases –building nuclear and hydroelectric power stations in order to considerably reduce CO_2 emission,
- Renewable energy and local power generation using local resources – supplementing traditional technologies with water energy and geothermal energy resources as well as accelerating the rate of development and implementing renewable and local technologies..

Local, regional and global ecological goals, particularly the acceleration of spreading of the technologies which reduce the environment pollution resulting from energy generation, its distribution and use have become most significant challenges in the energy sector.

The basic goal of the domestic energy policy is ensuring energy security. Energy security is such a condition of the economy which makes it possible to cover the current and prospective demand of consumers for fuels and energy, in a technically and economically justified way, with the minimum negative impact of the energy sector upon the natural environment and on the living conditions of the society.[2] The level of energy security depends on many factors, and the most important are:[3]

- the level of supply-demand balance achieved for energy and fuels, taking account of the structural aspects and the expected level of prices,
- the diversification of the structure of energy carriers constituting the country's fuel balance,
- the degree of diversification of sources of supply at the acceptable cost level and in relation to the projected demand,
- the technical condition and operational efficiency of machinery and installations, in which energetical conversion of energy carriers takes place, and of the systems for transport, transmission, and distribution of fuels and ,
- the volumes of stocks of fuels in the quantity ensuring the maintenance of continuity of supply to consumers,
- economic conditions for the functioning of energy enterprises and their financial results,
- economic and financial standing of fuels and energy consumers, both households and enterprises,
- the status of the local energy security, i.e. the ability to meet energy demand on the local community levels.

Apart from ensuring energy security, ensuring and maintaining ecological security of the country becomes a fundamental goal for the country. Ecological security of the country is the condition in which the pressure of all sectors of the economy, including the energy sector, upon the environment is being decreased. Therefore energy market entities are obliged to pursue the following:[4]

1. Full adaptation of sources of fuel combustion for energy to legal requirements for environmental protection – this is connected with an increase in requirements concerning allowed emissions SO_2, NO_x, dusts and CO_2 after Poland's accession to the European Union;

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[1] Z. Bicki,, J. Solinski: 18. Światowy Kongres Energetyczny World Energy Council. Energetyka Luty (2001): 54-55

[2] Energy Policy of Poland till 2025. Ministerstwo Gospodarki i Pracy. Warszawa 2005.

[3] Nowicka-Skowron M., Mesjasz A., *The Structure of Energy Production Market in Poland*. W: Proceedings of the IIIrd International Scientific Symposium ELEKTROENERGETIKA 2005, Stara Lesna, Slovak Republic 2005

[4] Energy Policy of Poland till 2025. Ministerstwo Gospodarki I Pracy. Warszawa 2005.

2. Energy carriers structure change – an increase of the share of renewable energy and hydrocarbon fuels in electricity and heat production will cause further limiting emissions of pollutants, especially greenhouse gases;
3. Application of Clean Coal Technologies – it is expedient to take advantage of the so-called Clean Coal Technologies which ensure meeting the standards of environmental protection in combustion of hard coal and brown coal, which are the basis for Polish energy sector as well as to develop technologies which allow for utilisation of carbon dioxide from exhausts in order to reduce the emissions of greenhouse gases;
4. Limiting the impact of hard coal and brown coal sectors on the environment – these activities are meant to restore the practical and landscape properties of the lands degraded with mining activity through reduction of salt water dumping from mines into surface waters, application of extraction technologies minimising the impact of mining activities, an increase in economic and industrial utilisation of wastes;
5. Application of liquid fuels with improved ecological properties in road transport and for heating purposes;
6. Implementation of mechanisms allowing for a reduction of air pollution emissions – trading in the allocated licenses for emissions of greenhouse gases may result in the reduction of costs of the companies' adaptation to more stringent requirements.

In order to implement the above mentioned directions, the following executive actions have been planned for:[1]

1. Agreeing with the European Commission the ways of realization of obligations resulting from Accession Treaty as regards the implementation of provisions of Directive 2001/80/EC,
2. Perfecting the legal and fiscal tools through implementation of differentiated tax rates and environmental fees stimulating greater consumption of environmentally-friendly fuels and energy,
3. Implementation of differentiated tax rates and environmental fees, giving preference to more ecological fuels,
4. Elaboration of legal regulations ensuring high quality standards for fuels in transport,
5. Implementation of market mechanisms for trading in emission certificate.

Formulation and realization of the requirements of ecological security in the energy sector is also connected with implementation of sustainable development principles in the scope of efficiency of energy use. Increase in energy use efficiency depends on a decrease in the consumption of primary energy calculated per unit of Gross Domestic Product. Improvement of energy efficiency of the economy requires actions in the following directions:[2]

1. Decreasing energy intensity of goods at the stages of designing, manufacturing, use, and disposal by commencing the production of machines, equipment and devices with the highest parameters of energy efficiency, launching and conducting information campaigns aiming at increasing consumer awareness of the expediency and profitability of using the most efficient devices as well as designing goods in such a way so as to be able to recover as much raw material as possible at the end of these goods lifespan;
2. Increasing the efficiency of energy generation by processes of combined electricity and heat generation and by using in heat and power generating plants condensation cycles of coal-fuelled energy generating units in order to use supercritical parameters of vapour as well as vapour-gas circulation;
3. Decreasing energy intensity of industrial processes by energy savings anticipated from modernisation of a number of industrial production processes and their adaptation to the

[1] Ibidem
[2] Energy Policy of Poland till 2025. Ministerstwo Gospodarki i Pracy. Warszawa: 2005

requirements of best available technologies. Development of production of highly-processed and technologically-advanced goods is also expected;

4. Decreasing energy losses in transmission and distribution by reducing energy losses in the domestic power system through increasing the throughput of power lines, enhancement of energy distribution, and limiting the long-distance transmission through 110 kV lines;
5. Implementation of management systems for energy demand in order to increase the efficiency of energy.

As far as ecological activities are concerned the following are the most important achievements of the domestic energy sector:

1. primary and final energy use structure change,
2. limitation of emissions of air pollutants and reduction of wastes from coal combustion processes.

The share of hard coal in the structure of primary energy generation in Poland is still most significant although each of the recent years shows its considerable decrease (table 1). The share of renewable energy sources (RES), on the other hand, is increasing, which is, among others, due to the following:

- an increase in the use of wood and wood waste,
- starting a few geothermal power station systems,
- starting a few wind power plants and numerous small-scale hydro-electricity generation facilities,
- starting a few thermal power stations and power stations fuelled by gas from communal waste dumps.

It should be emphasised yet again that the diversification of the balance of the structure of energy carriers constituting the country's fuel balance is one of the factors which the energy security of the country depends on.[1]

Table 2 presents the structure of the primary energy use. It shows the dominance of energy generated from hard coal although a significant growth of the energy from renewables can be noticed here.

Table 1. The structure of primary energy generation in Poland between 1990 and 2004/in the years 1990-2004

	1990	1992	1994	1996	1998	2004
Hard coal	82,39	80,77	78,69	78,97	75,87	59,92
Brown coal	13,73	14,53	13,66	12,83	14,53	36,22
Crude oil	0,16	0,22	0,29	0,31	0,41	0,52
Natural gas	2,42	2,90	3,20	3,05	3,66	3,33
Water power	0,11	0,14	0,15	0,16	0,22	-
Biomass, wind, geothermal energy, etc.	1,18	1,45	4,00	4,68	5,31	-

Source: author's own study

Table 2. The structure of the primary energy use in Poland in the years 1990-2004

	1990	1992	1994	1996	1998	2003	2004
Hard coal	62,25	42,27	58,93	57,60	50,64	51,15	48,13
Brown coal	13,59	14,03	13,68	12,19	13,99	12,85	13,82
Crude oil	13,98	14,30	15,48	16,25	20,20	18,45	19,62
Natural gas	9,00	6,10	8,58	6,72	10,19	12,67	13,45
Biomass, wind, geothermal energy, etc.	1,15	1,30	3,96	4,44	4,98	3,41	3,57

Source: author's own study

[1] Brzeziński S.: Strategie dywersyfikacji pozyskiwania gazu ziemnego w Polsce Materiały Konferencyjne VI Konferencji Logistyki Stosowanej "Total Logistic Management" Prace Wydziału Zarządzania Politechniki Częstochowskiej, Częstochowa 2002

A significant progress can be observed in the scope of limiting emissions of air pollution. In Table 3 the total emission of air pollutants coming from the energy sector is presented.

Table 3. The total emission of sulphur dioxide, nitrogen dioxide and dusts in the energy sector (thousands of tons)

Year	*SO_2*	*NO_2*	*Dusts*
1990	1570	370	570
1994	1270	380	260
1995	1223	377	193
1996	1195	360	157
1997	1107	310	117
1998	1034	264	94
1999	915	247	72
2002	706	237	56
2003	722	244	51

Source: author's own study based on statistical yearbooks

The data presented in the table above show that not only emissions of air pollutants from power plants are decreasing but also the share of the power plants in the total emissions of SO_2, NO_x and dusts is decreasing as well.

Dumping salt water from mining to surface water constitutes a different problem. The influence of power plants on surface waters is reflected in their quality and quantity, and it actually means reducing water capacity of a given region, changing their physical and chemical properties as well as increasing surface waters pollution and changes in living organisms. The problem of dumping salt water from mining to surface waters has been included in the Hard Coal Mining Restructuring Programme as well as in Geology Law and Mining Law.

Solid wastes constitute another problem. Wastes from power stations and other combustion plants can be divided according to the following criteria:[1]

According to the particle size of wastes from fuel combustion for energy

- fly ash, residue resulting from coal combustion in power plants' boilers collected from exhaust gases by particulate collection devices
- slag, residue resulting from coal combustion in power plants' boilers which collects at the bottom of the burner or settles on the grate and then is carried outside

1. Type of coal fuel

- from hard coal: ash, slag
- from brown coal: ash, slag

2. Type of the boiler used:

Ashes and slag from hard coal:

- when a boiler with a grate furnace is used:
- smoke-box ash
- grate furnace slag
- when a boiler with a pulvarized-fuel fired furnace is used:
- granulated slag
- when a melting chamber boiler is used
- fly ash

[1] Cz Rosik-Dulewska: Podstawy gospodarki odpadami. Wydawnictwo Naukowe PWN, Warszawa 2005.

– melted slag
– when a boiler with a cyclone furnace is used
– fly ash
– melted slag

ashes and slag from brown coal:

– when a boiler with a pulvarized-fuel fired furnace is used
- fly ash
– melted slag

In many countries solid wastes are not treated as waste but as a precious raw material or material available in large quantities. In Germany ashes are used in a number of ways:[1]

– in concrete industry as additive and fine aggregate,
– in mining as additive material and backfill,
– in road construction as backfill, additive material and road base,
– in cement industry as raw material and additive,
– in environmental rehabilitation as landfill and in masonry industry as additive material,
– in construction of noise protection embankments.

In Poland wastes from coal-fired power plants are mainly reused in three different ways:[2]

1) used in industry as recyclable waste,
2) used for ground levelling, rehabilitation and filling underground excavation sites, etc.,
3) ashes used in combined landfill disposal (shared coal combustion by-products with wste from power plants).

In Table 4 the main ways of utilization of wastes from power plants and other combustion sources are presented.

Table 4 Utilization of wastes from power plants and other combustion plants

Waste type	Utilization
Ashes and slags from coal combustion in power plants	▪ building ceramics production ▪ concrete production ▪ cement production ▪ ceramic powders production ▪ ceramic materials production ▪ hydraulic binding agents production
Microspheres – spherical grains	▪ used as functional fillers in products made of plastics, rubber, paints and varnishes ▪ as solid or liquid material used for machines and equipment sound-insulation ▪ material with improved fire resistance used in production of insulating tapes for wrapping high voltage electric power cables ▪ in production of fireproof and flame-resistant protective clothing ▪ in production of insulating boards for building industry ▪ in production of heat –insulating and fireproof materials in casting industry and metallurgical industry ▪ in ceramic materials production ▪ in drilling industry
Fly ash	▪ in backfilling undergroung mine workings ▪ in hydraulic engineering constructions ▪ sealing the bottom of municipal and industrial waste landfills ▪ fertilization and soil amelioration (structure change) in agriculture ▪ municipal sludge treatment

Source: author's own study based on Cz. Rosik-Dulewska: *Podstawy gospodarki odpadami.* Wydawnictwo Naukowe PWN, Warszawa 2005

[1] J. Kalotka: Utylizacja odpadów z elektrowni i elektrociepłowni – popioły, mikrosfery, www.zuter.com.pl /techmenu.htm
[2] Cz. Rosik-Dulewska: Podstawy gospodarki odpadami. Wydawnictwo Naukowe PWN, Warszawa 2005.

Environment protection objectives have been achieved due to the application of environment protection methods, where the following proved to be of significant importance:[1]

1. Direct methods:

- emission and imission standards
- quality standards
- product regulations
- technical standards
- permissions and licenses determining the scope and the ways of using particular environmental components
- environmental regulations (orders and bans)

2. Indirect methods

- microeconomic operational research
- competition pressure
- payments for the economic use of the environment

3. Other methods for assessing environmental impact of enterprises

- environmental reviews
- standard and non-standard methods for reducing environmental burden of enterprises
- eco-labelling
- environmentally sound technologies

Direct methods are administrative and legal methods, mainly based on technical standards of acceptable emission levels of pollution. Indirect methods determine to eliminate market imperfections in the scope of emission and protection activities. They aim at achieving better quality of the environment cleanness level as well as at significant cost reduction of achieving optimum emission/imission level of pollution. The other methods are of planning and informational nature and are directly connected with environment protection management in enterprises. All these methods, however, add to alleviating the negative impact that energy market entities have on the environment.

Poland's accession to EU has obligated the country to adjust to the Community's requirements. Tackling the problems connected with the environment protection has a relatively short history in Poland. It was not until the time of its political transformation when Poland had to adapt and follow the policy of environment protection in connection with the operation of its economic enterprises. The energy sector proved to have been particularly neglected in respect of its environmental activities. At present energy market entities do not constitute a threat to the environment since they comply with all the required standards. However, they are still searching for other solutions which would contribute even more to limiting the negative impact they do have on the environment.

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