A SWOT Analysis
for
Renewable Energy Sources
and
Energy Efficiency
in the Administrative
District of Gorlice

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Content

Tables

Graphs

Photos

1. Executive summary

The District of Gorlice is located in south-eastern part of Małopolska Voivodship. The seat of District Authority is in the City of Gorlice. The following administrative units consist of Administrative District of Gorlice:

- City of Gorlice,
- Cities and Communes : Biecz i Bobowa,
- Rural Communities : Gorlice, Lipinki, Łużna, Moszczenica, Ropa, Sękowa, Uście Gorlickie.

Electro-energetic system

Electricity for the Gorlice District is supplied by the national grid governed by two electricity companies: Polskie Sieci Energetyczne – Południe SA. and Polskie Sieci Energetyczne – Wschód S.A. In the area of the District there are not any electric lines of voltage of 220 kV or higher.

The distribution system in the region is managed mainly by the company TAURON Dystrybucja Ltd. - Kraków Branch company, apart from the City and Community of Biecz as well as Lipinki Community which are supplied by PGE Dystrybucja Ltd – Rzeszów Branch (some villages lying at the boundaries of these Districts are supplied from the lines owned by TAURON Dystrybucja S.A.)

Gas system

Gasworks in Jasło operates and develops the gas supply system in the Gorlice District. In the major part of the region, the system is operated by Regional Gas Distributor in Gorlice .

All communities of the District have an access to natural gas, but their gas supply systems vary in stage of development. In some places, like Sękowa ond Uście Gorlickie Communities, located in the south of the District, there are no gas pipelines.

Thermal Power system

The District heating system is operated by E-Star Heat and Power Plant Gorlice Ltd. (the area of the city). Scattered local boiler houses, satisfying a demand for energy of more than one consumer, are located close to the buildings to which they supply thermal energy. They are owned by industrial plants, businesses, housing associations or local councils. Most private houses in the area of the District make use of their own central heating systems generating thermal energy in low-power coal burning stoves

Electricity consumption

Altogether there are about 37278 consumers in the District and energy consumption reaches the figure of about 206236 MWh a year (data from 2010). The households comprise the largest proportion of energy consumers(88% - according to GUS data and the main suppliers operating in the District) and they use the largest quantity of electric energy

Gas consumption

In 2010 there were 22480 consumers connected to the network in the Gorlice District. The majority of the consumers are households (nearly 96%), including those who use gas for preparing meals and hot water. The remaining consumers are divided into the following groups: various services (2,4%), commerce (1,3%), industry and construction (0,5%), and other consumers (a total number of 10). Total annual gas consumption by consumers connected to the gas network in the Gorlice District in 2010 reached a value of 30.3 million Nm^3.

Demand for heat

The heat demand in the entire Gorlice District is about 283,8 MW, while the annual heat consumption is 2 353,2 TJ. This figure includes energy used for space heating (1872,3 TJ), and hot water (480,9 TJ).

Potential of Renewable Energy Sources and Energy Efficiency

For the purpose of the study the methodologies of estimation are source specific. We have estimated:

- theoretical potential - energy available in the Region.
- technical potential – theoretical potential reduced due to technical, legal, spatial planning as well as other restrictions.
- economic potential – part of technical potential which is feasible to utilize (economic and organizational criteria).

RES Potential

Potential (TJ/year)	Wood	Sawdust	Straw	Wind power	Solar thermal	Photovoltaic	Hydro power	Deep geothermal	Shallow geothermal
theoretical	x	39	192,8	238 981	3 827 182	3827182	0,34	x	x
technical	x	27,3	154,2	41 105	216,2	1425,6	0,17	x	x
economic	326	2,7	7,7	21 457	64,9	142,6	0,02	0	26,5

Energy Efficiency Potential

Potential (TJ/year)	Thermo-modernization of buildings	Power management of buildings	Replacement of heat sources	Energy efficient equipment and technology	Lighting public space	Total
theoretical	370	125	90	0,0324	0,54	585,57
technical	337	112,5	72	0,0324	0,54	522,07
economic	111	62,5	27	0,0324	0,54	201,07

SWOT ANALYSES

Strategies of RES have been defined on the basis of energy potential evaluation and then analyzed using SWOT method. SWOT analysis was performed according to the VIS NOVA project methodology, taking into account also the principles applied in the strategic planning of business organizations as described, among others, in "Key Management Models" by M. van Assen, G. van den Berg and P. Pietersma, Prentice Hall, 2009.

Renewable energy development strategy based on straw

Conclusions:

1. Strategy based on energy use of biomass straw is subject to many risks: organizational, economic and technological

Recommended priority: low

Renewable energy development strategy based on forestry biomass

Conclusions:

1. Inability to increase the level of energy use based on forest biomass. The economic potential is set at 326 TJ / year. This potential is practically totally in use.
2. Significantly higher levels of use of forest biomass cannot be expected
3. There are possibilities to increase efficiency of wood combustion among individual users. This could be done through:
    a. awareness raising – how to efficiently utilize energy of wood
    b. implementation of support schemes – current work on the Law on RES give grounds for cautious optimism in this regard

4. Recommended priority: medium.
   Weaknesses (lack of growth) are balanced by the strengths (of the stable supply and promotional value) - hence the proposed medium priority.

Renewable energy development strategy based on wind power – professional generation

Conclusion:

Strategy based on professional wind power generation is subject to high risk of conflict. Do not bring, however, virtually no economic benefits to the region.

Recommended priority: low

Renewable energy development strategy based on wind power – small wind turbines

Conclusion:

Recommended priority: high due to unlimited resources available and wide range of technologies

Renewable energy development strategy based on solar energy – photothermal conversion

Conclusion*:*

Recommended priority: high due to unlimited resources available, substantial savings for end-users and wide range of technologies.

Renewable energy development strategy based on solar energy – photovoltaic conversion

Conclusion:

Recommended priority: high due to unlimited resources available and rapid technological progress combined with price decrease of equipment

Renewable energy development strategy based on hydro power

Conclusion:

Recommended priority: low due to limited potential in the region and low public interest

Renewable energy development strategy based on deep geothermal energy

Conclusion:

Recommended priority: low due to expected high cost of space heating based on deep geothermal energy.

Renewable energy development strategy based on shallow geothermal energy – heat pumps

Conclusion:

Recommended priority: medium due unlimited and accessible resources, fast growing technologies and substantial savings.

Energy efficiency strategy through thermo-modernization measures

Conclusions:

1. The savings (technical) potential arising from thermo-modernization is significant (estimated at 337 TJ/year). Even with the assumptions that it will be used only partially due to technical and economic barriers – this will be the main area of the energy savings.
2. Thermo-modernization of buildings within the District is implemented constantly by owners of the objects mainly by private funds (without grants and concessional loans) This indicates a high awareness of energy savings by insulating buildings.
3. Thermo-modernization of buildings due to its potential and interest in the communities - can bring proportionally the greatest energy savings.
4. Greater availability of external measures could significantly accelerate the process of adapting the building to the applicable standards.

5. Actions of local government in the field of thermo-modernization is a good example of promoting this way of saving energy.

Recommended priority: high

Energy efficiency strategy through the use of energy efficient equipment and technologies in buildings

Conclusions:

1. Despite the relatively small saving potential the sector can be regarded as significant, because the replacement of old equipment and lighting systems for energy-efficient ones is done “by the way "every time the old ones expire.
2. 2.Government action that will facilitate the exchange of these devices is to correctly organize a system of collecting used household goods and bulky wastes.

Recommended priority: medium. Strengths balance the weaknesses.

Energy efficiency strategy through energy management in buildings

Conclusions:

1. The potential of savings resulting, among others from the introduction of temperature control systems in buildings and its temporary reduction on the District scale was estimated at 112.5 TJ per year. Despite the expected technical and economic barriers, the dissemination of energy management can bring significant savings.
2. A local example of the system’s effective functioning can be an important element of energy management popularization.

Recommended priority: high. After installing a system for enabling energy management in the building (bearing costs of investment) the sawing related expenditure is practically non-existing Strengths balance the weaknesses.

Energy efficiency strategy through the modernization of heat sources

Conclusions:

1. The technical potential associated with the exchange of the sources of heating for devices with higher efficiency in the District was estimated at 72 TJ per year. Due to the significant costs of investment we assume that the action will be implemented gradually over the next few years - in some cases due to desire to achieve savings, in other cases due to the necessity caused by usage the existing heat sources.
2. Intentional action will focus on popularization of modern heat sources with complex control systems, and heat supplied from renewable energy sources.

Recommended priority: high due to significant energy savings

Energy efficiency strategy through the modernization of lighting of public spaces

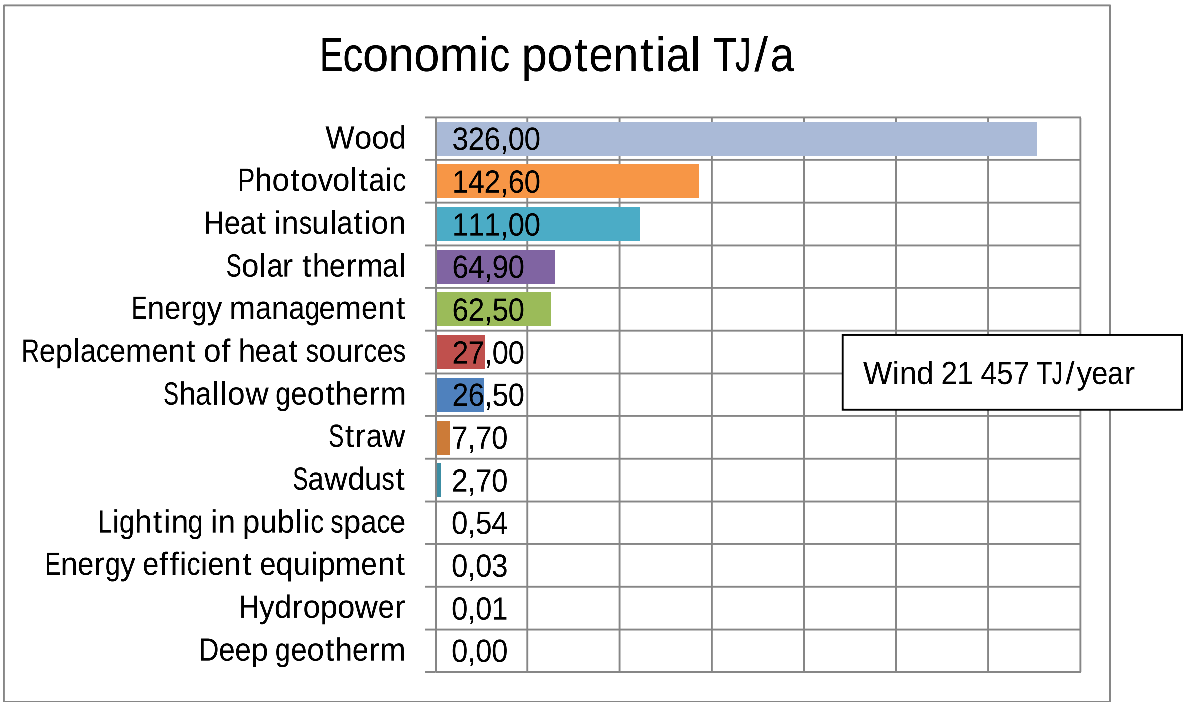
Conclusions:

1. Local authorities responsible for lighting public spaces gradually lead the modernization of lighting systems.
2. Rapid advances in technology may cause recently made investments to be outdated in the shortly, but nevertheless will continue bringing the expected benefits.

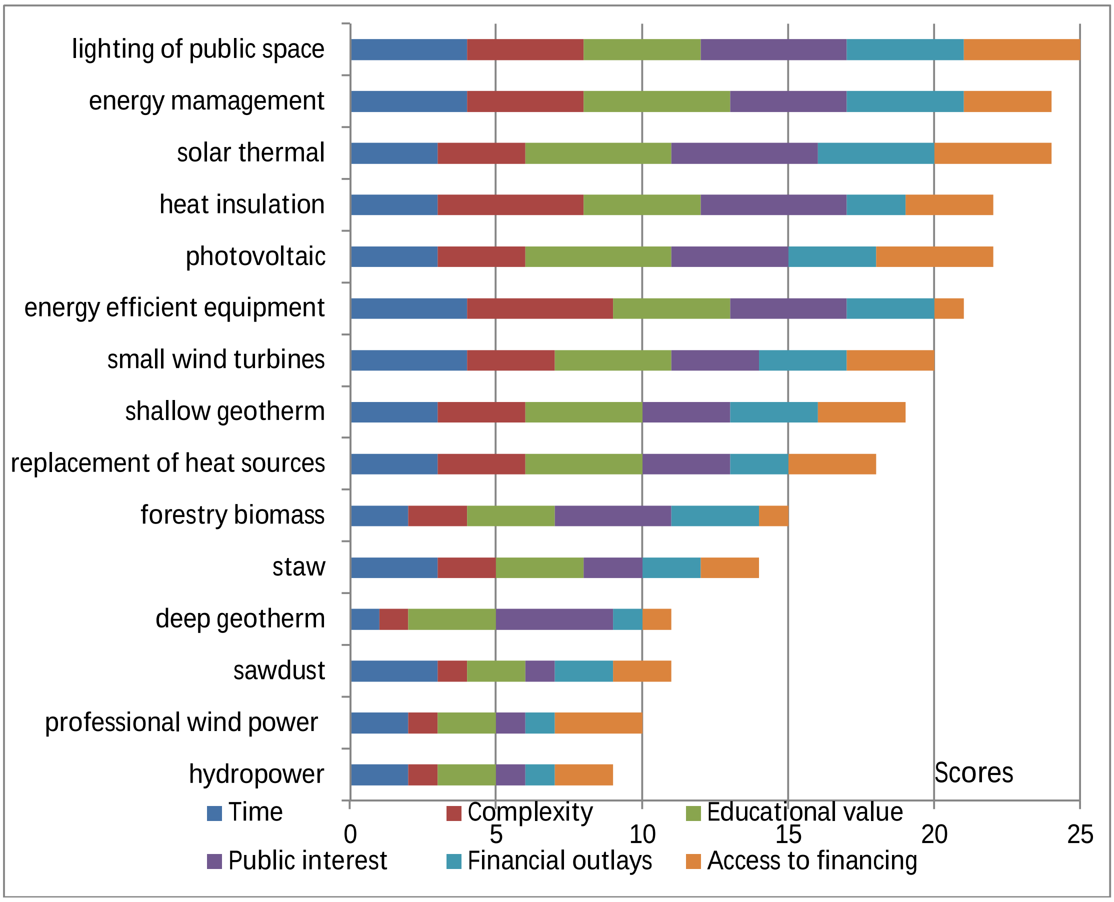
Recommended priority: medium.

Strengths outweigh weaknesses. The small saving potential is caused, mainly by the fact that investments in this area have been carried out over several years and most of the tasks have already been achieved.

ECONOMIC POTENTIALS



STRATEGIES ANALYSED - SCORES



We propose to adopt as the leading ones all strategies related to improving energy efficiency, complemented by compatible strategies involving the production of renewable energy in the place of use (i.e. solar, photovoltaic, small wind turbines and heat pumps).

The proposed strategy may take the name:

THE STRATEGY OF ENERGY EFFICIENCY IMPROVEMENT

COMBINED WITH

THE PRODUCTION OF RENEWABLE ENERGY IN THE PLACE OF ITS USE.

2. Methodology

This study is based primarily on the SWOT methodology of the project "VIS NOVA – Sustainable and Efficient Energy for Rural Regions". This assessment of the internal and external strengths and weaknesses is by definition a subjective one. Identifying opportunities and risks concerning reaching our objectives and their subsequent comparison may help define the priority of the necessary undertakings.

The partners of the VIS NOVA project have agreed upon their objective, which consists of two elements:

- improving energy efficiency in the region
- increase regional production of energy from renewable sources

These objectives were analyzed taking into account the sustainable growth and the economical feasibility.

The influence of economy, finances, politics and law have been considered while conducting the analysis. In addition raising the community`s awareness is expected to be a desired effect.

The Terms of Reference had an obvious influence on the content of this development.

The following methodologies were used for this study:

- while describing the energy infrastructure and energy consumption, the Energy Law regulations were obeyed as well as principles of developing Plan for supplying heat, electrical energy and gas.
- estimating energy savings potential is mainly based on the methodology of energy audit and many years of experience of the authors,
- when estimating the potential renewable sources energy production, we used data and indicators typical for this business. Detailed information on the estimated OZE potential may be found on Chapter 6.
- in the SWOT analysis, the methodology applied in the strategic planning for business organizations has been used (described in "Key Management Models" M. van Assen, G. van den Berg and P. Pietersma, Prentice Hall, 2009.)

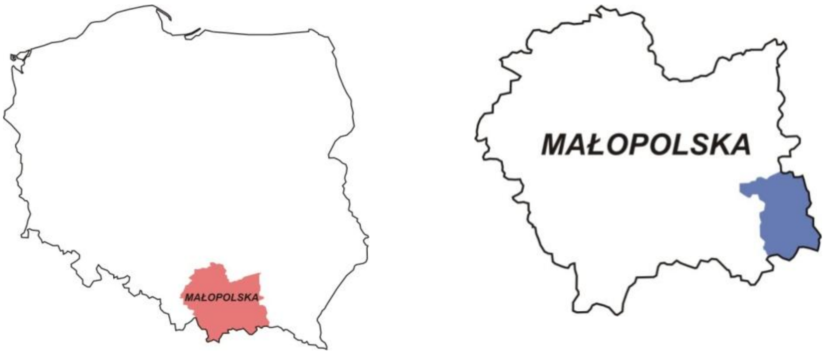
Various data and information sources were used in this study:

- published statistics,
- data obtained from institutions and companies,
- local, regional and national strategies, programs and analysis,
- information from experts,
- various literature data.

3. Basic information about the region

3.1 Location

Graph 1: The location of the Gorlice District.



<u>The following administrative units consist of Administrative Gorlice District :</u>

- city of Gorlice,
- city and community: Biecz and Bobowa,
- rural communities: Gorlice, Lipinki, Łużna, Moszczenica, Ropa, Sękowa, Uście Gorlickie.

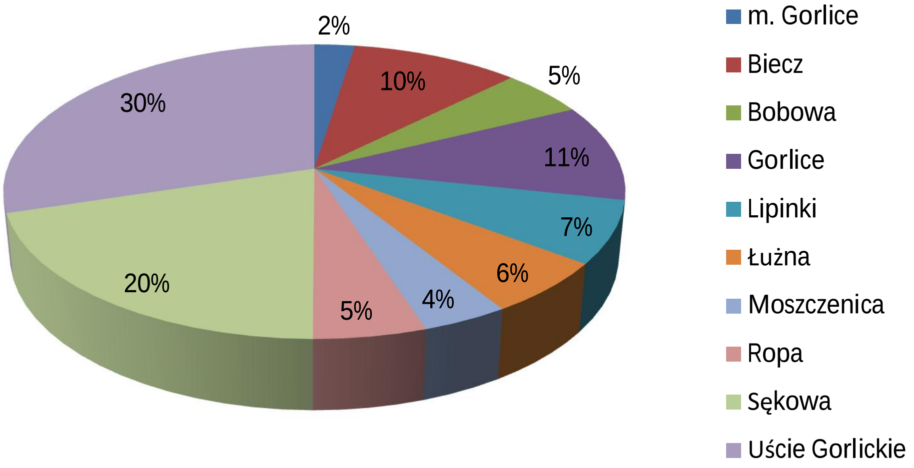
Graph 2: Administrative divisions of the Gorlice District.

The District is bordered by Districts Nowy Sącz and Tarnów in Prowince Małopolska and with the District of Jasło in Province Podkarpacie. The southern boundary of the community Uście Gorlickie is part of the Polish border from Slovakia.

Table 1: The area of the communities of the Gorlice District (GUS,2010).

Community	Area (in hectares)
m. Gorlice	2 353
Biecz	9 825
Bobowa	4 977
Gorlice	10 285
Lipinki	6 646
Łużna	5 627
Moszczenica	3 762
Ropa	4 911
Sękowa	19 480
Uście Gorlickie	28 780
District total	96 646

Graph 3: Percentage share of surface in the Gorlice District areas of individual communities (GUS, 2010).



3.2 Demography and social background

3.2.1 The Progress of demographic

Graph 4: The population of the Gorlice District over the years 2002-2010 (GUS,2002- 2010).

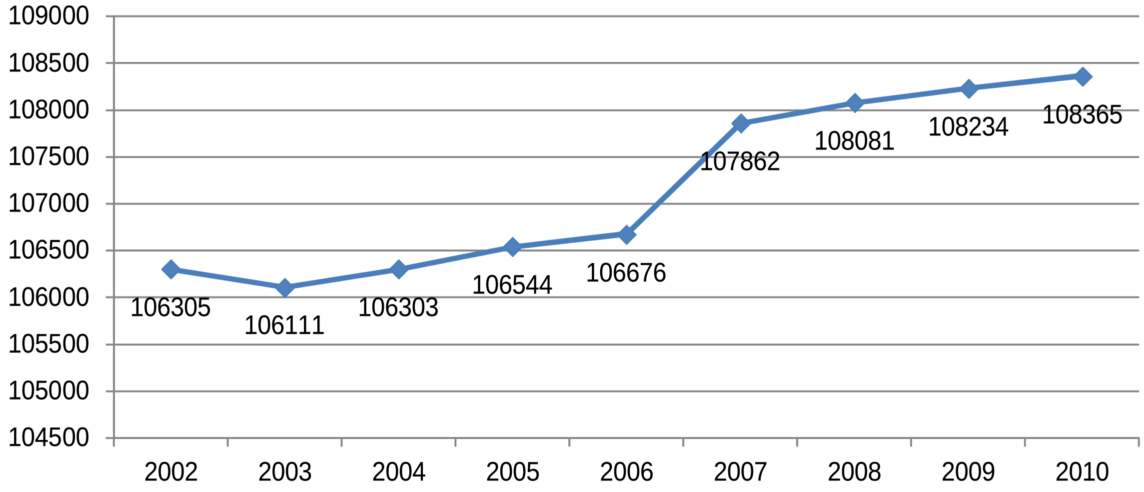


Table 2: The population In 2010 year In individual communities of the Gorlice District (GUS,2010).

Community	Population		Total
	Males	Females	
The city of . Gorlice	13 606	14 832	28 438
Biecz	8 383	8 745	17 128
City	*2 224*	*2 397*	*4 621*
Willages	*6 159*	*6 348*	*1 257*
Bobowa	4 793	4 647	9 440
City	*1 574*	*1 511*	*3 085*
Willages	*3 219*	*3 136*	*6 355*
Gorlice	8 256	8 369	16 625
Lipinki	3 330	3 512	6 842
Łużna	4 273	4 143	8 416
Moszczenica	2 377	2 419	4 796
Ropa	2 645	2 623	5 268
Sękowa	2 464	2 456	4 916
Uście Gorlickie	3 300	3 196	6 496
District total	53 427	54 942	108 365

Graph 5: The share of the population of individual communities within the total number of inhabitants of the Gorlice District (GUS,2010).

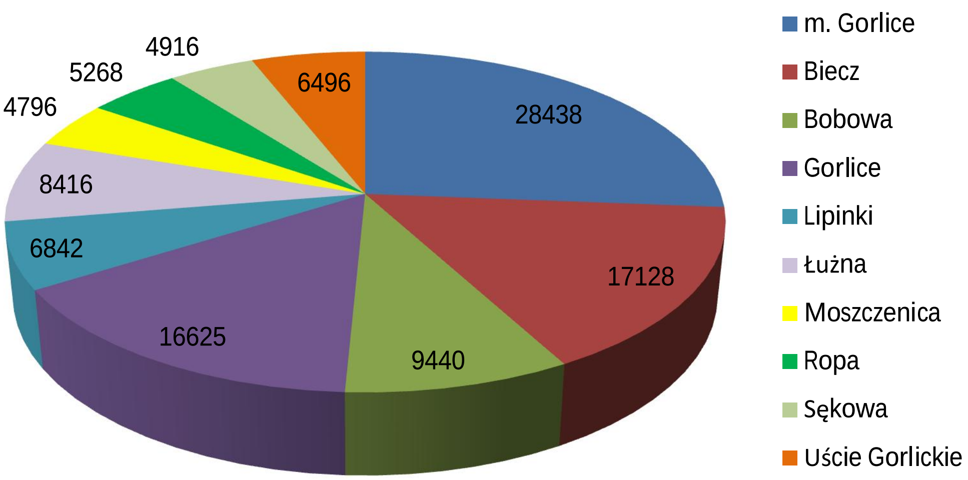


Table 3: Number of persons per 1 km^2 area in the communities of the Gorlice District in 2010 (GUS,2010).

Community	Number of persons per 1 km^2
The city of Gorlice	1196
Biecz	
city	258
village	153
Bobowa	
city	430
village	148
Gorlice	160
Lipinki	102
Łużna	147
Moszczenica	126
Ropa	107
Sękowa	25
Uście Gorlickie	22
District total	111

Table 4: Population growth and balance of migration (persons) in the communities of the Gorlice District in 2010 (GUS,2010).

Community	Natural increase	Balance of migration
m. Gorlice	60	-221
Biecz	62	-22
Bobowa	73	-11
Gorlice	25	45
Lipinki	-11	-15
Łużna	59	-39
Moszczenica	19	3
Ropa	28	-8
Sękowa	10	25
Uście Gorlickie	45	6
District total	368	-235

Graph 6: Indicators of natural increase and the balance of migration in the individual communities of the Gorlice District (GUS, 2010).

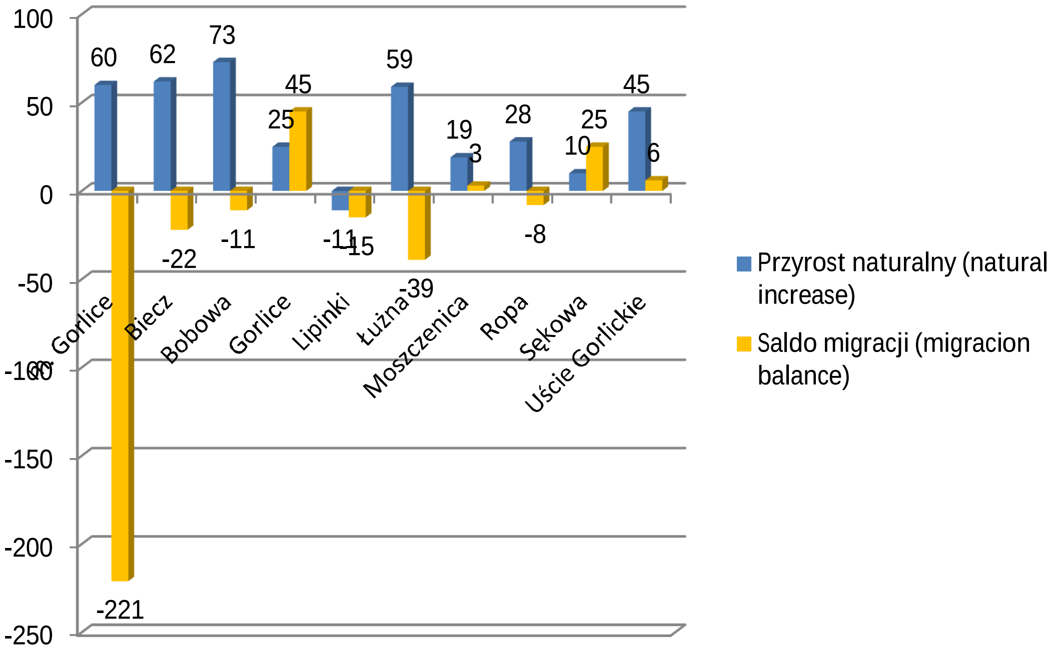
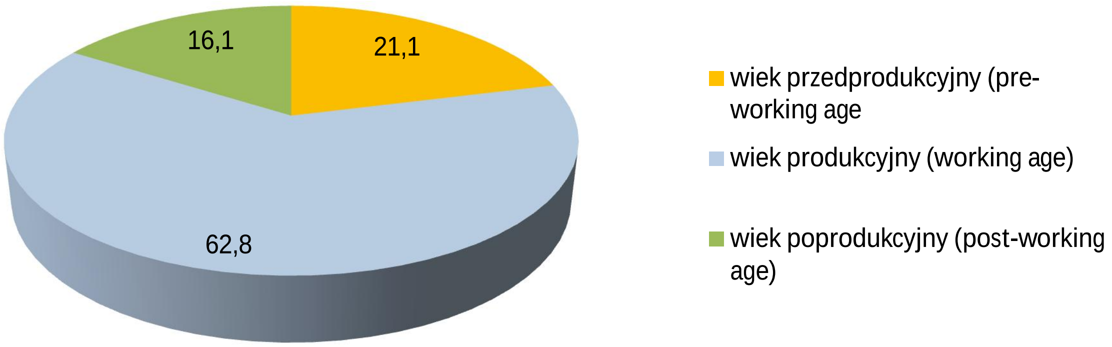


Table 5: Breakdown of the population by the economic age groups in the communities of the Gorlice District in 2010 (GUS,2010).

Community	Pre- working age	Working age	Working age mobile	Post- working age
m. Gorlice	4763	18484	10970	4888
Biecz	3510	10531	6710	3297
Bobowa	2519	5629	3831	1227
Gorlice	3533	10235	6700	2724
Lipinki	1360	4229	2686	1171
Łużna	1922	5096	3420	1277
Moszczenica	1108	2844	1892	789
Ropa	1326	3180	2187	730
Sękowa	1052	3008	1929	781
Uście Gorlickie	1558	4004	2633	823
District total	22651	67240	42958	17707

Graph 7: Breakdown by economic age groups in the Gorlice District (GUS, 2010).



Demographic indicators for the Gorlice District for 2010 year:

- population per 1 km^2 – the population density– 111 people,
- females per 100 males – 103 people,
- marriages per 1000 population – 7,1,
- live births per 1000 population – 12,1,
- deaths per 1000 population – 8,7,
- natural increase per 1000 population – 3,4.

3.2.2 Unemployment

Table 6: The number of unemployed in the years 2002-2010 in the Gorlice District (GUS, 2002-2010).

Years	Total	Males	Females
2002	11 650	5 529	6 121
2003	11 699	5 562	6 137
2004	10 971	4 981	5 990
2005	10 276	4 380	5 896
2006	9 545	3 822	5 723
2007	7 031	2 609	4 422
2008	5 690	2 066	3 624
2009	6 534	2 915	3 619
2010	6 446	2 776	3 670

Rate of unemployment for the year 2010 in the Gorlice District is 9,6% for the all people of working age.

Figure 8: Changes in the number of unemployed in the Gorlice District (GUS, 2010).

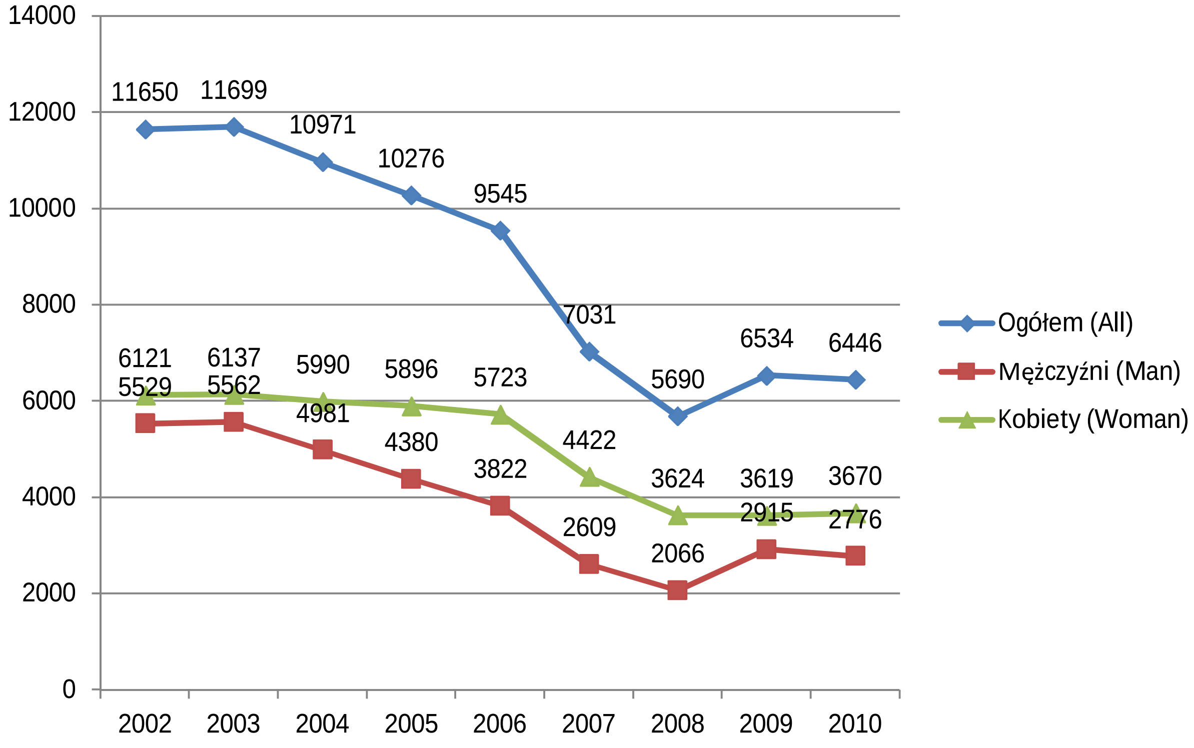
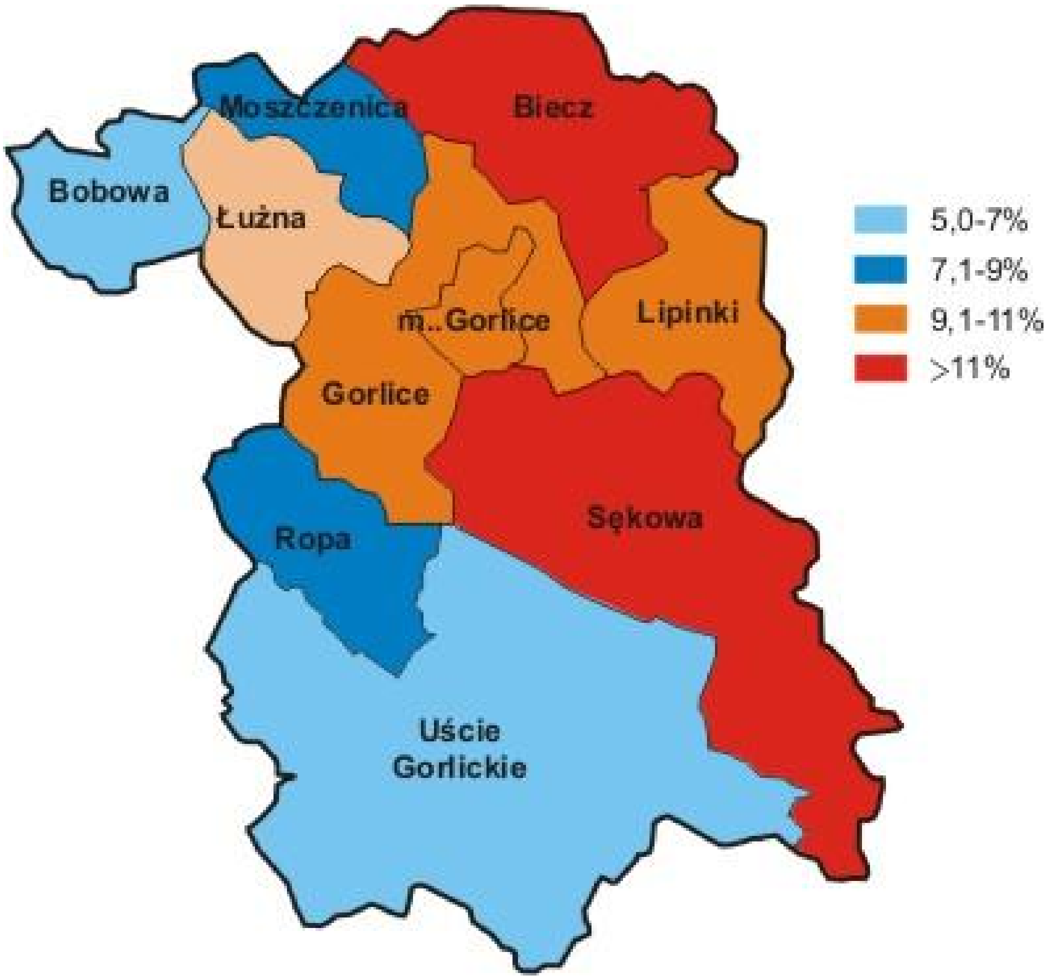


Table 7: Unemployed persons in 2010 in the individual municipalities of the Gorlice District (GUS, 2010).

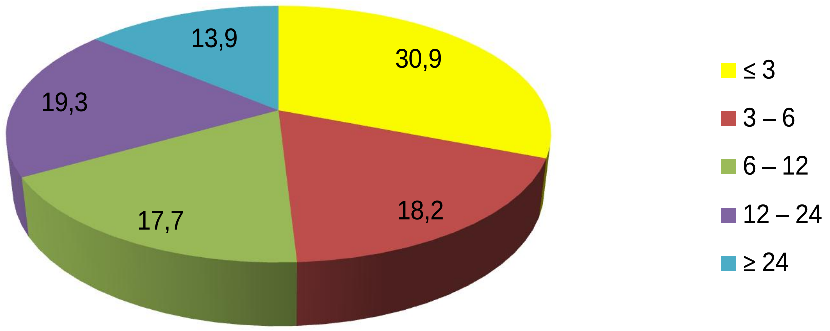
Community	The number		The number of total	% of unemployed persons in the age
	Males	Females		
The city of Gorlice	764	982	1746	9,4
Biecz	563	645	1 208	11,5
Bobowa	90	244	334	5,9
Gorlice	468	585	1 053	10,3
Lipinki	280	260	440	10,4
Łużna	182	285	467	9,2
Moszczenica	109	144	253	8,9
Ropa	76	161	237	7,5
Sękowa	140	208	348	11,6
Uście Gorlickie	104	156	260	6,5
District prospect	2 776	3 670	6 446	9,6

Graph 9: Unemployment in the various municipalities in the Gorlice District (GUS, 2010).



In 2010 the lowest unemployment rate in communities of Bobowa and Uście Gorlickie and the highest (more 11%) in communities of Biecz and Sękowa.

Table 8: Unemployed in 2010 at the time remain without work (in months) (GUS, 2010).

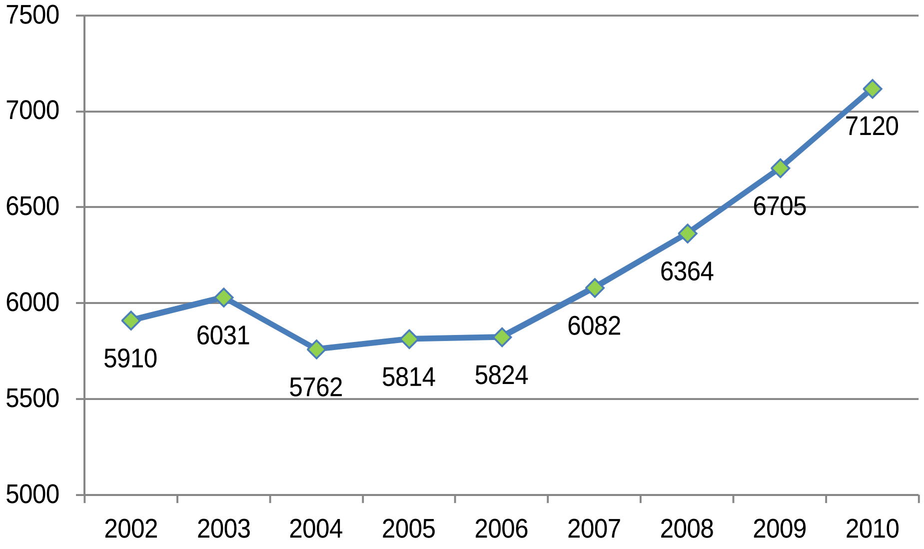


3.2.3 Business

The biggest employers in the Gorlice District are:

- public administration,
- education,
- Kerosene Refinery „Glimar" SA in Gorlice,
- Factory machinery „Glinik" in Gorlice,
- Mine oil and gas – the Polish Mining Oil and Gas in Warsaw – Sanok County Plant Oil and Gas in Sanok,
- Spa Wysowa S.A.

Graph 10: The number of entities of the national economy in the Gorlice District in 2002-2010 (GUS, 2002-2010).

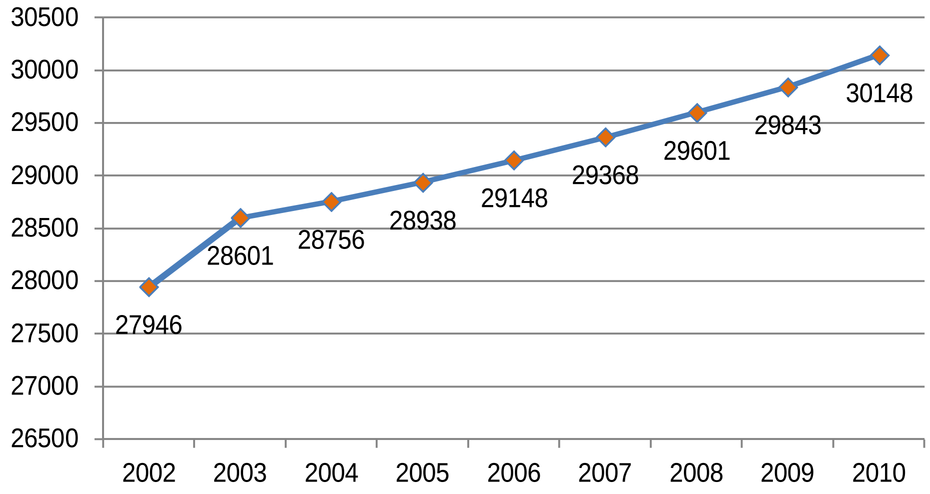


3.2.4 Housing

Table 9: Housing industry in 2010 in the Gorlice District (GUS, 2010).

Housing stock	Unit	Total	City	Village
Flats	no.	30 148	11 674	18 474
Rooms	no.	122 730	44 370	78 360
Floor area	m^2	2 405 150	797 116	1 608 034

Graph 11: Housing stock in the Gorlice District in the years 2002-2010 (GUS, 2002-2010).



Average floor area - 79,8 m^2.

Avarage metric area per person– 22,4 m^2.

Table 10: Housing in the Gorlice District by grade (%) equipment installations (GUS, 2010).

Installation	City	Willage
Water supply	96,6	86,8
Bathroom	93,5	78,7
Central heating	79,9	61,3

3.2.5 Summary

SWOT analysis-social sphere	
Strengths	Weaknesses
increase of population positive growth rate decreasing unemployment well equipped dwelling house (water, central heating, bathrooms) increasing number of businesses	uneven population distribution high migration rates
Opportunities	Threats
further economic growth	increasing migration economic collapse

3.3 Natural conditions of the Region

3.3.1 Geology

Gorlicki county area geologically belongs to the Carpathian Mountains, which are the young rock mass of the Alpine system built of crystalline rocks, volcanic and sedimentary, highly disturbed, folded and realocated in the form of large nappes during the Tertiary.

Western Carpathians form a curved bend and are characterized by the presence of upland belt - so called Pogórze (Foothils) and tectonic basins. The Western Outer Carpathians are the Carpathian foothills and the higher degree of medium and low mountain sculpture called Beskidy. They consist of Carpathian flysch deposits, Cretaceous and Paleogene, shaped as an overthrust fault (Silesian nappe, Magura nappe and Skole nappe). Foothills are the undulating plateau - 80-250 m - fragmented by valleys. Aligned plateau shear off flysch tectonic structures. Dominated by convex - concave slopes covered with thick loess – type beds. In the marginal zone, you can watch numerous landslides.

Foothills of Ciężkowice is composed of three nappes overthrusted at each other from the south: Skole, Podśląska and Śląska. On the whole it is a compact patch with aligned watershed ridges, deep valleys with rather convex slopes, characterized by the presence of diverse rock formations of hard sandstone. Single monadnock ranges reach a considerable height above sea level. In the Valley of Biała River, there are numerous sedimentary and rock terraces.

Low Beskids is the mountain range which runs from west to east. In this part of the Carpathian Mountain the Magura Nappe has the squamosal structure and consists of a series of shale-sandstone structures. The Magura Nappe unit starts with Inoceramus Cretaceous strata, then variegated shales and Eocene beloweskie layer, then hieroglyphics layers and Magura layers. The basic element of relief is thick-bedded sandstones of Magura layers. There are numerous faults, the largest of which is on the line of the Valley of Ropa River, from the village Ropa to Gorlite, buttery separating Maślana Hill from the LowBeskids.

The mountain ranges of heights 600 - 700 m above sea level, have a clear course northwestern - south-eastern and are separated by river valleys. The ridges are formed on the Magura sandstones, the little valley are carved in low resistant sandstone-shale series. This arrangement determines the shape of the slopes: steep in the upper parts and very mild in the middle and bottom. Typical for of the Low Beskids are small mountainous valleys. Pleistocene terraces and shelves create a strip extending along the main valleys. Holocene terraces composed of gravel and pebbles fill the bottom of all the larger valleys.

The Gorlice Syncline is a form of denudation situated among low resistant Krosno layers as part of the central Carpathian synclinorium. The nature of the sculpture is alternately hilly (up to about 350 m above sea level) and a valley. The main valley is the valley of Ropa River, to the west of the basin extends the Valley Libusza (there are extensive terraces with a height of 15-20 m, with base rock, wrapped with slope clays).

3.3.2 The earth's surface

The Gorlice District is located on the territory of the Outer West Carpathian sub-province. The entire space is counted to the upland-hummocky terrain. The northern part of the District bears the piedmont character, where broad elevations dominate – the altitude from 24,6 to 733,0 over the sea level (communes: Biecz, Łużna, Bobowa, Moszczenica, Lipniki, Gorlice). The southern part is composed of mild mountains of Beskid Niski with the elevations not exceeded 1000 meters over the sea level, with dominating arched ridges and easily accessible saddles – the altitude from 300 to 997 m over the sea level (communes: Ropa, Sękowa, Uście Gorlickie).

The highest point of the District is Lackowa mountain, 997,0 meters over the sea level, on the territory of Uście Gorlickie commune, the lowest point is 247,6 meters over the sea level, on the territory of Biecz commune. The difference between these two points is 749,4 meters.

3.3.3 Climate

The climate in the said territory is of transitory character, between the Atlantic and the continental climates. The sculpture of the earth's surface and the configuration of the terrain play significant role in shaping of the climate conditions. Bigger rain- and snow falls and lower temperatures of air as well as bigger number of frosty days and the longer snow lying period are noted on the north sides of the mountains and in the mountainous valleys.

The average annual temperature is 6 - 8°C. Warm and dry south winds blow here in the spring, winter and autumn (so called dukielskie or rymanowskie), which cause often changes of weather. The largest rainfalls take place in June and July.

3.3.4 Hydrography

The river network of the Gorlice District is composed of two water-courses: Ropa and Biała (also called Biała Tarnowska or Biała Grybowska) and their tributaries.

Graph 12: Main rivers in the Gorlice District.

The Ropa river is the main river of the District. It springs on southern slopes of Jaworzyna mountain at the altitude of 790 meters over sea level and falls into Wisłoka river in Jasło. Total length of the river is 78,7 kilometers (of which: 54,8 kilometers in the Małopolska Voivodeship). The area of the Ropa river's reception basin to Gorlice is 317 km^2 , and the total area of the reception basin is 974 km^2. The Ropa's reception basin drains water from the highest mountain range of Beskid Niski and flows through the territories of Biecz, Gorlice, Uście Gorlickie, Ropa communes. The largest tributaries of the Ropa river are: Sękówka (Sękowa commune and the city of Gorlice), Zdynia (Uście Gorlickie commune).

The Biała river is the right-bank tributary of the Dunajec river, with total length of 101,8 kilometers. It rises at the altitude of 730 meters over the sea level, from under Ostry Wierch mountain in Beskid Niski. The Biała river's reception basin adjoins the Ropa river's reception basin from the west, and its total area is 983 km^2. The remaining bigger water-courses in the District are: Moszczanka, Olszanka, Figa, Sitniczanka, Banica, Libuszanka, Zborowianka. Baniczanka, Stawiszanka, Przysłup, Gładyszówka, Ropka, Czarna, Regetówka, Szuwniak, Oderne, Jaśkowa, Łosianka, Bielanka, Skwirtne, Brzanka, Stróżnianka.

Water reservoirs

There are no natural water reservoirs on the territory of the Gorlice District. There is one man-made dam reservoir, on the Ropa-Klimkówka river, also called Klimkowskie Lake. The reservoir is located at the 54th kilometer of the Ropa river, about 19 kilometers south of Gorlice. Total capacity of the reservoir is 43,5 million m^3. The reservoir was built to counter-balance low level of water, for elimination the water deficit in the Gorlice and Jasło region, to lower the culmination of flood waves, for production of electricity, for recreation and rest.

Parameters of the reservoirs:

- area of the reservoir's reception basin 210 km^2
- area of reservoir 3,06 km^2
- total capacity 43,5 million m^3
- steady flood capacity 8,0 million m^3
- compensating capacity 33,0 million m^3
- below the level of damming up water capacity 2,5 million m^3
- length of the reservoir about 6,0 kilometers
- width of the reservoir from 200 to 800 meters
- length of the waterside 12,7 km
- average depth about 13 meters
- highest level of damming up water 398,6 m over sea level

There is a small pumped-storage power station with 1,1 MW wattage rating at the reservoir's dam.

3.3.5 Underground waters

The quantity of underground water in the Gorlice District is small. Main reservoirs of the underground water exist in Quaternary formations (characterized by big quantities but small range) and in Tertiary and Cretaceous formations.

In the Gorlice District there are fragments of two main reservoirs of underground water: GZWP no 433 (Major Groundwater Reservoirs no. 433) – the Valley of the Wisłoka river, and no 434 – the Valley of the Biała Tarnowska river. Both appear in the Quaternary formations and have porous, water-bearing character . GZWP no 433 has disposable quantities at the level of 26 thousand m^3/d and the average depth of an intake is 8 meters, the area of the reservoir is 181 km^2. GZWP no 434 has the disposable quantities estimated at 7 thousand m^3/d, the average depth of intakes is 6 meters, the area 54 km^2

In the Carpathian mountains there are two coats swelling springs, rocks of the bed-rock and covering formations. An average output of the springs does not surpass in general 0,5 l/s, the depth of the water-level in the rocks of the bed-rock exceeds 20 meters. The density of the springs jest relatively high. Conditions of infiltration in Carpathian mountains are unfavourable.

On the Gorlice District's territory the bore-holes were done also for natural mineral water. Healing springs of mineral water are located in Wysowa (Uście Gorlickie commune) and Wapienne (Sękowa commune).

In the Health Resort „Wysowa" there are 14 commonly accessible intakes of mineral water highly mineralized. Those are mostly the intakes of the following water: carbohydrogen-chloride-sodium oxalates. The output of the intakes comes from 0,06 m^3/h

to 9,0 m^3/h, the depth varies from 6 to 100 meters. The water existing here is counted to the second hydro-chemical zone of the Carpathian province of mineral waters.

In Wapienne there are intakes of low mineralized sulphide water. The springs “Kamila”, „Marta” and „Zuzanna” have total output of 1,7 m^3/h. They are used as medical raw material.

3.3.6 Natural resources

There are oil pools, deposits of natural gas and loamy raw materials for construction ceramics on the territory of the Gorlice District:

- oil – 9 active pools;
- natural gas – 6 active deposits;
- construction ceramics raw materials (localized in the Ropa river’s valley).

Natural springs of mineral water in Wysowa and Wapienne should be also added to natural resources of the Gorlice District. In Wysowa, those are mostly carbohydrogen-chloride-sodium oxalates, while in Wapienne, low mineralized sulphide water.

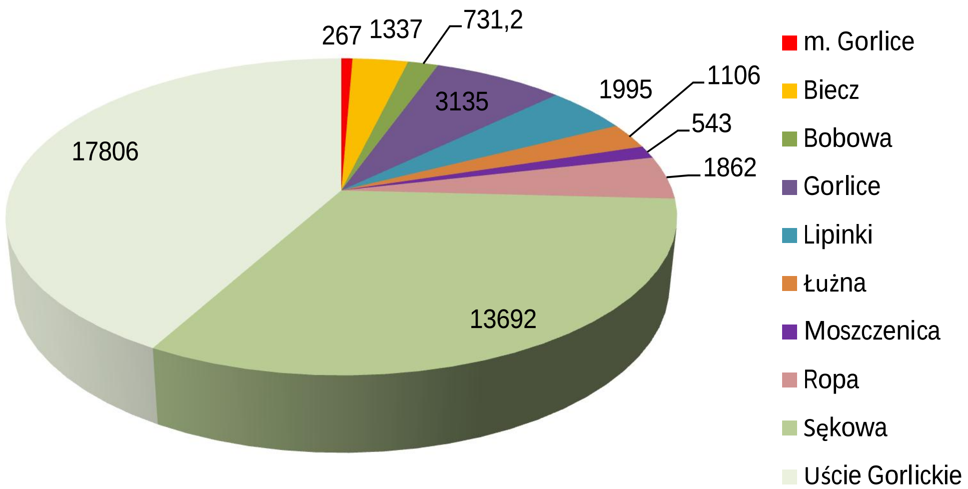
3.3.7 Forests

Table 11: The area of forests in the communes of the Gorlice District in the years 2005 and 2010 and forestage index for the year 2010 (GUS, 2005, 2010).

Commune	Forests in ha	
	2005	2010
City of Gorlice	267	204,3
Biecz	1 337,0	1416,5
Bobowa	731,2	731,2
Gorlice	3 135,0	3 023,9
Lipinki	1 995,0	2 069,6
Łużna	1 106,0	1 127,0
Moszczenica	543	552,9
Ropa	1 862,0	1 866,0
Sękowa	13 692,0	13 616,8
Uście Gorlickie	17 806,0	17 754,6
District total	42 481	42 367,7

Forests occupy significant part of the Gorlice District – 42 367,7 ha, which constitutes for over 43% of the total area of the District. The index is much above the average for the voivodeship (which is 28,60% of the area) and the average for the country (29,20% of the area)

Graph 13: The share of the forest space of particular communes in total area of forest in the Gorlice District (GUS, 2010).



The area of state forests in the District is 34 673,2 ha, private ownership stands for 6 910 ha. All forests are supervised by forest inspectorates: Gorlice, Kołaczyce and Łosie.

The highest level of afforestation has Sękowa and Uście Gorlickie communes, located in the southern part of the District. The dominating biotope type of forest is the mountain forest. In the existing natural stand of trees dominate: beech-tree, fir-tree, oak and sycamore. Apart from above mentioned species one can also meet: pine-trees, alders, larches, ash-trees, yews, maple-trees and other forest species.

Beskid Gorlicki is characterized by the richness of plants. There is smaller number of various species of mountain plants than in neighboring mountain ranges, whereas there are relatively lots of stenothermal species. The dominating plant community is the fertile Carpathian beechmast. On the territory of the Beskid Gorlicki we deal with two plant floors. There are here: the plateau floor (up to 530 meters over the sea level) and the lower subalpine floor (up to the summits of the mountains).

Beskid Gorlicki creates excellent living conditions for many species of animals, including big mammals as: noble dear, roe-deer, wolf, wild boar, bear, fox and beaver.

3.3.8 Forms of the natural environment protection

Based on the Act on the natural environment protection, as the protected are considered national parks, sanctuaries and landscape parks along with their immediate surrounding and the zones of the protected landscape. A special form could also have some monuments of the nature, ecological lands, and especially natural and landscape complexes. The terrains characterized by special natural values have been taken under the various forms of protection in the District:

- The Magura National Park,
- South Małopolska Terrain of Protected Landscape,
- Nature Reserves: Kornuty and Jelenia Góra,
- Nature 2000 sites: Low Beskid, Magura Sanctuary, Springs of Wisłoka River, Wisłoka River and their tributaries, Biała Tarnowska River , Bat Sanctuaries of the Gorlice District, Bat Sanctuary near Bukowiec,
- Natural Monuments.

Graph 14: The territories legally protected in the Gorlice District.

┈ South Małopolska Terrain of Protected Landscape
▨ Nature 2000
┈ Magura National Park
🟩 Nature Reserve

Table 12: The area of the legally protected territories in the Gorlice District (GUS, 2010).

Territory	Area (ha)
National parks	1898,9
Nature reserves	24,8
The Terrains of the Protected Landscape	57 021,6
Documentation stations	0,2
Natural monuments	36 pcs
Total protected area in the District	58 920,7

The Magura National Park (the area of municipalities Sękowa and Uście Gorlickie - 10.3% of the total area of the Park) was created by the Directive of the Council of Ministers of 25 November 1994 (Journal of Laws No. 126 item. 618). Functioning commenced 1 January 1995, and the current area is 194.39 km² and the buffer zone of 22 697 ha. The 89.7% of the park lies in Podkarpacie Voivedship. Magura National Park is predominantly a forest. Forest and scrub communities cover about 95% of the Park, a herbaceous communities - natural and synanthropic occupy only about 5% of the area.

The South Małopolska Terrain of Protected Landscape covers an area of Ropa, Uście Gorlickie municipalities and parts of Gorlice, Sękowa and Łużna municipalities (Regulation No. 92/06, the Governor of 24 November 2006). To protect nature and landscape there are also the limitations related to established protected areas of spa resorts Wysowa and Wapienne and their mining areas as well as the protection of water resources in the areas located above the Klimkówka Reservoir.

The Nature Reserve “Kornuty” - (the Sękowa municipality) landscape and geological nature reserve created in 1953 on the surface of 11.90 ha. Located on the south - western slope of the Magura Wątkowska, protects part of the fir-beech forest. There are huge rocks with a height of 2 to 15 m, scattered boulders and rock blocks, and several caves (the largest is the cave Mrocza having a length of 175 m and a depth of 17) and relict shrubs and dwarf-pines.

The Nature Reserve “Jelenia Gora” - (the Gorlice municipality), created in 1984 in Szymbark, on the hill of the same name, on the border of Lower Beskid and the Carpathian Foothills. Its total area is 12.97 hectares. Here are protected natural habitats of fern *Phyllitis scolopendrium* growing in *Acer pseudoplatanus* community. Protected are also fragments of natural communities of Carpathian beech. There is also the largest in the Polish Carpathian flysch landslide lake called "Beskid Sea Eye" with dimensions of about 50 by 20 meters.

Natural monuments in the District are a single tree, groups or avenues of trees and elements of inanimate nature.

Table 13: The area of Nature 2000 on the territories of particular communes of the Gorlice District.

Name	Code	Location
Low Beskid	PLB 180002	Gorlice Ropa Sękowa Lipinki Uście Gorlickie
Magura Sanctuary	PLH 180001	Lipinki Sękowa
Springs of Wisłoka River	PLH 120057	Sękowa Uście Gorlickie
Wisłoka River and their tributaries	PLH 180053	Biecz Lipinki
Biała Tarnowska River	PLH 120090	Uście Gorlickie
Bat Sanctuaries of Gorlice District	PLH 120094	Gorlice Ropa Uście Gorlickie
Bat Sanctuary near Bukowiec	PLH 120020	Bobowa

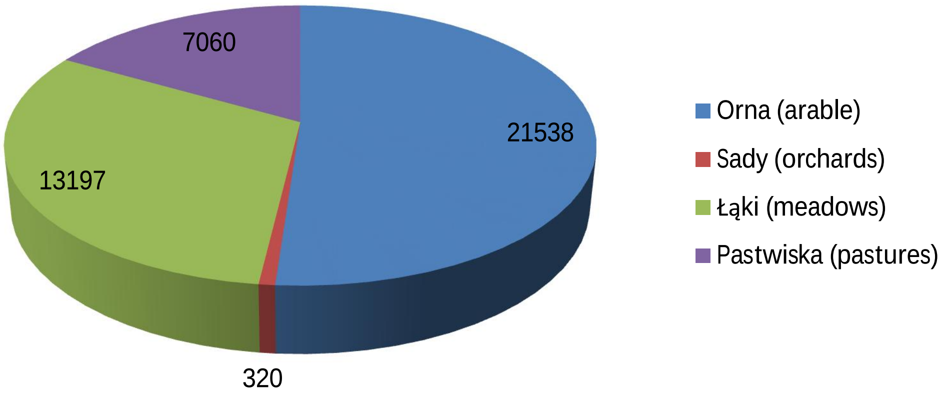
3.3.9 Agriculture

Table 14: The area of the farming land in the communes of the Gorlice District in 2005 (GUS, 2005).

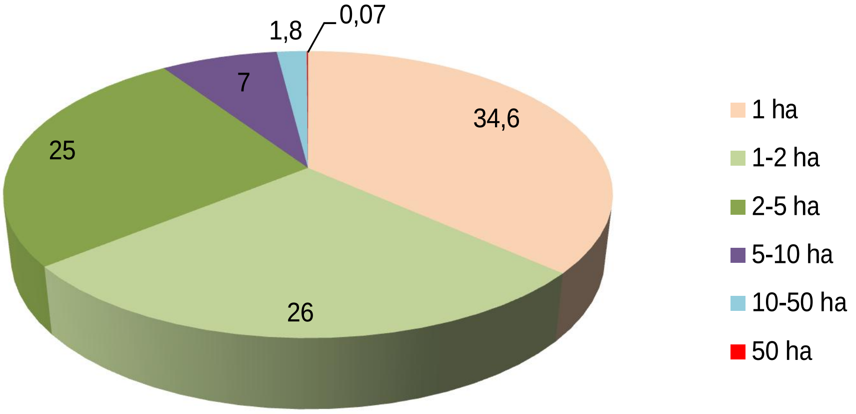
Community	Area of arable land in ha				
	Total	Arable	Orchards	Meadows	Pastures
City of Gorlice	1 031	605	28	283	115
Biecz	6 666	4 601	83	1 105	877
Bobowa	3 610	2 709	42	513	346
Gorlice	5 736	3 173	81	1 721	761
Lipinki	3 481	1 854	30	1 042	555
Łużna	3 907	2 241	23	1 191	452
Moszczenica	2 690	1 735	15	590	350
Ropa	2 334	962	11	1 024	337
Sękowa	4 572	1 673	4	1 803	1 092
Uście Gorlickie	8 088	1 985	3	3 925	2 175
District	42 115	21 538	320	13 197	7 060

Total area of the farming land in the Gorlice District is 42 115 ha (43,5% ot the total area).

Graph 15: The division of the farming land in the Gorlice District (GUS, 2005).



Graph 16: Percentage share of the farms with regard to the area in the Gorlice District (GUS 2005).



Considering natural conditions, the District's territory can be divided into two regions:

the southern region (communes: Uście Gorlickie, Sękową, Ropę, part of Gorlice commune) described as the terrain of mountains, with the forest-agricultural type of exploitation,

the northern region (communes: Bobowa, Biecz, Moszczenia, Łużna, Lipinki, part of Gorlice commune) counted as piedmont terrain, where there is soil with higher valuation and the longer time of vegetation.

The whole area of crops in the Gorlice District amounts to 1 482 516 are. The largest amount of land is used for farming grains (winter wheat crop, spring crops mixtures, oat) and growing of potatoes. The significant proportion are fodder vegetables, followed by ground vegetables and strawberries.

Poultry farming dominates among live stock in the Gorlice District, followed by cattle, swine and sheep.

There is a growing interest in an ecological farming in the largest, in terms of area, farms of the Gorlice District. Currently there are 200 ecological farms in the District, of which 50 with the certificate, the biggest number of them in the Uście Gorlickie and Sękowa communes.

3.3.10 Summary

SWOT analysis – nature and exploitation of natural resources	
Strengths	Weaknesses
- interesting sculpture of the earth's surface - big area of forests - biodiversity	- poor river network, underground water and water reservoirs - the division of the District into regions more and less useful for agricultural production - big number of small farms
Opportunities	Threats
- exploitation of natural resources for the economic development – tourism, health resorts - appropriate exploitation of natural raw materials, reaching for alternative sources of energy - development of ecological farms	- non-investment in a technical infrastructure friendly for natural environment and renewable sources of energy

3.4 Technical infrastructure

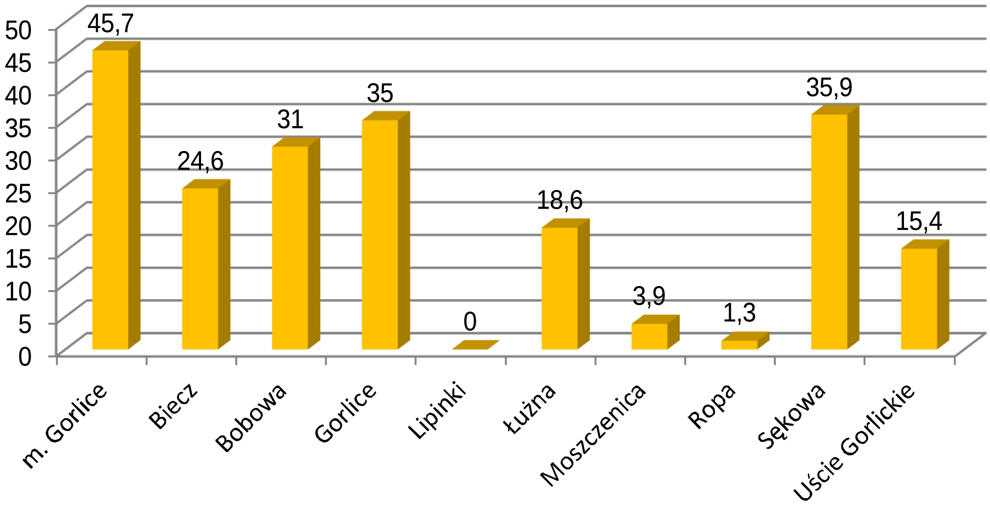
3.4.1 Water supply

Communes of the Gorlice District are not well provided with water pipes. It is caused by the configuration of the District's terrain and by accessibility to digged wells. The City possess the longest sections of the water network

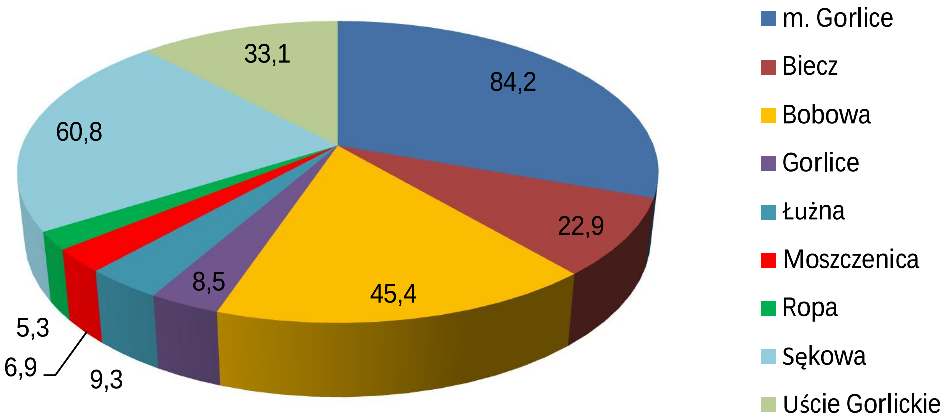
Table 15: The length of the water distribution network and number of people percentagewise, utilizing the water in particular communes of the Gorlice District (GUS, 2010).

Commune	Length of the distribution network in km	Number of people utilizing the system to the total population in %
The city of Gorlice	45,7	84,2
Biecz	24,6	22,9
Bobowa	31	45,4
Gorlice	35	8,5
Lipinki	0	0
Łużna	18,6	9,3
Moszczenica	3,9	6,9
Ropa	1,3	5,3
Sękowa	35,9	60,8
Uście Gorlickie	15,4	33,1
District	211,6	35,6

Graph 17:The length of the water distribution network in particular communes of the Gorlice District (GUS, 2010).



Graph 18: The access to the water network in the Gorlice District – percentage of population (GUS, 2010).



Only 35,5 % of inhabitants of the District have an access to the water mains.

Table 16: Water intakes for the water network in the Gorlice District (The Programme of the Natural Environment Protection and the Plan of the Management of Waste for the Gorlice District for the years 2004 – 2015).

Commune	Water intake location	Information
The city of Gorlice	Gorlice	Surface water intake , the Ropa river
Biecz	Biecz	
Bobowa	Bobowa Siedliska Jankowa Wilczyska	Surface water intake, the Biała river
Gorlice	Kwiatowice Klęczny Bielanka Bystra Kobylanka	4 wells 1 wells 2 wells 1 well 2 wells
Lipinki	b.d.	
Łużna	Łużna Szalowa Bieśnik	
Moszczenica	b.d.	
Ropa	Łosie	2 boundary water intakes on the Łosianka brook.
Sękowa	b.d.	
Uście Gorlickie	Uście Gorlickie Hańczowa Kwitoń Brunary Jaśkowa Brunary Wyżne	

The water mains network does not meet the demand for water. There is no network in many localities of the District at all, the inhabitants use the individual digged wells.

3.4.2 Sewage system

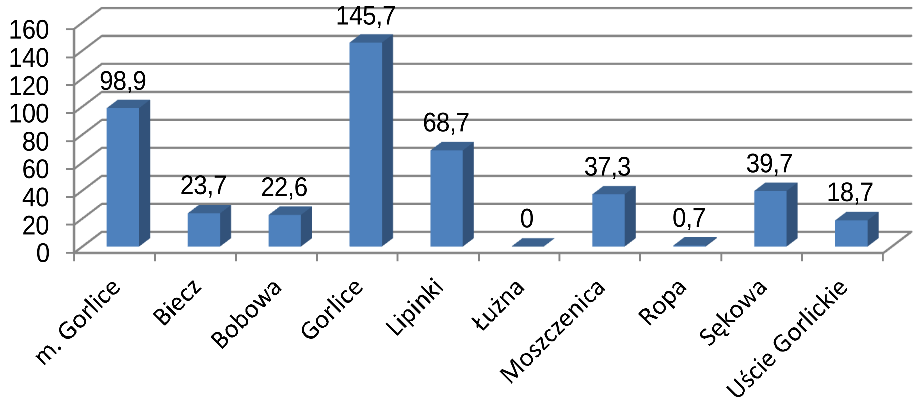
The sewage system is incomplete in the Gorlice District. A commune wastewater treatment plants function in almost every commune, there also treatment plants at factories and at some homes.

Table 17: The length of the sewage network and number of people connected (GUS, 2010).

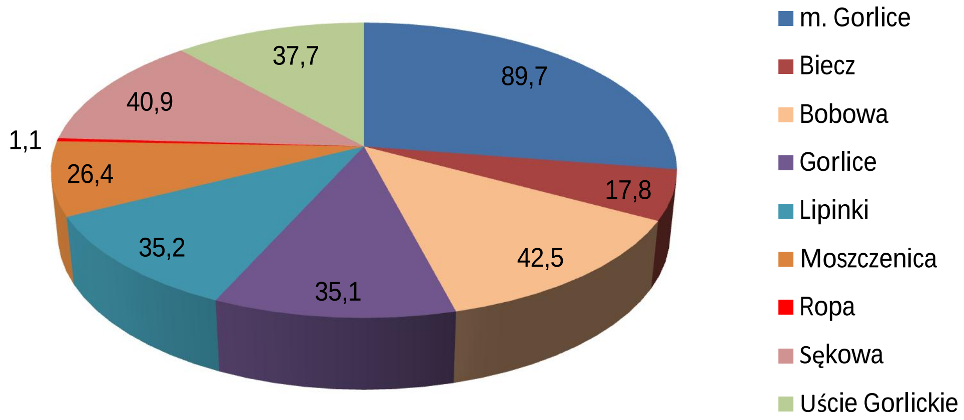
Commune	Length of the sewage network in km	Number of people connected the system in % of total population
The city of Gorlice	98,9	89,7
Biecz	23,7	17,8
Bobowa	22,6	42,5
Gorlice	145,7	35,1
Lipinki	68,7	35,2
Łużna	0	0
Moszczenica	37,3	26,4
Ropa	0,7	1,1
Sękowa	39,7	40,9

Uście Gorlickie	18,7	37,7
District	456	41,1

Graph 19: The length of the sewage network and number of people connected (GUS, 2010).



Graph 20: The access to the sewage system in the Gorlice District – percentage of population (GUS, 2010).



41,1% of inhabitants of the Gorlice District have an access to the sewage system network.

Table 18: Commune wastewater treatment plants in the Gorlice District (The Programme of the Natural Environment Protection and The Plan of the Management of Waste for the Gorlice District for the years 2004 – 2015).

Commune	Place	Type of plant	Discharge of treated wastewater	Capacity m^3/d	
				Planned	Actual
The city of Gorlice	Gorlice	Mechanical-biological	Ropa river	16.000	4249
Biecz	Biecz	Mechanical	Ropa river	515	277
Bobowa	Bobowa	Mechanical-biological	Biała river	198	110
	Siedliska	Mechanical-biological	b.d.	8,5	N/A

Lipinki	Kryg	Mechanical-biological	Ropa river	111	N/A
	Wójtowa	Mechanical-biological	Ropa river	125	99
Moszczenica	Moszczenica	Mechanical-biological	Potok Moszczanka	70	63
Ropa	Ropa – Klimkówka	Mechanical-biological	Zbiornik Klimkówka	66	10
Sękowa	Sękowa	Mechanical-biological	Potok Sękówka	63	60
Uście Gorlickie	Uście Gorlickie	Mechanical-biological	Zbiornik Klimkówka	1000	52
	Wysowa	Mechanical-biological	Ropa river	1325	205
	Gładyszów	Mechanical-biological	Potok Gładyszówka	50	8
	Hańczowa	Mechanical-biological	Ropka river	100	32

The rural commune Gorlice utilizes the Wastewater Treatment Plant in Gorlice, whereas the commune of Łużna does not possess neither the treatment plant nor sewage system network.

3.4.3 Transport

The road network in the Gorlice District is composed of the national road no. 28, voivodeship, District and commune roads.

Table 19: The length of roads according to classification (The Programme of the Natural Environment Protection and The Plan of the Management of Waste for the Gorlice District for the years 2004 – 2015).

Type of roads	Leight in km
National	34,5
Voivodship	94
District	316,3
Commune	1 154,8

The main railway lines in the Gorlice District: Stróże – Zagórz and Gorlice – Zagórzany. Gorlice has such a direct rail connection with Krakow, Rzeszów, Katowice.

Table 20: Railway stations in the District (The Programme of the Natural Environment Protection and The Plan of the Management of Waste for the Gorlice District for the years 2004 – 2015).

Community	Place – stations
The city of Gorlice	Gorlice Gorlice Glinik Gorlice Zagórzany
Biecz	Libusza Biecz
Bobowa	Bobowa (2 stops) Jankowa Wilczyska
Łużna	Wola Łużyńska Szalowa
Moszczenica	Moszczenica Małopolska

3.4.4 The management of waste

In the Gorlice District there are three wasting dumps for municipal waste and two for waste products, one of which for dangerous waste. They are:

- municipal wasting dump in Uście Gorlickie commune
- municipal wasting dump in Biecz commune
- municipal wasting dump in Bobowa commune – in reclamation process
- waste products dumps are situated in Gorlice – owned by the Fabryka Maszyn Górniczych GLINIK S.A. (The Manufacture of Mining Machinery GLINIK S.A.)

3.4.5 Summary

SWOT –technical infrastructure	
Strenghts	Weaknesses
- good accessibility to the natural gas network - good transport connections	- not sufficient length of the water mains and sewage networks - lack of sewage treatment plants
Opportunities	Threats
- development of the technical infrastructure - development of renewable sources of energy	- lack of funds for pro-ecological investments

4. Energetic infrastructure – current status and perspectives

The chapter contains basic information on the local infrastructure ensuring the supplies of:

- electricity
- natural gas
- heating

4.1 Electro-energetic system

Electricity for the Gorlice District is supplied by the national grid governed by two electricity companies: Polskie Sieci Energetyczne – Południe SA. and Polskie Sieci Energetyczne – Wschód S.A. In the area of the District there are not any electric lines of voltage of 220 kV and higher than that.

The distribution system in the region is managed mainly by the company TAURON Dystrybucja Ltd. - Kraków Branch, apart from the City and Community of Biecz as well as Lipinki Community which are supplied by PGE Dystrybucja Ltd – Rzeszów Branch (some villages lying at the boundaries of these Districts are supplied from the lines owned by TAURON Dystrybucja S.A.)

Graph 21: The system of electricity distribution.

The whole area of the District has been electrified and there is no information about buildings unconnected to electricity grid.

TAURON DYSTRYBUCJA S.A. - Kraków Branch

Electricity delivered to the District comes from the high-voltage 110 kV transmission network situated in

- 110 kV Tuchów
- 110 kV Ciężkowice,
- 110 kV Grybów
- and 110 kV Biecz.

Electricity in the Gorlice District is delivered from

- *Stróżówka substation* – situated on boundary between City of Gorlice and Gorlice Community
- *Glinik substation* – situated in Ściegiennego Street in Gorlice.

Both substation deliver electricity by medium-voltage lines to the communities of Łużna, Moszczenica, Ropa, Uście Gorlickie, Gorlice, Sękowa, Biecz and Lipinki.

- *Grybów substation* – located outside the District limits in Biała Niżna, on the boundary of Grybów. It supplies energy to the city and community of Bobowa. Additionaly, they can be supplied from Stróżówka substation in case of power failure.
- *Wiertnicza substation* – situated in Chopin Street in Gorlice, with step-down transformer (110/6 kV) delivers energy to the premises of the former Machine Factory "Glinik" and to the part of the special economic zone (owned by the factory).

Table 21: Data about the energetic infrastructure (owned by TAURON Dystrybucja) in the Gorlice District.

Specification	The number of km in 2011
Underground lines – medium voltage 15kV (Sn)	55,85 km
Overhead lines - medium voltage 15kV (Sn)	494,9 km
Overhead lines – low voltage (nN)	1 111,31 km
Underground lines – low voltage (nN)	334,84 km
Distribution transformers Sn/nN, *of which:*	527 pcs
pole-mount	*401 pcs*
in building	*96 pcs*

The investment and modernization plans of TAURON in 2012-2016:

- the construction of two circuits separated from the existing 110 kV line in order to supply energy to the special economic zone ….
- the modernization of 15 kV line connecting Grybów and Bobowa, supplying the city and community of Bobowa as well as the building a new substation.
- the investment connected with an attachment of customers and maintenance of existing lines in good condition the building of a transforming station 110/15 kV in Uście Gorlickie (Hańczowa) together with
- the 110 kV line from Stróżówka substation (realization of it is dependant on demand for electricity in Gorlice Community)

<u>PGE Dystrybucja - Rzeszów Branch</u>

PGE Dystrybucja - Rzeszów Branch provides electricity for the city and community of Biecz and Lipinki Community.

The regions are fed with power coming from the following substations:

- - Biecz substation 110/15 kV – located in Biecz.
- - Niegłowice substation 110/30/15 kV – located in Jasło.

The investment and modernization plans of PGE Dystrybucja - Rzeszów Branch

- for the 110 kV network
  - the adaptation of existing, 14,2 km long 110 kV electric line with cross- sectional area of 120 mm^2 stretching between Nigłowice and Biecz to the new service condition in the temperature of 80 C
  - the adaptation of existing, 3,5 km long 110 kV electric line with cross- sectional area of 120 mm^2 stretching between Biecz and Glinnik to the new service condition in the temperature of 80 C
- for modernization of low and medium-voltage lines aiming at avoiding voltage drops

  - Biecz – the building of a transforming station (15/0,4 kV) as well as one kilometer long medium-voltage overhead line and 0,5-km long low-voltage overhead line
  - Strzeszyn School – the renovation of the transforming station (15/0,4 kV)
  - Strzeszyn – the construction of four transforming stations (15/0,4 kV) and eight-kilometre long medium-voltage overhead line
  - Biecz – the reconstruction of the transforming station 14 / 0,4 kV, two-kilometre long medium-voltage overhead line and one-kilometer long low-voltage one.
- for service lines
  - the city and community of Biecz – the connection of consumers (group IV and V), 1,778- kilometre long overhead service line, 2,68-kilometre long underground cable service line
  - Lipinki Community - the connection of consumers (group IV and V), 0,624-kilometre long overhead service line, 0,888-kilometre long underground cable service line
- the construction of the wind-power plant “Rozdziele” in Lipinki Community with the power of 4,5 MW attached to the 30 kV line connecting Niegłowice and Równe

Machine Factory “Glinik” Ltd.

Machine Factory “Glinik” Ltd operates the energetic infrastructure (medium and low-voltage lines, substation 110/6 kV, step-down transforming stations) and transmits and sells electrical energy. The Wiertnicza substation in Gorlice delivers medium and low-voltage energy mainly to prime consumers.

The largest consumers are

- Pressing Plant “Glinik” Ltd (about 55% of total consumption)
- Mining Mashine Plant (about 17%)
- Tools and Drilling Equipment “Glinik” Ltd. (about 10%)

“PKP Power Engineering” Ltd South Plant

“PKP Power Engineering” Ltd South Plant has got a license for selling, transmitting and distributing electrical energy. It makes use of its own transmission and distribution network in the area of the Gorlice District. Besides selling energy it also provides service on wiring system. The company mainly delivers energy to railway electric tractions, maintains electric tractions, provides electric service, repairs damaged cables, electrical equipment and wiring systems.

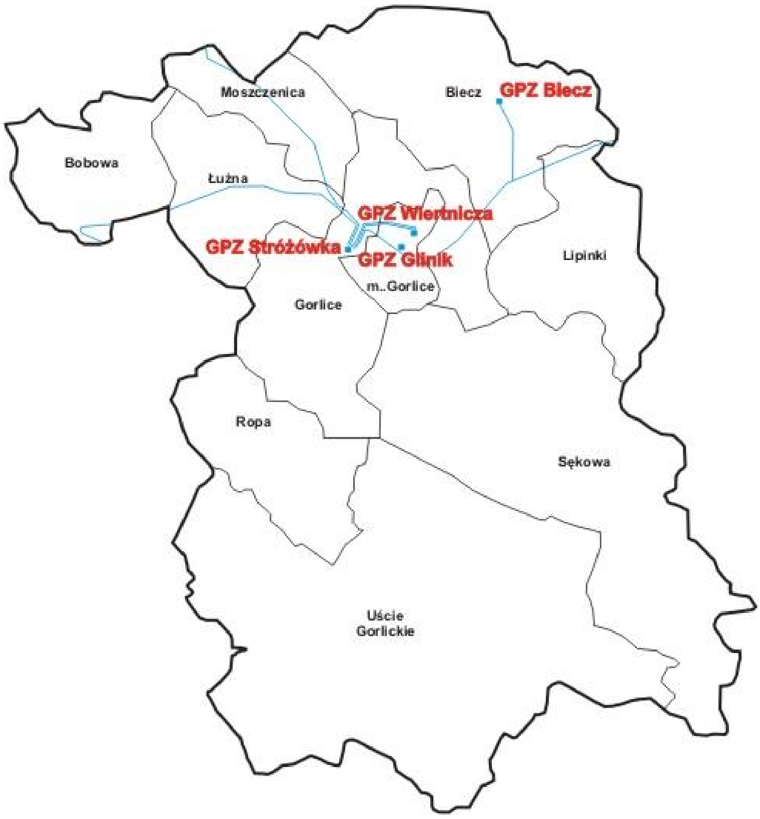
E-Star Heat and Power Plant Gorlice Ltd.

E-Star Heat and Power Plant Gorlice Ltd. is a main supplier of thermal energy for Gorlice and industrial plants in Glinnik Mariampolski and one of suppliers of electrical energy for consumers in Gorlice. Within a period of seasonal demand for thermal energy the station additionally produces electrical one.

Table 22: Production and sale of electricity in 2010 i 2011 of E-Star Heat and Power Plant Gorlice Ltd.

Specification	2010	2011
Production MWh	8 616,024	7 619,808
Sale w MWh, total	6 252,279	5 207,824
of which:		
- Machine Factory “Glinik” Ltd.	3 436,182	3 640,5291
.TAURON	2 773,577	518,631
Another	42,520	48,664
Consumption of electricity from own production	2 363,745	2 411,984

Graph 22: High voltage lines of the 110 kV.

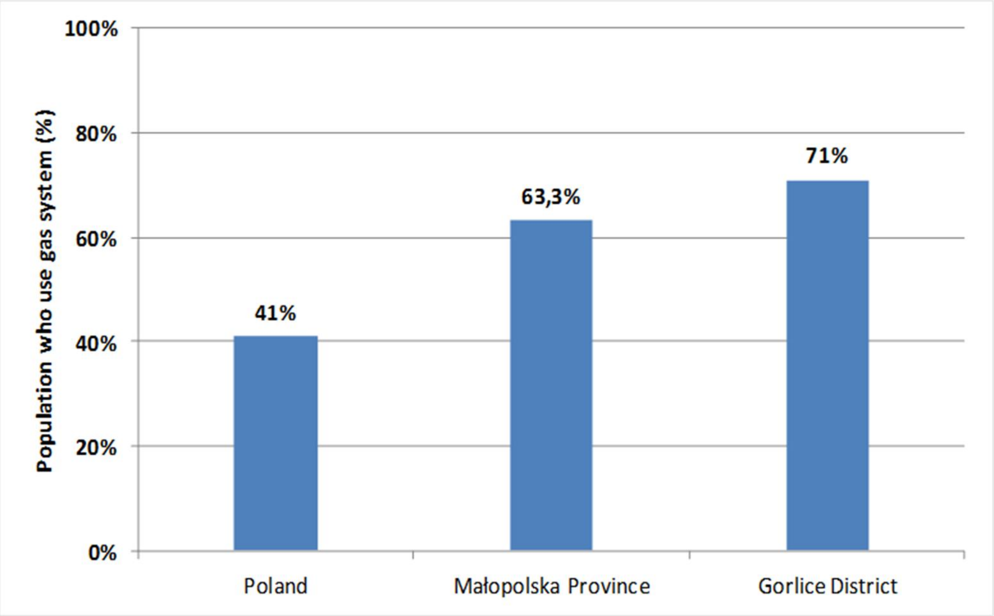


4.2 Gas system

Carpathians Gas Company is one of six companies belonging to the leader on the Polish gas market – PGNiG Ltd.

As the operator of the distribution system, the company carries out its business activities in four provinces in south-eastern Poland including Małopolskie Province. Gasworks in Jasło operates and extends the gas supply system in the Gorlice District. In the major part of this region, the system is operated by Regional Gas Distributor in Gorlice having its seat in Kolejowa Street 2. The places such as Brunary, Śnietnica, Banica and Izby in Uście Gorlickie Community from 1st January 2012 are supplied with gas by Regional Gas Distributor in Krynica-Zdrój in Stara Droga Street 30.

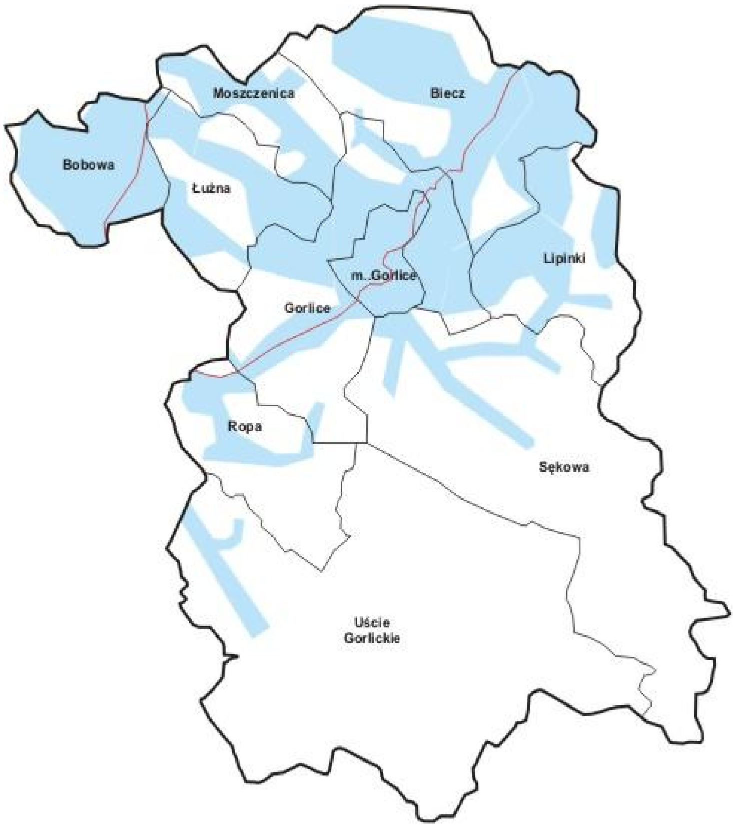
Graph 23: Index of the gasification of the Gorlice District (GUS 2010r.).



**index of gasification determined as the proportion of gas consumers to the total number of inhabitants*

All communities of the District have an access to natural gas, but their gas supply systems vary in stage of development. In some places, like Sękowa and Uście Gorlickie Communities, laying in the south of the District, there are no gas pipelines.

Graph 24: Gas system in the Gorlice District.



Graph 25: Index of the gasification of the communities (GUS, 2010).

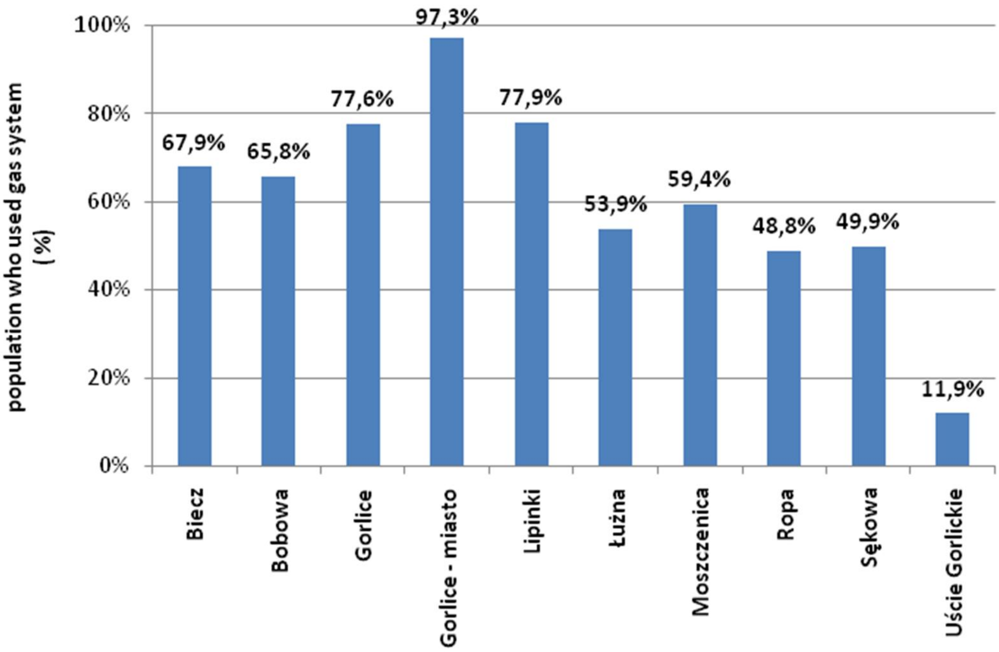


Table 23: Gas infrastructure in 2010 (KSG Ltd in Tarnów - Jasło Branch).

Community:	Length of pipelines (m)		
	pressure		Total :
	low (up to 10 kPa)	average (from 10kPa to 0,5MPa)	
Biecz	88 327	90 592	178 919
city	33 976	12 762	46 738
village	54 351	77 830	132 181
Bobowa	-	110 381	110 381
city	-	29 163	29 163
village	-	81 218	81 218
Gorlice	75 921	159 714	235 635
City of Gorlice	70 646	42 803	113 449
Lipinki	20 262	83 496	103 758
Łużna	-	105 914	105 914
Moszczenica	-	71 273	71 273
Ropa	-	62 086	62 086
Sękowa	-	49 965	49 965
Uście Gorlickie	-	24 231	24 231
Total :	255 156	800 455	1 055 611

Graph 26: Gas distribution grid in the communities (based on data of KSG Ltd in Tarnów - Jasło Branch).

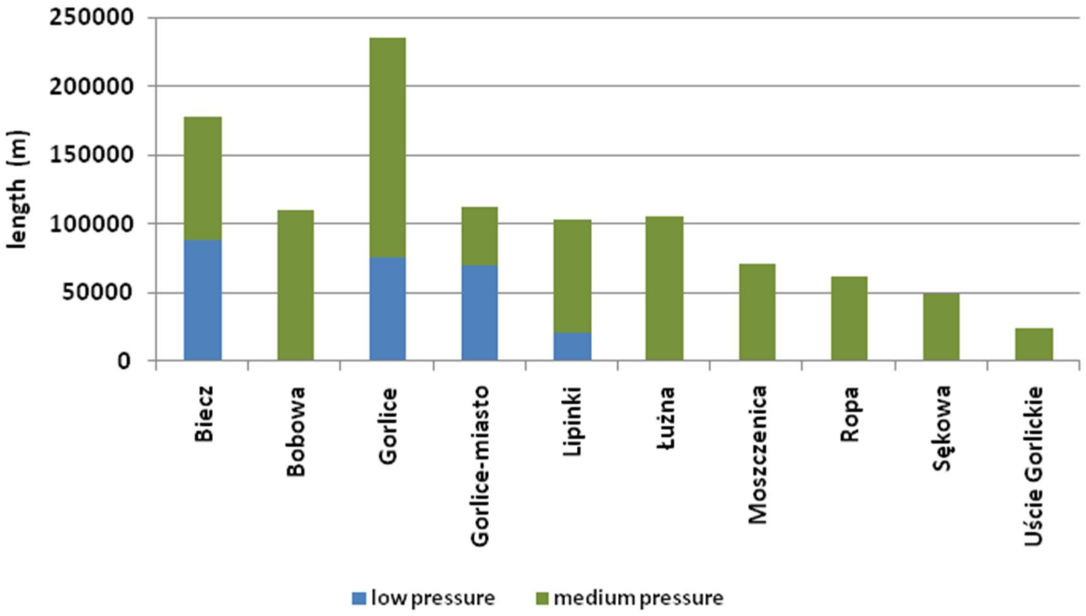
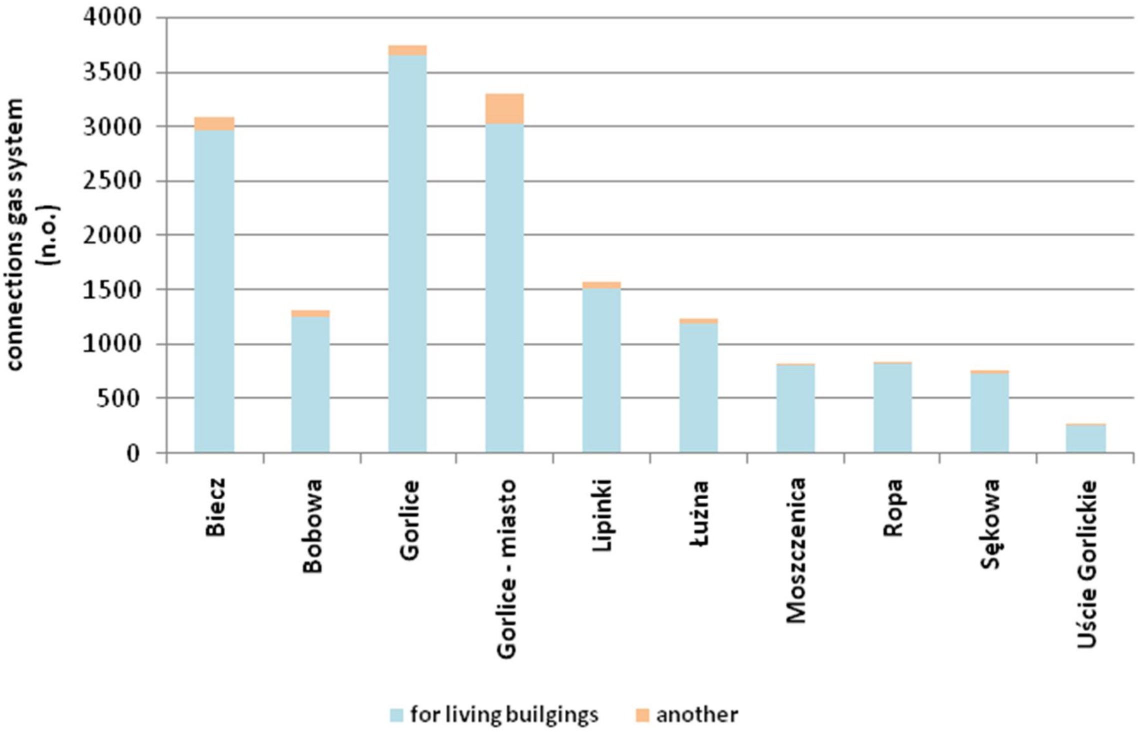


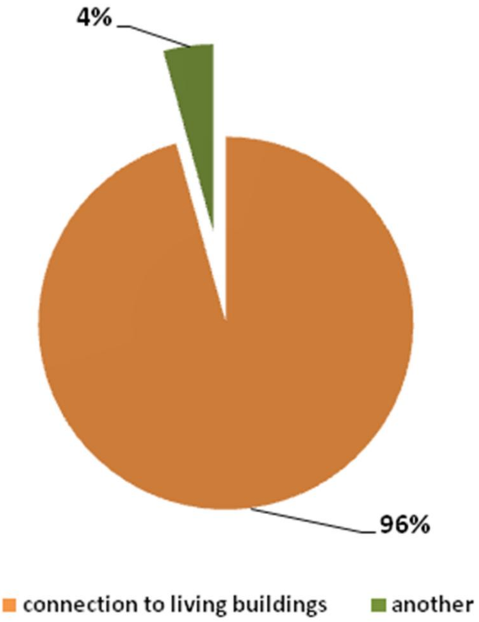
Table 24: The number of gas connection in 2010 (KSG Ltd in Tarnów - Jasło Branch.

Community	Active gas connections (no.)	
	Total :	of which to dwelling houses
Biecz	3 097	2 973
city	1 173	1 104
village	1 924	1 869
Bobowa	1 316	1 257
city	484	464
village	832	793
Gorlice	3 753	3 658
City of Gorlice	3 306	3 036
Lipinki	1 571	1 511
Łużna	1 235	1 198
Moszczenica	832	815
Ropa	850	829
Sękowa	763	731
Uście Gorlickie	277	264
Total	17 000	16 272

Graph 27: The number of gas connection in 2010 (based on data of KSG Ltd in Tarnów - Jasło Branch).



Graph 28: Number of active gas connections - type of buildings (KSG Ltd in Tarnów - Jasło Branch).



The investment and modernization plans of Gas Plant in Jasło in 2012 - 2014

- the renovation of short sections of some medium and low-pressure pipelines of total length of 432 m in Gorlice Community,
- the renovation of the medium and low-pressure service gas pipes of total length of 225 m in Gorlice Community,

the redevelopment of the low-pressure gas pipe system (total length of 2156 m, 21 service gas pipes) in Strzeszyna and Biecz Communities,

- the redevelopment of the medim-pressure gas pipe systm (total length of 30942 m) together with six service gas pipes in Zagórzany and Moszczenica,
- the redevelopment of the medium-pressure gas pipe system (total length of 6810 m) and seventy-three
- Service gas pipes Gorlice and in Mszanka and Stróżówka belonging to Gorlice Community,
- the redevelopment of the low-pressure gas pipe system (total length of 3050 m) together with twenty-nine service gas pipes in the City and Community of Gorlice,
- the redevelopment of the low-pressure gas pipe system (total length of 1850 m) and fifty-eight service gas pipes in Gorlice,
- the redevelopment the low-pressure gas pipe system (total length 2072 m) and thirty-two service gas pipes in Gorlice.

4.3 Thermal energy supply

The supply of thermal energy in the area of Gorlice directly depends on a density of the local population, which concentrates in urban areas and is sparser in rural ones. The demand for thermal energy in the District is satisfied by:

- The city central heating system
- Local heating systems
- Domestic boiler rooms

4.3.1 The District heating system

The District heating system is operated by E-Star Heat and Power Plant Gorlice Ltd. (the area of the city). The production of thermal energy together with electricity is its basic productive activity. In the area of the Gorlice District, E-Star Ltd. is the only licensed producer of thermal energy.

The Public Utility Company and Machine Factory “Glinik” Ltd. have licenses for distribution and a sale of thermal energy.

The main consumers of thermal energy generated by the station are:

- Public Utility Company (about 75%) dealing in a transmission and distribution of it to dwelling houses and businesses in Gorlice
- Machine Factory “Glinik” Ltd. (about 24%)
- Private Housing Association Chopin Street 35
- District Diary Cooperative (about 0,3%)

E-Star Thermal-Electrical Power Station is planning the undertaking called “Modernization of the Thermal-Electrical Power Station Gorlice”, consisting in the construction of a new steam boiler. fuelled with municipal waste or SRF (Solid Recovered Fuels).

4.3.2 Local heating systems

Scattered local boiler houses, satisfying a demand for energy of more than one consumer, are located close to the buildings to which they supply thermal energy. They are owned by industrial plants, businesses, housing associations or local councils.

4.3.3 The infrastructure of thermal energy supply system

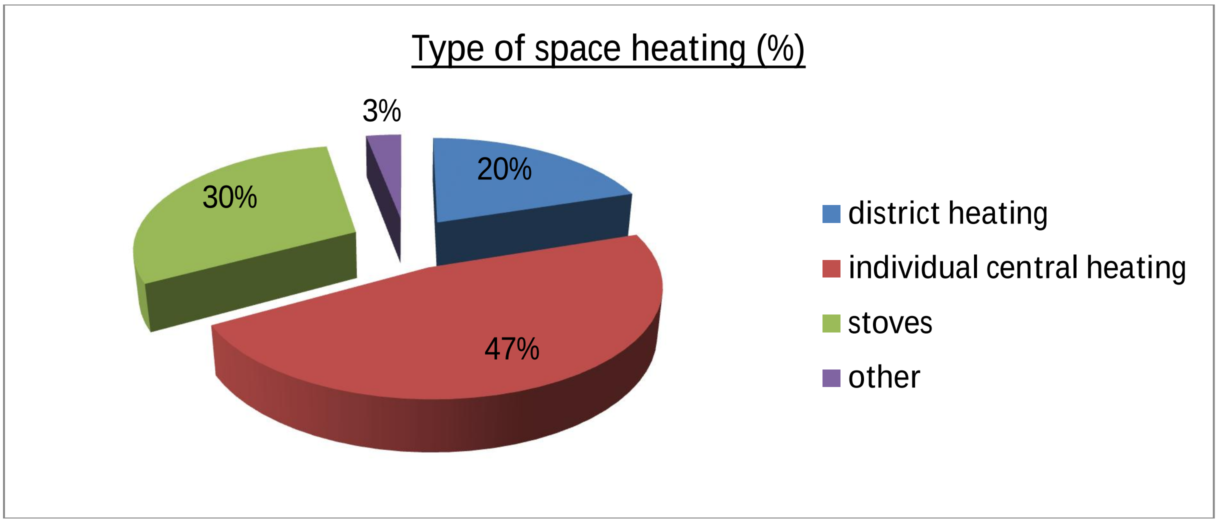
Table 25: The infrastructure of central heating systems in the Gorlice District (GUS, 2010).

Specification	Total number	of which housing associations
Total number of boiler houses	38	6
The length of transmitting pipe lines (km)	22,3	1,2
The length of service pipes (km)	9,9	1,6

Graph 29: The buildings within the District of heated in an organized manner (GUS 2010r.).

Institutions of general interest usually are equipped with own heat source, based on the prevalence of fuel gas. Part of the buildings in the City of Gorlice is in range and is powered by the district heating system.

Graph 30: The methods of space heating (GUS)



<u>District heating</u> – thermal energy from heat and power station, thermal power station, boiler house serving more than one building or single multi-family bulding

<u>individual central heating</u> – source of thermal energy in single family house (in boiler house or in basement) or in single flat of multi-family house (in kitchen or bathroom)

<u>stoves</u> – heating room using tiled stoves or portable stoves (fuelled with coal, coke, wood or sawdust) or tiled stoves equipped with electric heater

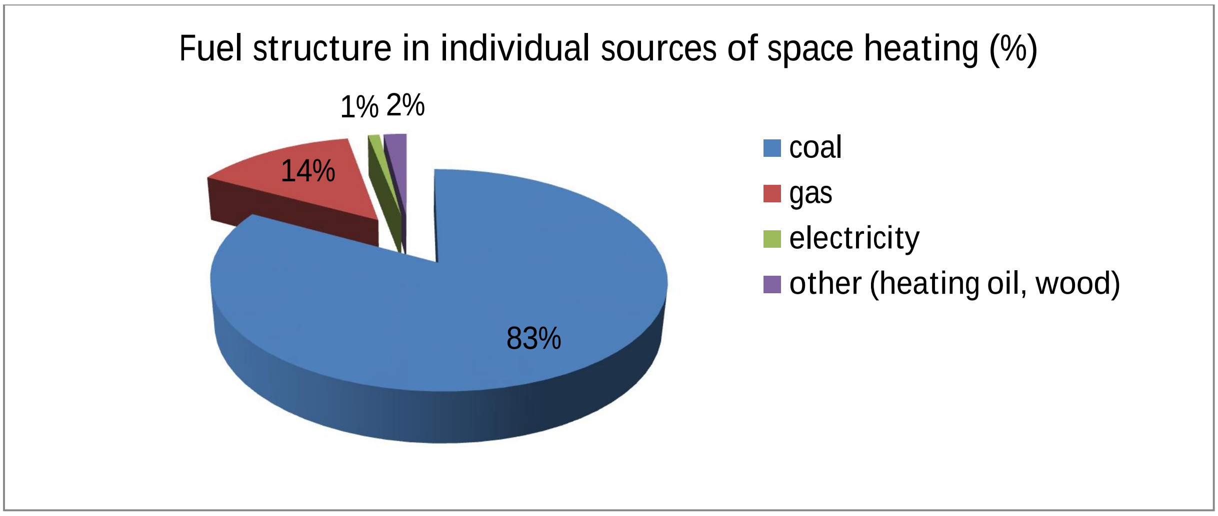
<u>other</u> – portable small gas stoves, thermo ventilators, portable radiators etc.

4.3.4 Individual boiler rooms

Most private houses in the area of the District make use of their own central heating systems generating thermal energy in low-power coal burning stoves

The buildings belonging to public institutions (local and District councils) usually have their own central heating systems, mainly making use of natural gas. Some of them are connected to the city central heating system.

Graph 31: Fuel structure in individual sources of space heating (GUS.).



5. Energy consumption

5.1. The number of electricity consumers and electricity consumption

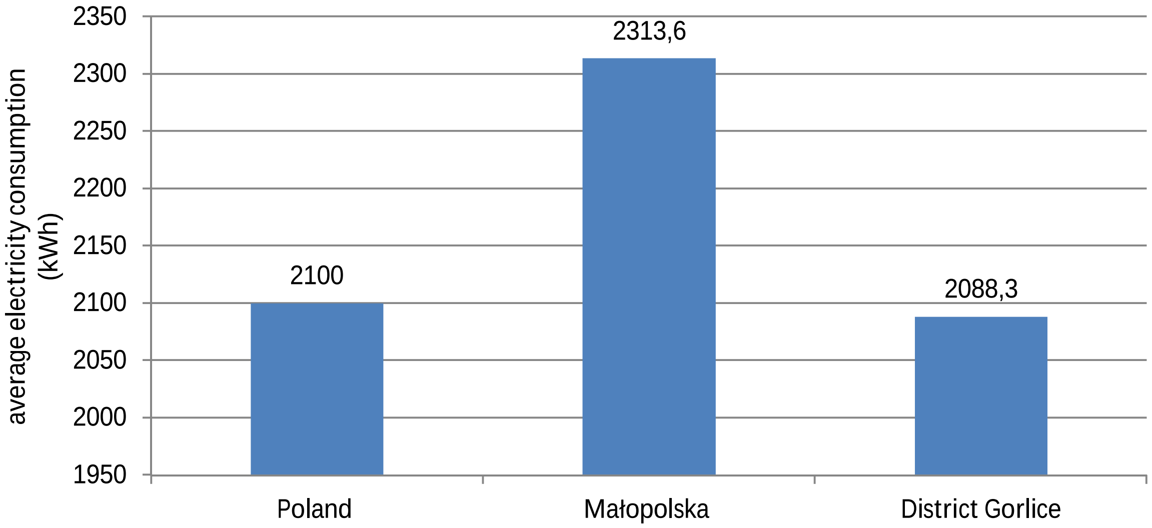
The number of electricity consumers in the District, supplied by TAURON Distribution Ltd. amounts to 29578, and energy consumption reaches the figure of 143819,77 MWh a year (data from 2010).

According to PGE Distribution Ltd. Rzeszów branch, the total number of electricity consumers in the city and community of Biecz is currently equal to 7700. The consumers living in the area mentioned above, fed from medium and low-voltage lines, consume about 22,3 GWh a year (in 2010 it was about 18,3 GWh).

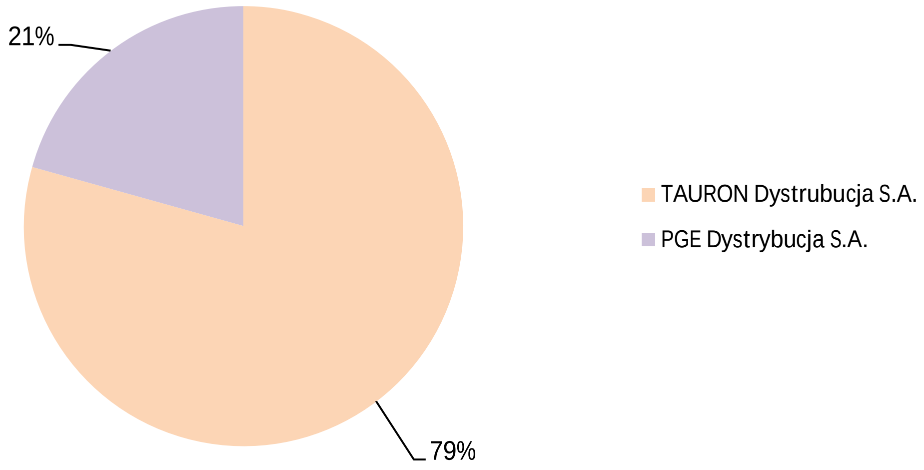
Machine Factory "Glinik" Ltd. Generates about 40 MWh of energy, while E-Star Thermal-Electro Power Station Gorlice – 8616 MWh.

Altogether there are about 37278 consumers in the District and energy consumption reaches the figure of about 206236 MWh a year (data from 2010). The households comprise the largest proportion of energy consumers(88% - according to GUS data and the main suppliers operating in the District) and they use the largest quantity of electric energy. An average consumption of it in the group of private households amounts to 2088,3 kWh per head and it is lower than the province's and country's one.

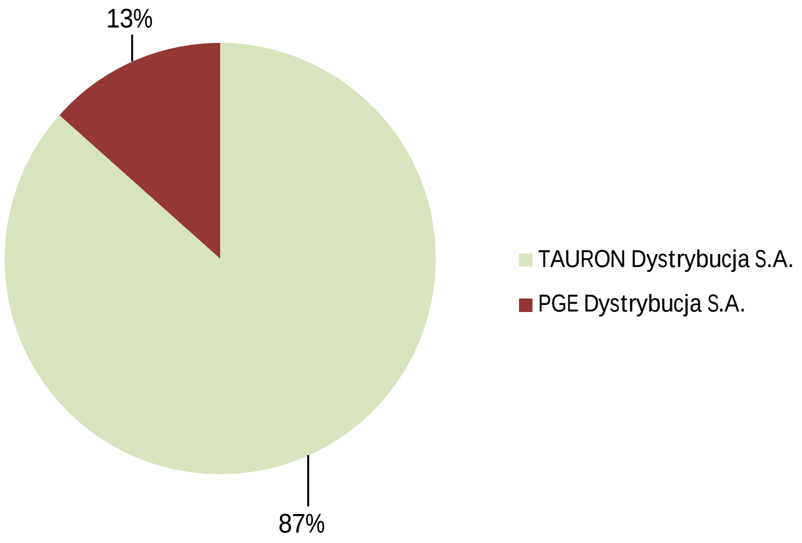
Graph 32: The average electricity consumption by the household in the Gorlice District compared to the province and the country (GUS, 2010).



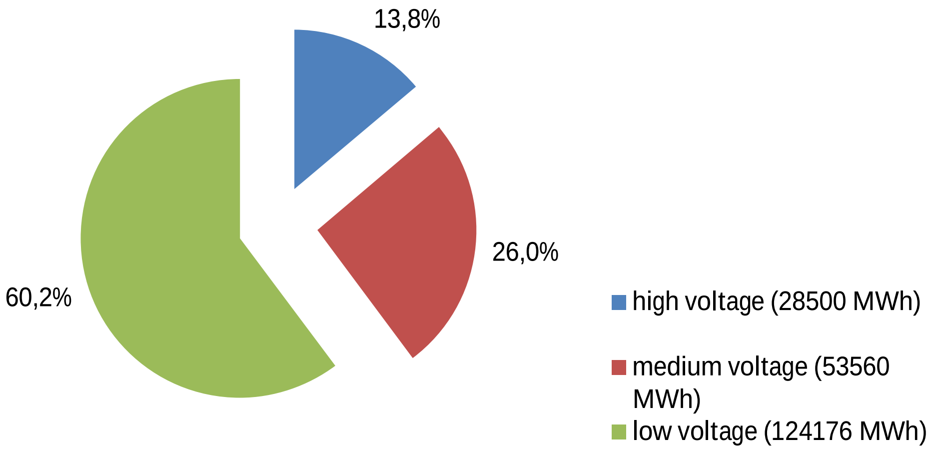
Graph 33: *Electricity consumers in the distribution of the supplier – in percentage.*



Graph 34: Amount of electricity supplied to the District divided by the electricity provides- in percentage.



Graph 35: The electricity consumer in the Gorlice District by the type of power supply.

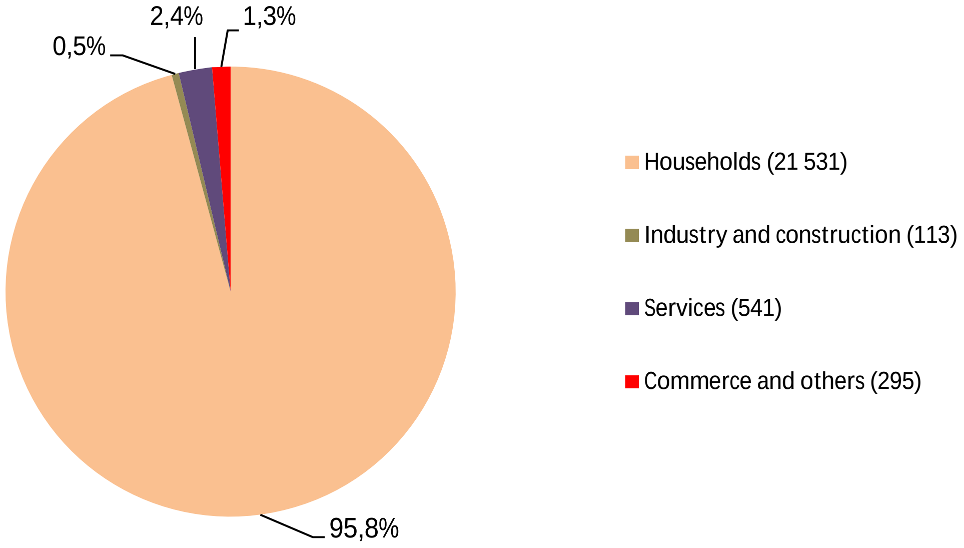


5.2 Gas consumption

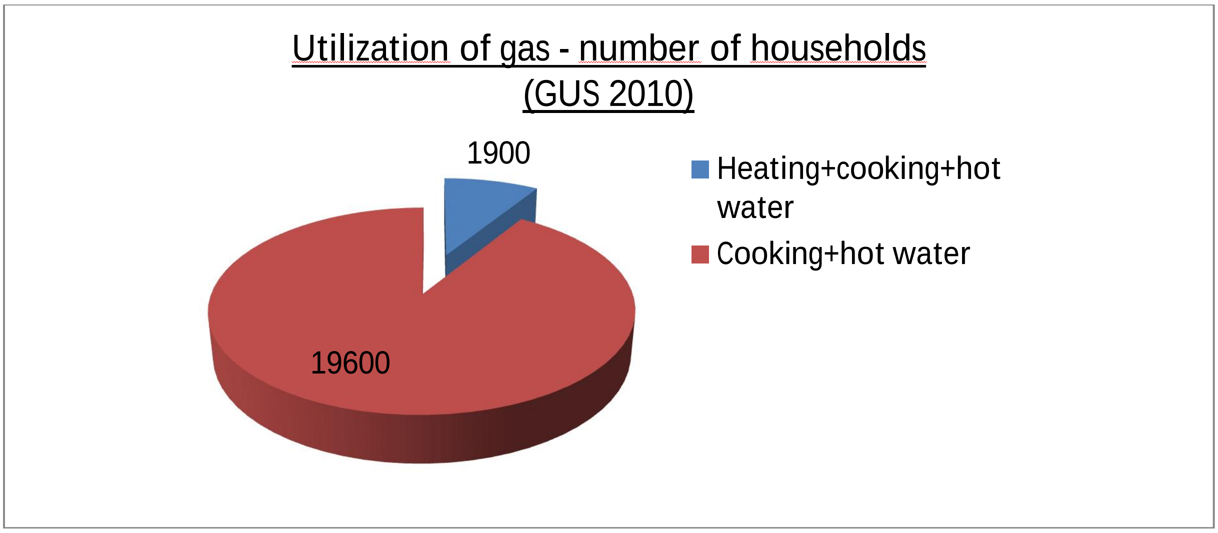
5.2.1 Structure of gas consumers

In 2010 there were 22480 consumers connected to network in the Gorlice District. The majority of the consumers are households (nearly 96%), in this number those who used gas for preparing meals and hot water. The remaining consumers are divided into groups: various services (2,4%), commerce (1,3%), industry and construction (0,5%), and other consumers (a total number of 10)

Graph 36: Structure of gas consumers in the Gorlice District in 2010 (Gasworks Jasło and GUS 2010).



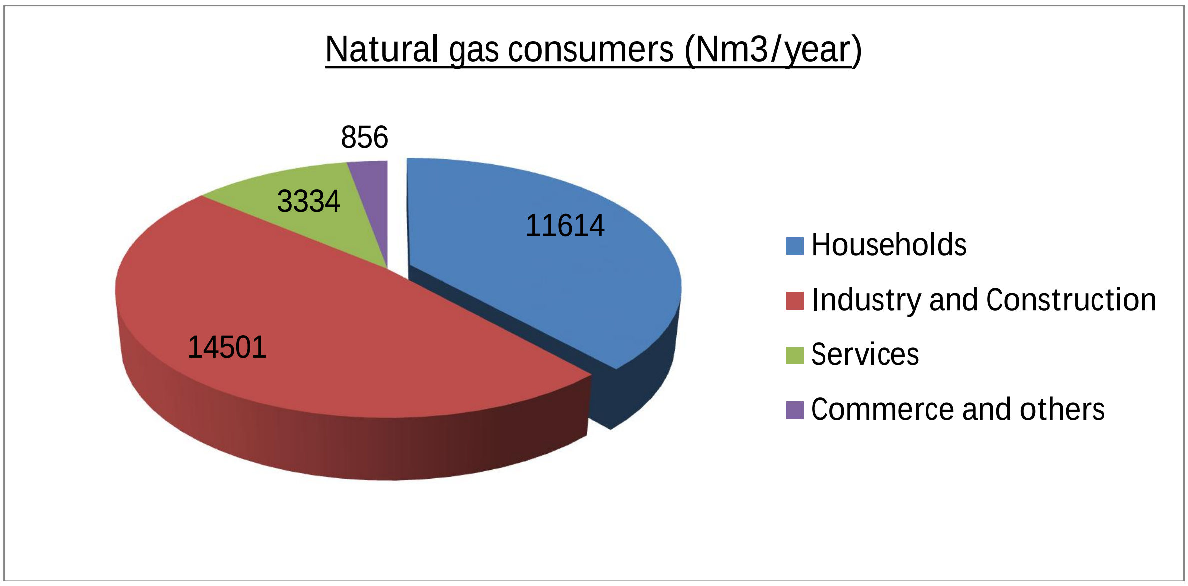
Graph 37: *Utilization of gas – number of households (GUS, 2010.).*



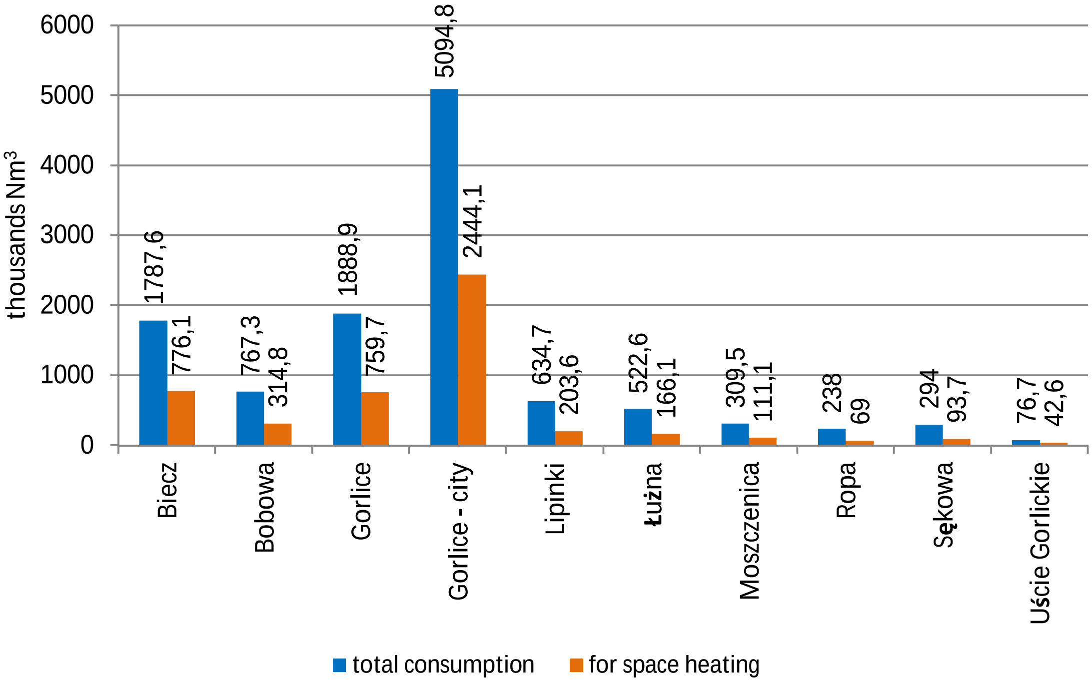
5.2.2 Structure of gas consumption

Total annual gas consumption by consumers connected to the gas network in the Gorlice District in 2010 reached a value of 30.3 million Nm^3 (sales / consumption of natural gas is given by the gas plant in Nm^{3,} this is a standard cubic meter, not from the SI system. In statistics, 1Nm^3 usually equals 1m^3).

Graph 38: Natural gas consumer (Nm^3/year) (Gasworks Jasło).



Graph 39: Gas consumption by households in 2010 (Gasworks Jasło).



Graph 40: Annual gas consumption per single consumer (GUS).

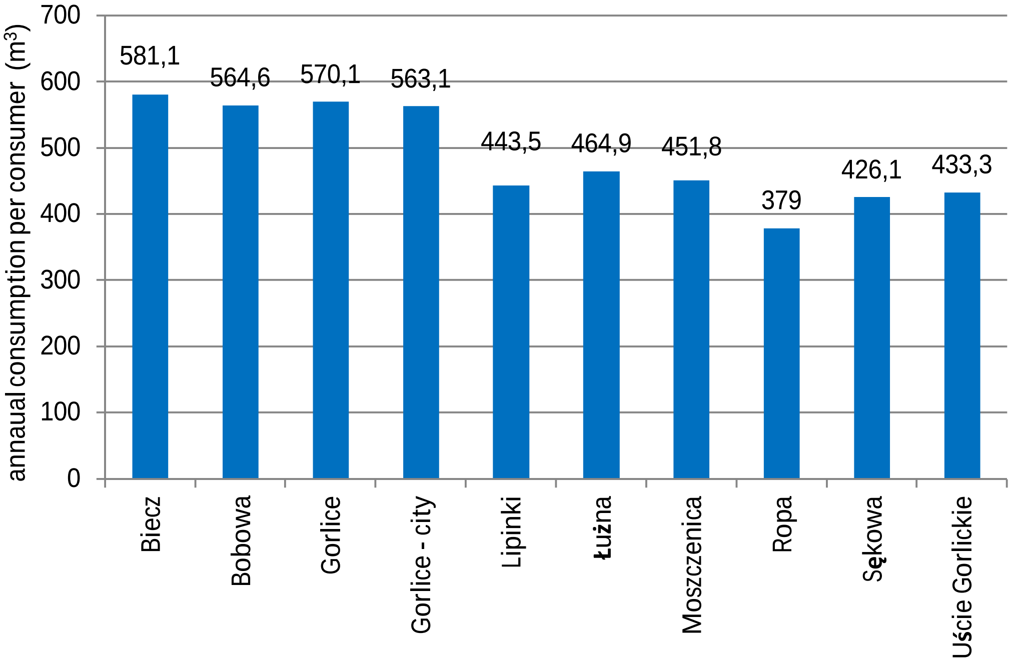
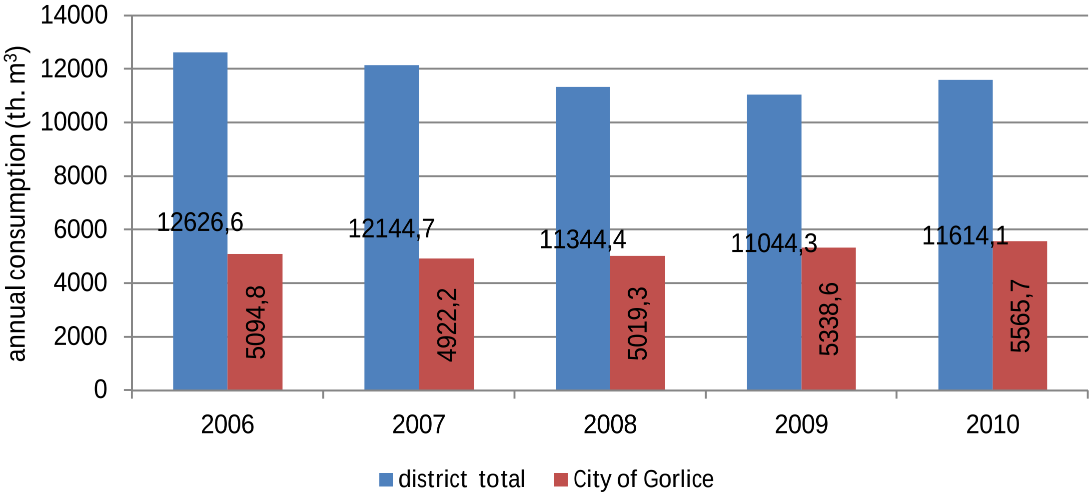


Table 26: Natural gas demand in households in the District and City of Gorlice in the years 2006 - 2010 (Gasworks Jasło).

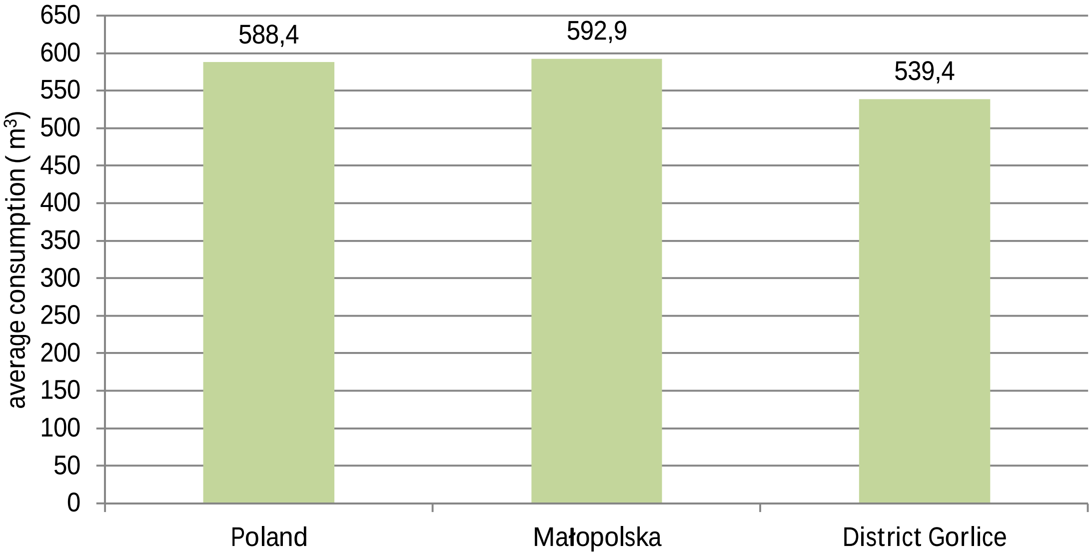
Details	2006	2007	2008	2009	2010
(th. Nm^3)					
Gas consumption in the District	12626,6	12144,7	11344,4	11044,3	11614,1
Gas consumption in the city of Gorlice	5094,8	4922,2	5019,3	5338,6	5565,7
(% of District)	(40,3%)	(40,5%)	(44,2%)	(48,3%)	(47,9%)

In 2010 there has been noted an 8% decrease of demand for gas in the households compared to the year 2006 . The demand for gas in the city limits of Gorlice (the main gas consumption area) has increased by over 9%.

Graph 41: Natural gas consumption in households in the years 2006-2010 in the District and city of Gorlice (Jasło Gasworks).



Graph 42: The average consumption of gas by a household in the Gorlice District in 2010 (GUS).



The remaining gas consumers are services and trade businesses, who in 2010 have spent a total of less than 4.2 th. Nm^3. Detailed information on natural gas consumption by specific groups in 2010, are shown in the table below:

Table 27: The consumption of natural gas in the Gorlice District in 2010, (PGNiG SA Carpathian Branch of Gas Trading in Tarnow and Gasworks Jasło).

Municipality	Households	Industry and construction	Services	Commerce	The other (agriculture, forestry, hunting, fishing)	Total:
Biecz	1 787,6	814,3	623,8	80,2	0	3 305,9
of which: city	856,3	124,7	371,2	40,6	0	1 392,8
rural areas	931,3	689,6	252,6	39,6	0	1 913,1
Bobowa	767,3	218,6	281	6,3	0	1 273,2
of which: city	379,2	217,1	159	6,3	0	761,6
rural areas	388,1	1,5	122	0	0	511,6
Gorlice	1 888,9	155,8	434	25,1	12,6	2 516,4
Gorlice city	5 094,8	13 153,8	1173	652,7	6	20 080,3
Lipinki	634,7	99,6	170,6	27	1,8	933,7
Łużna	522,6	52,4	199,3	14	0	788,3
Moszczenica	309,5	0	92,2	11,1	0	412,8
Ropa	238	2,1	153,1	3,2	9,4	405,8
Sękowa	294	4,9	129,3	6,4	0	434,6
Uście Gorlickie	76,7	0	77,7	0	0	154,4
Total:	11 614,1	14 501,5	3 334	826	29,8	30 305,4

5.3 Heat consumption

E-Star Heat and Power Station Gorlice Sp. z o.o. is the main supplier of heat for Gorlice and industrial plants located in Glinik Mariampolski and one of the suppliers of electricity to end-users located in the area of Gorlice.

Table 28: Sales of heat and power ordered in 2010 and 2011.

Buyer	2010		2011	
	sales [GJ]	power ordered [MW]	sales [GJ]	power ordered [MW]
Municipal Public Utilities	163 968	18,79414	148 437	18,5475
Machinery Factory "Glinik"	51 416	6,5	47 247	6,0
Chopin 35 Housing Community	647	0,085	581	0,085
Regional Dairy Cooperative	110	0,002	84	0,002
TOTAL	216 141	25,38114	196 349	24,6345

* Source: E-Star Heat and Power Gorlice

Power and heat demand

There are three types of thermal energy consumers in the Gorlice District:

- dwelling houses incl.:
  - single family houses and individual flats
  - multi-family buildings
  - local authority housing
- public buildings;
- buildings of business activities (services, industry, commerce).

Assumptions for estimating the demand for power and heat:

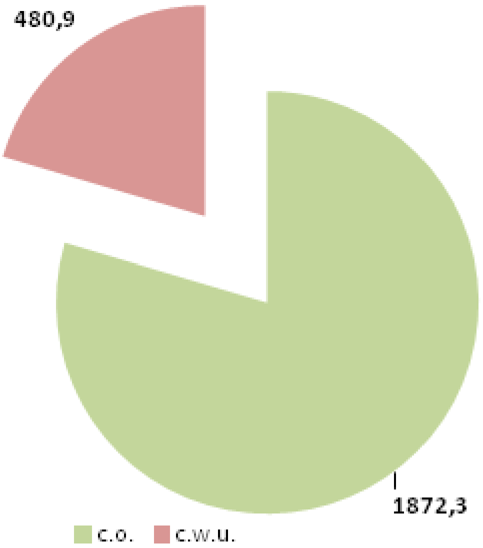
- approximately 20% of dwelling houses were built after 1990 (it is assumed that energy-efficient technologies were used) - about 60% of individual buildings were partially thermo-modernized. About 30% of the total usable floor space (and total capacity) in the District are in a new buildings.
- the average usable floor space of a flat built after 1990 is estimated to be between 120-150 m^2;
- buildings in the District have been constructed in the course of many years, in accordance with regulations and standards of construction of that time. Since it is not possible to reliably determine the age of the buildings, the average annual rates of heat consumption were set to asses the energy required to heat $1m^2$ in a multi-family building at the level of 315 kWh/m^2. This is an equivalent of - 0.05 kW/m^2;
- heat demands for single-family houses were set accordingly,, but assuming a higher rate of heat demand of- 0.07 kW/m^2;
- heat demand depends on the age of the building, because certain construction techniques have changed over time. Approximate heat demands according to the age of the building is shown below:

Buildings constructed in years	The average rate of heat consumption (KWh/m^2a)
up to 1966	240 – 350
1967 – 1985	240 – 280
1985 – 1992	160 – 200
1993 – 1997	120 – 160
after 1998	90 – 120

- heat demand for commercial and industrial buildings were calculated as for residential buildings;
- heat demand for public buildings was estimated according to the actual demand of 2010;
- annual energy demand for heating dwelling houses (both single and multi-family) were estimated to be between 500 to 650 $MJ/m^2/year$;
- the daily average water consumption rate is estimated to be of 80 dm^3/person/day. While calculating the total heat consumption for heating water in households, the average of 4000MJ/person/year was estimated. For other buildings, i.e. public and business the demand for hot water is assumed to reach 10% of the total demand for heating.

Taking account of the above assumptions and the estimated figures, the heat demand in the entire Gorlice District is about 283,8 MW, while the annual heat consumption is 2 353,2 TJ. This figure includes energy used for space heating (1872,3 TJ), and hot water (480,9 TJ).

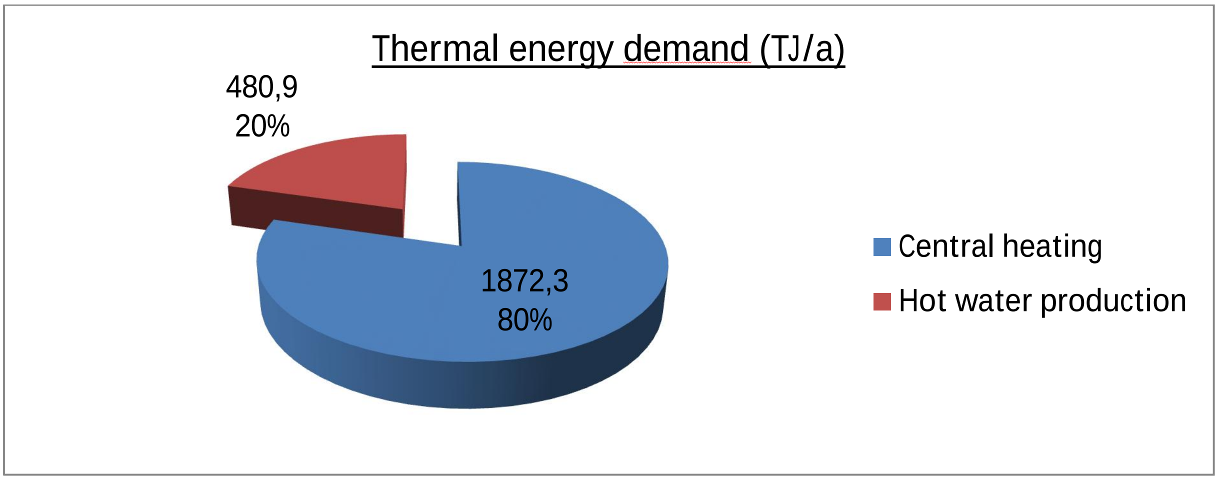
Graph 43: Current heat demand in the Gorlice District (TJ/a).



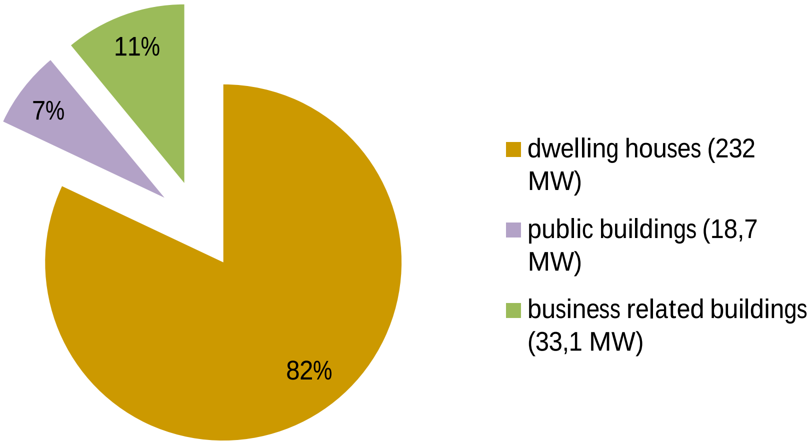
c.o. – central heating; c.w.u – hot water production

Dwelling houses have the highest heating demands - 82% (232 MW) of the total thermal power supply and 79% of thermal energy consumption. The next highest consumer is the industry, commerce and services- 11% of the total demand for power (14% of energy consumption) and public buildings- 7% (for both power demand and energy consumption).

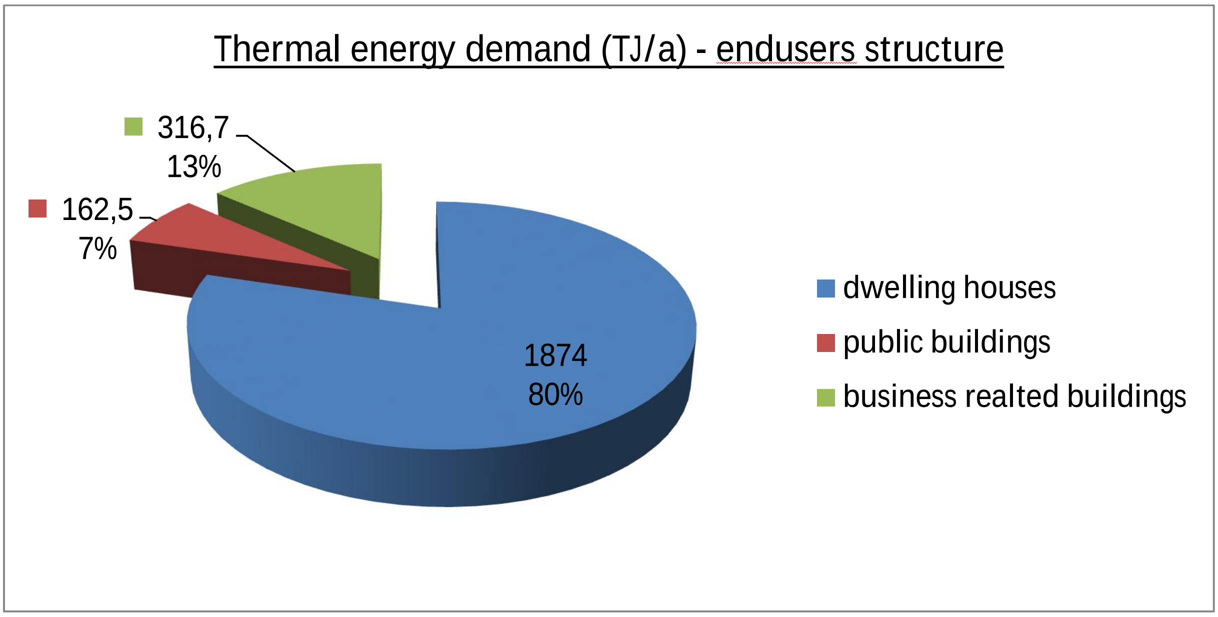
Graph 44: Thermal energy demand in the Gorlice District.



Graph 45: The demand for thermal power in the Gorlice District – the structure of users.



Graph 46: Heat demand in the Gorlice District – the structure of users.



5.3 Assessment of the current status of supply of electricity, gas and heat in the Gorlice District

Supply of electricity	
A positives	Requires improvement
Certain and secure power sources - system stations (110/15kV) General easy access to electricity - a well-developed network of power transmission of medium and low voltage The present system of providing the District with electricity is satisfactory and is estimated to remain thus for future plans (considering routine breaks in electricity supply). Reserve transmission Production of electricity in combination with heat (cogeneration) - E-Star and Power Gorlice	Some elements of the medium and low voltage network require replacing or modernization. A considerable number of bare overhead lines medium voltage and low voltage The high cost of street lighting
Supply of natural gas	
A positives	Requires improvement
Well developed gas distribution system: - a network of transmission gas pipes and reduction stations - majority of the region has access to the gas network - gradual reconstruction and modernization of distribution networks in order to reduce the failure rate	Some areas do not have access to the gas network (southern region) Gas pipelines are eligible for exchange – longterm use of steel pipelines -risk of failure Only a single provider of gas - the lack of competition and guarantee of continuity of supply (in case of failure)
Supply of heat	
A positives	Requires improvement
Most of the District has access to the gas system Modern/economical heating systems in most public buildings Investments in modernizing heating in buildings-the value of heating requirements Meeting recipients demands in fuel access- energetic security Thermo-modernization work done in most blocks of flats Access to reserves of power E-Star and Power Co. Gorlice - Production of electricity and heat in combination	Low emission sources supply a great part of heat demands The low activity of investors and households in the use of RES The presence of traditional heat sources based on carbon and carbon-based products - environmental pollution Lack of funds for the modernization of home heating and insulation of buildings by the residents (high unemployment, poverty of the local community)

Supply of electricity	
Expected support	Requires improvement
The development of renewable energy sources and hence energy production Efficient flow of information between municipalities and the powerplant considering investments in areas requiring construction of electricity network Funds for infrastructure development	Disproportion of investment in the modernization or replacement of obsolete and worn out parts of the network in relation to needs - lack of funds for investment Very high investment costs of renewable energy
Supply of natural gas	
Expected support	Factors restraining development
Increasing the transmission capacity (in the area with pressure below 6.3 MPa) Expansion of gas distribution network in the southern part of the District including the recreational area The community`s high interest in expanding the gas network Diversification of gas supply in terms of suppliers	The rising price of gas - for households using gas for heating purposes it is a problem The unfavorable price of gas in relation to coal fuels Lack of stability in the external fuel market - a threat to security of gas supply The risk of using natural gas as a means of political pressure - a risk on a national scale
Supply of heat	
Expected support	Factors restraining development
The development of renewable energy sources based on local resources Increased ecological awareness of the society The availability of new technology, managing heat consumption in households Obtaining external funds (subsidized loan, non-refundable loans) to popularize and fund the installation utilizing renewable energy sources Pricing policy encourages changing the traditional heating technology to ecological ones.	The rising cost of using non-coal energy sources for heating (gas, electricity) - the lack of stable pricing in the market of energy fuels Insufficient funds for the modernization of heating systems (including installation of high efficiency boilers) and reducing heat loss through thermal modernization works in private buildings

6. RES potential in the Region

Potential of Renewable Energy Sources for the purpose of SWOT analysis has been estimated based on statistical data, information supplied by Local Authorities and Forest Superintendancies, interviews and discussion as well as on available literature. Quantitative data on RES potential are rough estimations only to examine current and future regional importance of individual source.

In the case of commencing of activities in one of the area of renewable energy more detailed analysis, including field surveys, are strongly recommended.

For the purposes of the SWOT analysis RES have been divided into following groups/types:

- Biomass
- Wind power
- Solar energy
- Hydropower
- Geothermal energy

Methodologies of estimation are source specific. We have estimated:

- theoretical potential - energy available in the Region.
- technical potential – theoretical potential reduced due to technical, legal, spatial planning and other restrictions.
- economic potential – part of technical potential which is feasible to utilize (economic and organizational criteria).

6.1 Biomass

According to Minister of Economy and Labour order dd. 09.12.2004: *"Biomass is a solid or liquid substances of plant or animal origin, which are biodegradable, originating from products, waste and residues from agriculture and forestry, as well as the industry's processing of their products, as well as parts of other wastes that are biodegradable" (Dz.U. Nr 267, poz 2656).*

According to EU directive "***biomass***" shall mean the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste (Directive 2011/77/EC).

Types of biomass:

- wood and woodwaste (sawdust, shavings, wood chips, bark)
- energy crops from plantations: *Salix vinimalis, Rosa multiflora, Sida hermaphrodita, Heliantus tuberosus, Polygonum sachalinense, Miscanthus sp, etc.*
- agricultural products and by-products: straw, hay, oilseedrape, dung
- bio- fractions of communal wastes and organic deposits from sewage treatment plant
- organic waste from paper industry

Thus biomass can be sourced from:

- forestry
- wood processing industry
- agriculture
- public utility companies
- paper industry

From practical point of view energetic potential of biomass can be classified as follows ((*K. Siejka, M. Tańczuk, K. Trinczek, Koncepcja szacowania potencjału energetycznego biomasy na przykładzie wybranej gminy województwa opolskiego; Inżynieria Rolnicza 6(104)/2008*):

- THEORETICAL POTENTIAL - the amount of energy available for use from biomass, provided you have the appropriate equipment with 100% efficiency (does not take into account the flaws in the process), and assuming that the total available acreage is used only for the energy purposes.

- TECHNICAL POTENTIAL - part of the theoretical potential that can be exploited, less because of technical restrictions, (efficiency available on the market today, sometimes needs its own process, geographical location, energy storage). Usually determined on the basis of a detailed technical analysis.
- ECONOMIC POTENTIAL (market) - is dependent on the price of fuel, the size of taxes, economic indicators and the amount of subsidies. It is this part of the technical potential that can be used after taking into account the results of analysis of the cost effectiveness.

Because of the large difference between the theoretical and the potential economic value, these estimations can be only the basis for further analytical work conducted for specific areas using economic tools and optimization method to evaluate technical and economic feasibility of potential ventures of production and processing of biomass to useful forms of energy.

6.1.1 Forestry

Timber is the oldest and readily accessible renewable fuel, containing solar energy spare as a result of the process of photosynthesis. Mainly produced within forest management. The data shown in the table below reflect the very high woodiness in the Gorlice Region (43,4% compared with the national average 29.2%). Large woodiness we note especially in the southern part of the Region.

Table 29: Forest in the Gorlice District.

Municipality	Forest acreage in ha of		Woodiness in %
	public	private	
City of Gorlice	88,3	116,0	8,6
Biecz	293,5	1 123,0	14,4
Bobowa	304,4	435,0	14,8
Gorlice	2 239,9	784,0	29,2
Lipinki	1 860,6	209,0	31
Łużna	370	762,0	20
Moszczenica	150,9	402,0	14,6
Ropa	1 318,0	548,0	37,7
Sękowa	12 479,8	1 137,0	69
Uście Gorlickie	16 359,6	1 395,0	61,1
District	35 465,0	6 911,0	43,4

On the area of the Gorlice District there are the woods of the State Forest Superintendancies Łosie, Kołaczyce, and Gorlice. Data for the year 2011, obtained from these Superintendancies are the basis for estimating the potential of forestry biomass.

Taking into account the environmental policy of the State Forests of cautious increase in supply of timber, a long-term planning (10 year management plans), the increasing demand of the industry and a relatively large share of timber intended for heating for the purpose of this SWOT analysis we assume that theoretical potential of biomass from State owned forests less conversion factor (80%) is equal to their economic potential.

This corresponds to the current sale of timber for heating purposes, which was in 2011 ca. 33 000 m^3.

Assume that the private forests producing as much firewood as the State Forests per hectar of forest area, which roughly is 7 000 m^3.

Thus, the combined economic potential of forest biomass for energy is 40 000 m^3.

For the conversion of the amounts of wood for energy the following conversion factors have been used:

- wood density - depending on the species of wood from 380 to 640 kg/m^3, our assumption - 510 kg/m^3
- energy value at a moisture content of 20-30%- depending on the species of wood from 11 to 22 MJ/kg, our assumption - 16 MJ/kg

Estimation of economic potential of forest biomass:

40 000 m^3 x 510 kg/m^3 x 16 MJ/kg = 326,0 TJ/year

6.1.2 Wood processing industry

The potential of biomass waste from wood processing industry was evaluated on the basis of an estimate of the volume of wood processed by the largest sawmill in the Gorlice Region - CMC Sawmill in Uście Gorlickie. Annual output is around 100 000 m^3 of sawmill timber of different size. It can be assumed that by using modern machinery, the quantity of the resulting sawdust shall not exceed 10% of volume processed which will be approximately 10 000 m^3.

Estimation of theoretical potential of sawdust biomass:

10 000 m^3 x 300 kg/ m^3 x 13 MJ/kg = 39 000 GJ/year = 39,0 TJ/year

Estimation of technical potential of sawdust biomass:

Having regard the rate of conversion equal to 70% technical potential of sawdust biomass is 27 300 GJ/year = 27,3 TJ/year

Estimation of economic potential of sawdust biomass:

The economic energy potential of biomass sawdust directly used for the heating is very difficult to estimate, due to, inter alia, the following determinants:

• competition for this raw material from the plants producing different type of woodboards is able to offer a much higher price than the price at which one can pay for heating purposes;

• competition for this raw material from companies producing pellets and briquettes - due to the high profitability of the production price of the raw material (sawdust) may be comparatively high;

• use in industrial processes in the processing plants, wood and sawmills, to drying wood, heating, etc.

Taking this into account it is estimated that the economic potential of sawdust biomass for direct use on heating is ca. 10% of the technical potential meaning around 2.7 TJ/year.

6.1.3 Agriculture

The characteristics of agriculture in the Gorlice District presented in Chapter 3 indicates that an essential element of that theoretical potential of biomass of agricultural origin is straw.

Due to the weather, soil and moisture requirements of energy crops their cultivation in the region is too risky. Also, lack of sufficient experience in their cultivation in sub mountain areas do not encourage the establishment of plantations. The existing farms structure do not encourages to bear the costs and risks of the establishment of plantations. From an economic and an organisational point of view it is better to plant energy crops on larger fields. In view of the above, estimates of the potential of the energy crops were not performed. And the assumptions is that the economic potential of energy originating from energy crops is 0 GJ/year.

Similarly, in the case of biogas production based on manure the potential of energy from this source has not assessed, given the low number and concentration of breeding animals. Therefore, the assumption is that the economic potential of energy biogas from agricultural is 0 GJ/year.

Straw

Agriculture in recent times is recognised as one of the main sources of biomass for the production of renewable energy and the basic source of raw materials for the production of biofuels. One of the harvest by-products which may offer agriculture for energetic purposes is a straw.

In the past, the straw was used mainly for bedding,, feeding, and underploughing. In the most recent period, as a result of the reduction of the population of animals and the introduction of bedding-free methods of breeding, and the changes in feeding practices there is a surplus of straw, which can be used for energy purposes.

Basic cereals (wheat, rye, barley, oat, triticale) according to Country Agricultural Census (2002) are sown on total area of 8 567 ha.

Table 30: Basic cereals - results of Country Agricultural Census (2002).

Area sown (ar)											
Crop	Community										
	Biecz	Bobowa	Gorlice	City Gorlice	Lipinki	**Łużna**	Moszczenica	Ropa	Sękowa	**Uś**cie Gorlickie	Total
winter wheat	136 013	87 184	86 392	11 373	45 069	77 690	60 583	28 336	15 961	17 330	565 931
spring wheat	2 480	3 433	2 120	908	357	2 922	520	553	752	3 030	17 075
rye	5 096	3 292	1 668	487	448	1 708	1 020	847	1 081	3 278	18 925
winter barley	3 396	5 770	2 108	278	1 206	1 915	1 152	341	567	2 140	18 873
spring barley	10 318	11 416	3 703	744	7 515	3 036	2 722	4 381	2 233	8 039	54 107
oat	36 038	8 451	22 966	2 588	10 052	19 061	14 227	3 935	12 423	15 881	145 622
winter triticale	4 482	6 732	5 449	602	1 126	1 958	1 868	2 625	2 356	4 709	31 907
spring triticale	84	1 794	455	40	97	470	113	140	260	855	4 308

When calculating the quantities of straw obtained from 1 ha of cereals the indicator equal to 1.5 t/ha was carefully assumed, although the literature indicates that this may be more, in some cases up to 4 t/ha.

This indicator is fluctuating due to:

- cultivar and variety,
- lodging-preventing agent,
- level of fertilization,
- weather condition.

Estimation of theoretical potential of straw biomass in the Gorlice District

8 567 ha x 1,5 t -> 12 851 t of straw x 15 MJ/kg of calorific value equals 192 768 GJ per year = 192,8 TJ/year.

Estimation of technical potential of straw biomass:

Taking into account the efficiency of the conversion of chemical energy to the thermal energy at the level of 80%, the technical potential reach 154 214 GJ per year = 154, 2 TJ/year.

Estimation of economic potential of straw biomass

This value depends on many, various factors. Among them are:

- alternative to the cultivation of cereals forms of agricultural use – including in particular the use of in the context of agri-environmental programmes;
- • the scale of production - the smaller farms mean that the logistics (harvesting and transport) is more complex and consequently this lower the economic potential of straw. In the Gorlice Region prevail relatively small farms;
- • the technology of harvest - only pressed straw is suitable for transport and combustion;
- • straw left on for under ploughing - straw and other biomass in the form of leftovers after harvesting crops is a valuable source of organic matter for the soil, therefore its excessive harvesting may lead to the degradation of the soil and reduce their productivity;
- models of straw use for energy
  - individual boiler rooms using straw from their own farm - for heating and hot water – this possibility is determined by the acreage of cereals grown.. For year-round heating the house with an floor area of 200 m^2 requires about 12-15 tonnes of straw. Such quantity of straw may be available only in the farms with an area of over 20 ha. According to the data from Chapter 3, there are 47 such farms. They are located in the municipalities of Gorlice, Sękowa and Uście Gorlickie,
  - local boiler houses fuelled by straw sourced locally. Large investment, the cumbersome logistics of supply, the need to sign long-term contracts with farmers, the uncertainty of supply and the price level leads to the conclusion that this form of energy utilization of straw is inappropriate in the realities of the Gorlice District.

Taking above into account, the economic potential of straw biomass shall be 5% of technical potential meaning 7.7 TJ/year.

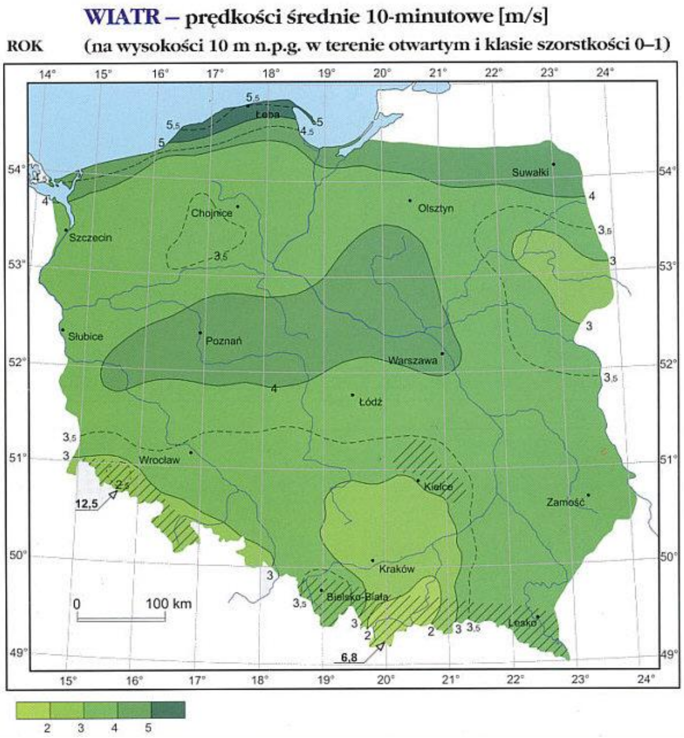
6.2 Wind power energy

Potential of wind power generation depends on:

- local wind energy resources
- availability of good locations.

Map of wind resources for the Małopolska has not been developed so far, therefore estimation of wind energy resources is based only on the general maps developed for the entire territory of the country as published in the Atlas of Climate in Poland (2005). Map of this publication are provided below.

Graph 47: Average wind speed.

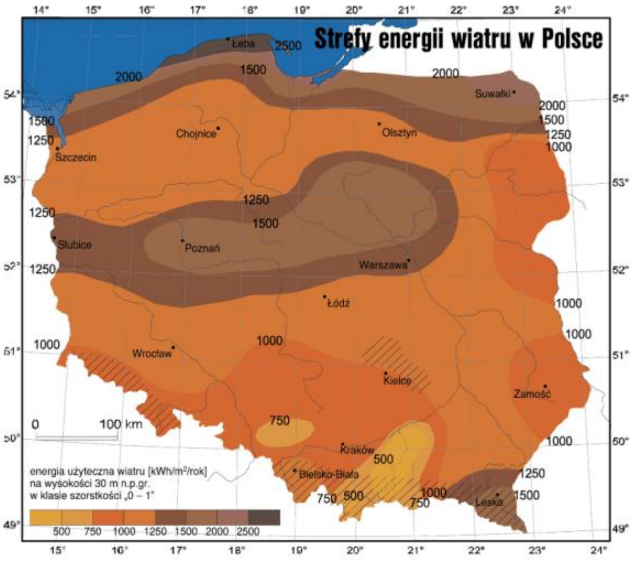


Source: Atlas of Climate in Poland, Halina Lorenc (ed.), Instytut Meteorologii i Gospodarki Wodnej. Warszawa 2005

It appears that the Gorlice District is located where the wind speed is between 3 to 3.5 m/s which means that is located in zone III - the conditions advantageous from the point of view of the wind power generation.

The best location for wind power generation is in eastern part of the region, in the municipality of Lipinki, where one wind farm „Rozdziele (4.5 MW) is currently under construction.

Graph 48: Wind energy zones in Poland.



Rys. 6 Strefy energii wiatru w Polsce wg H. Lorenc

Source: Atlas of Climate in Poland, Halina Lorenc (ed.), Instytut Meteorologii i Gospodarki Wodnej. Warszawa 2005

Estimation of theoretical potential of wind power energy:

Map of zone of wind power in Poland shows that throughout the District useful wind energy at a height of 30 m above the ground (of roughness class "0-1") varies from 750 to 1000 kWh/m^2/year.

Assuming that the installation of 1 wind turbine of 2 MW capacity and a rotor length of 50 m requires 10 ha of area, theoretical potential of wind power energy is 238 981,39 TJ/year.

This theoretical potential cannot be fully utilised, because it means that the wind turbines can accommodate the entire surface area of the Gorlice District.

Estimation of technical potenctial of wind power energy:

When estimating the technical potential we take into account the efficiency of the conversion of wind energy for electricity (40%) and constraints arising, inter alia, with the determinants of natural condition (forests), the forms of nature protection, spatial planning, etc.

As a very rough, practical estimation, we evaluate that the area under wind turbines is equal to the area of agricultural land (43% of the area of the District).

So, the technical potential of wind power energy is: 41 104,80 TJ/year.

Estimation of economic potential of wind power energy:

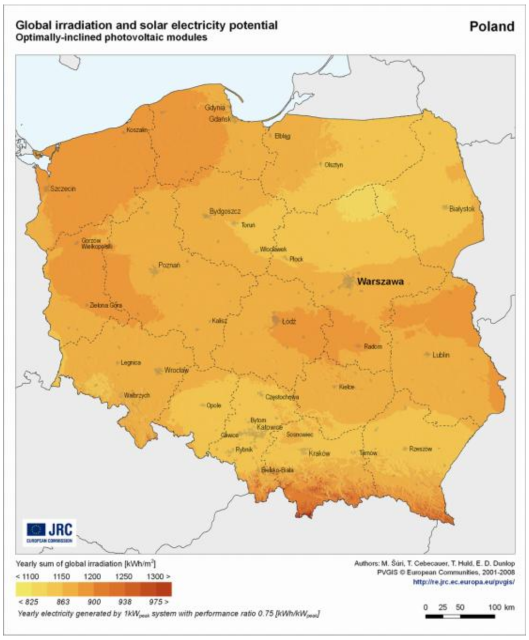
On the basis of the results of the project SIWERM, and recommendations of the Polish Wind Energy Association to estimate the economic potential of wind power energy we have reduced the total area of the agricultural land by 42% due to their legal protection (protected areas plus their buffer zones) and additionally 10% safety factor presumes constraints from other reasons.

So, the economic potential of wind power energy is: 21 456,71 TJ/year

6.3 Solar energy

The results of the annual survey carried out by the Joint Research Centre, operating under the auspices of the European Commission, and published as a map of the irradiation for the whole of Europe, including Poland, are the starting point for assessing the potential of solar energy in the Gorlice Region.

Graph 49: Global irradiation in Poland.



The Gorlice Region is a slightly above country average in terms of energy potential with the annual total solar radiation of 1100 kWh/m².

Estimation of total theoretical potential of solar energy:

Area of District 94646 ha x 1100 kWh/m2/year = 1 063 106 000 000 kWh/year i.e. 3 827 182 TJ/year.

This amount of energy greatly exceeds the annual demand in the Gorlice District it means that is the unlimited amount of energy to use. Because of this, a further estimate was based on the potential demand for photovoltaic on the basis of standard figures.

Further estimations (technical and economic potential) have been carried on independently for 2 the most common methods of solar energy conversion:

- photo thermal conversion,
- photovoltaic conversion.

6.3.1 Photo thermal conversion

Estimation of technical potential of solar energy:

It was assumed that solar thermal systems for hot water production can be installed on roofs of all buildings in the region – i.e. 22 751 (2010). Assuming 8 sq. m. of solar per one building (which is typical size of solar for 4 person family) and conversion factor (efficiency factor) of 30% the estimated potential is:

22 751 buildings x 8 m^2 x 1100 kWh/m^2/year x 30% = 60 062 640 kWh/year i.e. 216,2 TJ/year

Estimation of economic potential of solar energy:

It was assumed that from economic as well as technical and organization point of view solar instalation is reasonable for only 30% of buildings (due to their technical condition and exposure to the sun).

So, the economic potential of solar energy use as heating is 18 018 792 kWh/year i.e. 64,9 TJ/year.

6.3.2 Photovoltaic conversion

Estimation of technical potential of solar energy:

It was assumed that photovoltaic power plant should be located close to energetic infrastructure, on southern slopes and within reasonable distance to protected areas. Such conditions exist in part of municipalities Biecz, Lipinki, Łużna, Gorlice, Moszczenica and Bobowa. Estimated area of such photovoltaic farms is 1 000 ha of which 30% is area of photovoltaic panels.

So, 300 ha x 1100 kWh/m2/year x 12%(photovoltaic conversion factor) = 396 000 000 kWh/year i.e. 1 425,6 TJ/year.

Estimation of economic potential of solar energy:

Given the degree of complications of the technical, organizational-related construction and connection to the transmission network but at the same time provided a significant increase in interest of State supporting this technology was adopted that

economic potential of solar energy for electricity production is equal to 10% of technical potential i.e. 39 600 000 kWh/year = 142,56 TJ/year

6.4 Hydro power

In the Gorlice District, there are two rivers that can be seen from the point of view of their potential of hydro power: Ropa and Biała. Their hydroenergetic potential is based on the data of Regional Water Management Authority(RZGW) in Kraków, inter alia on the basis of the "guidelines for the conditions of the development of water infrastructure in the area of action of RZGW in Kraków" (2010).

Taking into account $P_{śrj}$- average unit of theoretical resources of power per 1 km of watercourses (kW/km)- estimated in such a value of a maximum annual production of electricity for the rivers covered the calculations. It was assumed the construction of the hydroelectric power station at every 1 km of the river and working time of 8760 h per year.

For River Ropa $P_{śrj}$ is equal to 0,17 kW/km from spring to Klimkówka Resorvoir and 0,11 down the river. For river Biała $P_{śrj}$ is 0,15 kW/km for watercourse within District boundaries.

Estimated theoretical potential of hydro power these 2 river is 94608 kWh/year i.e. 0,34 TJ/year.

It was assumed based on literature the technical potential is equal 50% of theoretical potential, i.e. 0,17 TJ/year.

Economic potential of hydro power was estimated as 10% technical potential because of:

- restriction on construction of new dams and small hydro power in the protected areas;
- relatively low hydro power potential of these two rivers in comparison to other rivers in Małopolska;
- long and complicated procedures related to building consent;
- and high investment costs.

So, the economic hydro power potential is 0,02 TJ/year.

6.5 Geothermal energy

The potential of geothermal energy in comparison with other types of renewable energy resources is already stacked and multi-annual. For the assessment of potential energy literature recommends separate estimations for so called deep geothermal (high temperature, most are professional installations) and shallow geothermal (low temperature, heating system using so-called heat pumps in non-grid situations).

6.5.1 Deep geothermal

Analysis of literature data and analysis of deep-drillings near Gorlice carried out by the authors of "the Atlas of hydro resources and geothermal energy of the Western Carpathian Mountains" (Kraków, 2011) indicates the possibility of use existing geothermal water for heating purposes and for recreation.

The authors emphasize, however, that any planned investments using resources of geothermal water in the cities/municipalities should be preceded by a detailed resolving the parameters of the hydrogeological conditions, in relation to a specific hole/location and analysis of the chemical composition of the waters is what determines the possibilities of their use for the purposes of balneotherapy and/or recreation.

Due to the lack of data regarding the resources of geothermal water for the whole of the Gorlice District - the recently released a.m. atlas covers only part of the District - the estimation of the potential was limited to conclusions of the, "Study of the economic feasibility of investments related to geothermal energy for heating purposes and recreational with drillings existing on the territory of the City of Gorlice and communes: Ropa, Biecz and Moszczenica." (by ZSTG "GEOS", 2009) which provide interesting conclusions in terms of market potential and the use of geothermal energy in the region.

A study of profitability was carried out for the 3 locations (Ropa, Gorlice, Biecz), in which, based on the reconstructed (on the expense of several million PLN each) holes drilling geothermal energy for heating as well as recreational and balneological purposes could be used. In the analysis investment and operational costs of additional peak boiler and costs of distribution system were not calculated. For the village of Moszczenica in analysis cost related to new hole drilling was included.

With these parameters, the authors draw the following conclusions:

Ropa: "the utilisation of geothermal water heat in Municipality of Ropa is cost-effective irrespective of how to finance the reconstruction of the hole, but the reconstruction based on own financing is close to the limit of profitabilty. The calculated capital expenditures do not include the peak heat source and the construction of the system of distribution of heat "

Gorlice: „ the utilsation of geothermal water heat in City of Gorlice is cost-effective, provided finance the reconstruction of the hole, for example. with grants or other non-returnable funds ".

Biecz: „the utilsation of geothermal water heat in Municipality of Biecz is uneconomic, regardless of how to finance the reconstruction of the hole ".

In the case of Moszczenica necessary would be a new hole-works (the cost of. 30 million PLN) which condemns this venture failed, from the point of view of economic and financial.

In the SWOT analysis we focus on energy, which can be widely used for living purposes in the form of electricity or heat. Treating deep geothermal the source of heat for heating buildings, account should be taken of any investment for not only getting water but a new infrastructure for the distribution of heat.

Regardless of the source of financing of the investment cost of depreciation is the element that affects the tariff for heat.

In view of the above, for the purposes of this SWOT analysis it was assumed that within the Gorlice District the economic potential of deep geothermal energy is 0

6.5.2 Shallow geothermal

To assess the economic potential of shallow geothermal energy and used by the heat pump it was assumed for the purposes of the analysis, that the installation of heat pumps only new residential buildings constructed after the year 2000 "qualify". In older buildings there is a greater number of unfavourable decision factors: old installations, established garden, non-insulated walls, etc.

The calculations were therefore a number of buildings built after the year 2000 (4375) and assume that only 5% of them will be equipped with heat pumps. For the purposes of the estimate it was assumed that they heat demand for space heating and hot water production isu. 120 GJ/year – i.e.,. that so much energy we need to acquire from the ground. To keep the system operating additional electricity (25-30%) is required.

Estimated economic potential of shallow geothermal energy is 4375 x 5% x 120 GJ/year = 26,5 TJ/year

6.6 RES potential - summary

Summary of potentials (theoretical, technical and economic) for analysed RES is presenting presents the following table.

Table 31: Theoretical, technical and economic potentials of RES (TJ/rok).

Potential:	Wood	Sawdust	Straw	Wind power	Solar thermal	Photovoltaic	Hydro power	Deep geothermal	Shallow geothermal
theoretical	x	39	192,8	238 981	3 827 182	3827182	0,34	x	x
technical	x	27,3	154,2	41 105	216,2	1425,6	0,17	x	x
economic	326	2,7	7,7	21 457	64,9	142,6	0,02	0	26,5

7. Available technologies in the field of renewable energy production

7.1 Solar energy

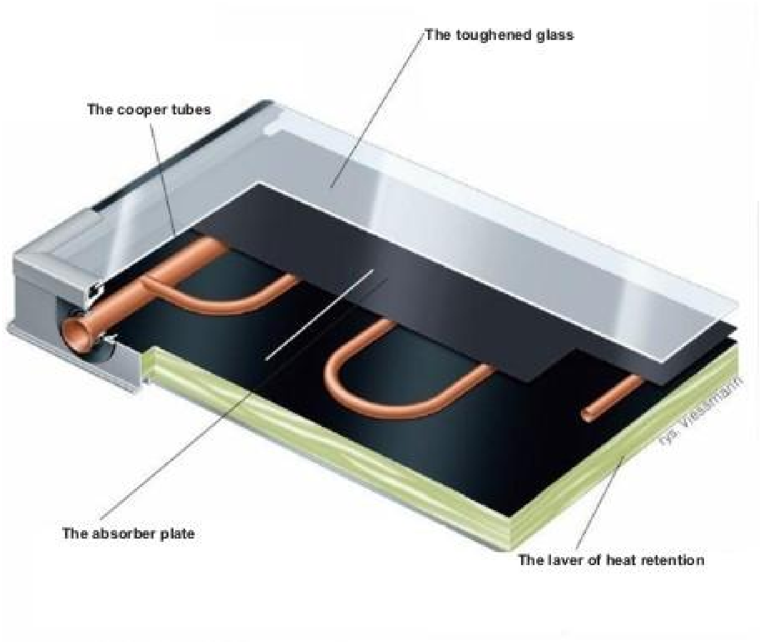
The most widespread technology of solar energy acquisition are water heating installations (mainly flat collectors).For preparation of hot water for one person solar collector of 1 to 1,5 m^2 surface is required. In the Polish climate conditions 1 solar collector can produce from 300 to 500 kWh of energy per year.

At the insolation level of 950 to 1050 kWh/m2 during the spring-summer period, the demand for hot water may be covered by solar energy in 85% maximum and during the entire year at the level of 60%. On average, in a 220 day period a year, the water can be heated to a temperature of approximately 50^{o}C.

Collectors can be divided into following groups:

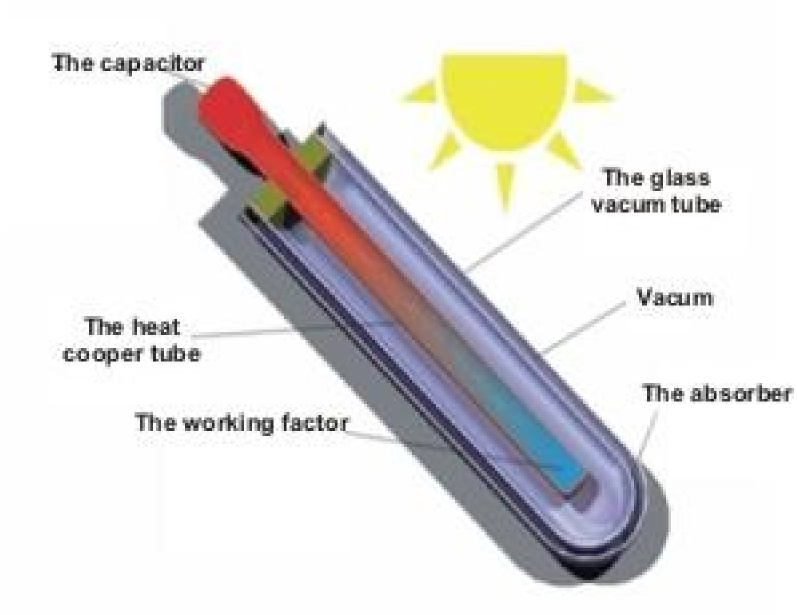
- flat
    - gas
    - liquid
    - two-phase
- flat vacuum
- •vacuum tubes (also called vacuum collectors, in which the role of insulation is provided by the vacuum pipes)
- focusing (almost always liquid)
- special (e.g. thermal windows transparent insulation)

Graph 50: Construction of flat solar collector.



Source: http://instalacjeb2b.pl

Graph 51: The vacuum tube.



Source: http://instalacjeb2b.pl

Operating principle of each solar collector is the same: the solar radiation is converted to heat, which is then sent to the home installation for the preparation of hot water, less often-for space heating

Photo 1: Flat-plate collectors on the roof of a residential building.

Source: http://muratordom.pl

7.1.1 Solar cells

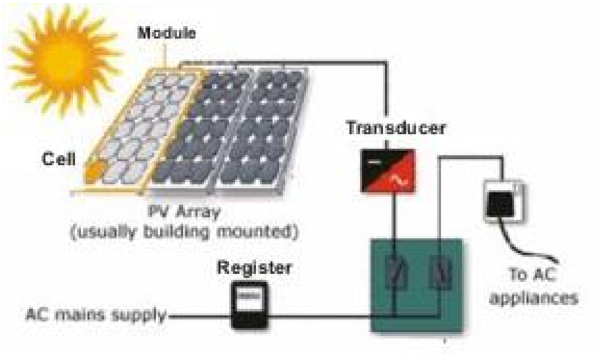
Photovoltaic cells otherwise known as solar cells, are thin semiconductor wafers of silicon used for the production of electricity. They produce electricity under the influence of radiation.

The maximum power that can be used directly from the solar energy on one square meter surface is the so-called solar constant. This is an average of 1367 W/m^2 and is the power of solar radiation which enters the outer layers of the atmosphere. 35-37% of this energy reflects from the atmosphere or is absorbed by it, so 1000 W/m^2 reaches the Earth's surface

Solar cells have the following advantages:

- electricity is produced directly;
- the efficiency of processing power is the same, regardless of the scale of production;
- power is produced even in cloudy days, using the dispersed radiation;
- usage and maintenance require minimum effort;
- during the production of electricity there is no harmful exhaust gases;
- photovoltaic modules do not have any moving parts.

Graph 52: Elements of photovoltaic system.



Source: *www.instalacjebudowlane.pl*

The type of photovoltaic cells:

FIRST GENERATION CELLS

- monocrystalline – using a layer of silicon;
- polycrystalline - using non- homogeneous layer of silicon;
- amorphous - silicon cells, in which the silicon is less organized compared to traditional cells.

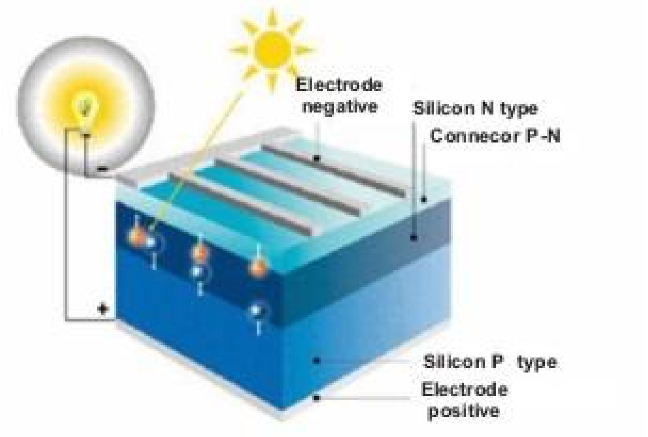
SECOND GENERATION CELLS

- These cells are - like first generation cells- based on P–N junction. The difference is that their construction is not based on silicon crystalline but, for example, cadmium telluride, indium telluride, a mixture of copper, selenium (GIGS) as well as the amorphous silicon. These cells are characterized by a very thin light absorbing semiconductor layer, approximately 1-3 micrometers, they are also called thin layer cells.

THIRD GENERATION CELLS

- These cells do not have P-N junction, which is an essential element in the case of first and second generation cells. The most famous third generation cells are organic cells. The biggest advantage of these cells are low cost and simplicity of production. Their main disadvantage is the low efficiency compared to silicon cells.

Graph 53: Profile of silicon crystalline module.



Source: *http://www.mae.com.pl*

Single photovoltaic cell can have a power of 1-2 W. Power of a single cell depends on its surface. In order to obtain the higher voltages, cells are combined in serial or serial-parallel pattern, forming panels or photovoltaic modules. Power of 0.3 to 1 m^2 modules usually operates at the level of 30-300 Wp (Watt peak power).

Photo 2: Solar panels on the roof of a residential building.

Source: *http://muratordom.pl*

7.2 Geothermal energy

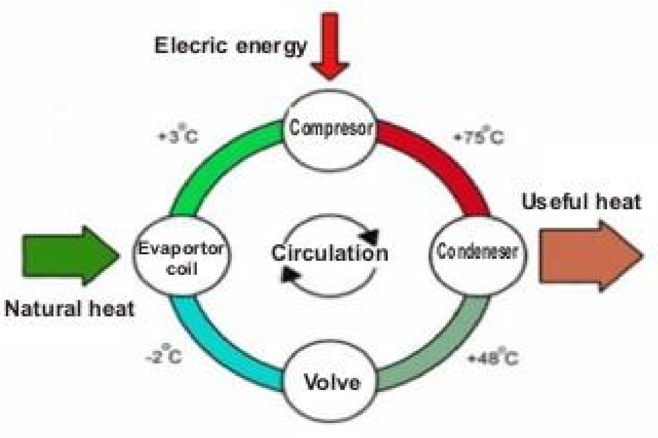
7.2.1 Deep geothermal energy

Deep geothermal energy is the energy contained in waters at considerable depths (2-3 km and deeper), most commonly in the form of natural reservoirs with temperatures above 20^0C. In Poland at such depths temperature of geothermal water falls within the limits of 80^0C-90^0C. Only in specific locations can exceed 100^0C. Deep geothermal energy can be used for the purpose of heating on a wide scale. In Poland there are facilities which process this type of energy.

7.2.2 Heat pumps

Heat pumps are devices that allow the usage of low temperature heat and waste heat for heating, ventilation, and preparation of hot water. The main advantage that distinguishes heat pumps from other heating systems is that 75% of the energy needed for heating is gathered from the environment, and the remaining 25% is the electrical current. This situation makes the heat pumps competing devices in relation to other unattended heating systems.

Graph 54: Heat pump operation scheme.



Source: *http://energiaodnawialna.net*

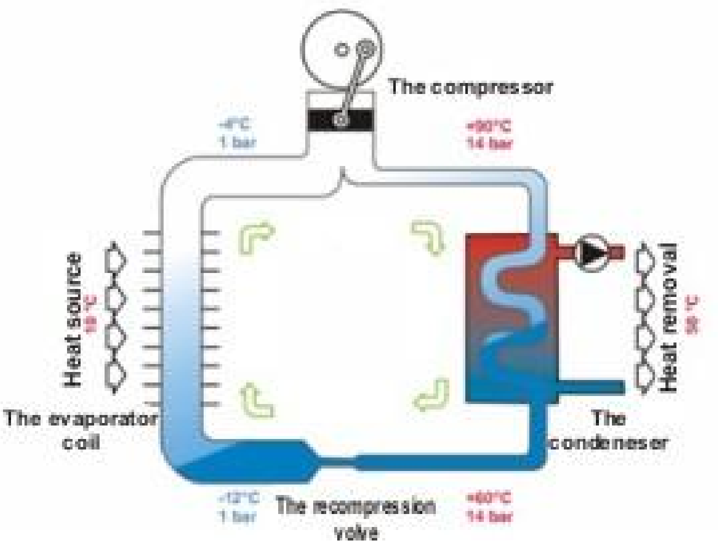
The larger is the energy efficiency factor (the ratio of received heating power to the amount of electricity used) the more sparingly heat pump operates. The size of this factor depends on two factors: the construction of the heat pump and the temperature of the heat source. The size of this factor indicates the expected costs of heating.

Types of heat pumps are highlighted, given the lower source:

- ground;
- water;
- air;
- using the internal air - used for heating water.

Heat pumps may have horizontal and vertical-ground heat exchangers.

Graph 55: S Diagram of the construction and operation of heat pumps.



Source: http://www.biomasa.org

7.3 Wind power

Wind power depends on its speed. In this connection, the important aspect is the wind turbines location. The choice of the location is the basis for the efficiency of the turbine. The location of the wind power station's foundation should be dictated mainly by wind conditions. Different types of power plants require a different wind to boot. The number of generators, the height of the tower or the range of blades is also very important.

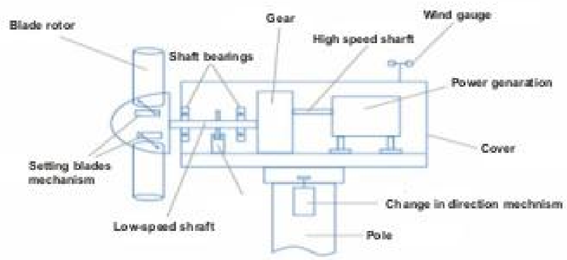
For optimal use of locations in which favorable conditions for localization are present wind power stations are built consisting of multiple turbines set close together - the so-called wind farms.

Types of wind turbines:

- Horizontal axis wind turbines with gear;
- Horizontal wind turbines without gear with slow rotating generator.

The following diagram shows the construction of a horizontal axis wind turbine with gear.

Graph 56: Diagram of the construction of wind turbine.



In Poland the average wind velocity is 2,8 m/s in summer and 3,8 m/s in winter. In the very few places seasonal wind speed exceeds 5 m/s, which represents an absolute minimum to supply wind turbines.

Photo 3: Wind farm.

Source: „Energetyka wiatrowa"- Instytut na rzecz Ekorozwoju

The latest data of the Energy Regulation Office shows that at the end of December 2011 in Poland 1 616,36 MW of wind energy is installed.

Wind power farms saturation in Poland is one of the lowest in Europe. Installed power in the wind energy sector per capita is 0,012 kW. While at km2 area of the land is 1.44 kW.

The advantages of wind energy:

- no emissions of pollutants into the environment;
- wind is free;
- possibility of location on fallow lands and contaminated areas.

Problems arising from the wind power plants construction:

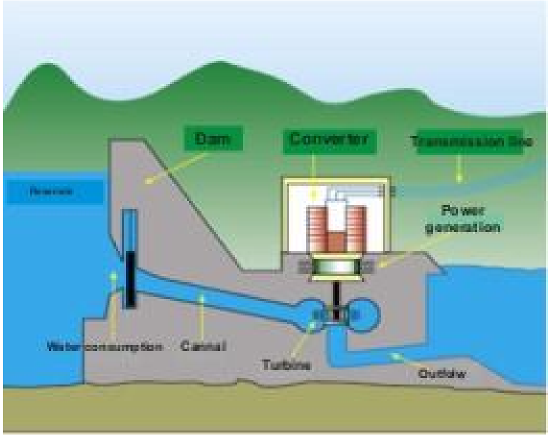
- the cyclicality of the work (the reason is the variable wind speed);
- high investment costs - in the case of high power wind turbines (environmental monitoring, measurements of the wind conditions, geological studies; investment contracts: the purchase of turbines, development of internal infrastructure and roads, connection to the grid);
- high operating costs (costs of service, support, or the costs of the land lease);
- noise (wind turbines are the source of noise - both audible and infrasound - in the close vicinity are harmful for humans and animals);
- danger to birds and bats (wind turbines may constitute a barrier to bats and migratory birds, so environmental observations are carried out on testing risk of danger to birds and bats in case of construction of large wind turbines).

7.4 Hydro power

The most common use of water for production of electricity takes place in hydroelectric facilities

These stations change the energy of the water flow into electricity. This process is carried out using water turbines.

Graph 57: Diagram of the hydroelectric operation.



Source: http://energiaodnawialna.net

According to the information provided by Web portal dedicated to renewable sources of energy *www.energiaodnawialna.net* hydroenergetic resources of Poland are estimated at 13,7 TWh per year, of which 45,3% falls on the largest Polish River Vistula. 43,6% of the basin of Vistula and Oder, 9,8% for the Oder alone. The remaining 1.3% on the rivers of Pomerania.

Poland currently uses only 12% of its hydroenergetic resources, representing a 7.3% of installed capacity in the national energy system.

In Poland, the official value that divides the hydroelectric facilities on small and large is size of 5 MW. So, we have:

- small hydro facilities with power below 5 MW,
- system power plants with a power above 5 MW.

Photo 4: Small hydroelectric power plant.

Source: http://www.mew.pl

Due to the way of bringing water to the turbines there are following types of hydropower plant:

- flow;
- tank (regulatory);
- pumped-storage

HYDRO POWER PLANT	
SMALL	BIG
ADVANTAGES	
does not contaminate the environment and can be installed in numerous places with small watercourses	creation of electricity in a clean way and technically easier (less maintenance costs, greater reliability the plant and lower operating costs)
the technical simplicity causes high reliability and long life	less vulnerable failures(technological process is simpler than in conventional power)
numerous staff is not required and can be controlled remotely	does not consume natural fuels
the correct location of retention tanks works as reservoir in case of flooding (regulation of rivers) and increases small retention.	energy produced is approx. 8-10 times cheaper
DISADVANTAGES	
bad technical condition of hydraulic objects	noise and pollution during construction
plants overgrowing reservoirs and channels	high level of water in the tanks may lead to flooding of settlements and agricultural, which may result in the need for resettlement of the population
risk of damages to dams	may adversely affect soil fertility in the premises of rivers, the local climatic conditions, causing the formation of fog, ice dams, etc.
buildings undermined by water	contribute to the plant overgrowing of the reservoir and the erosion of the shores which leads to the deterioration of the conditions of the selfgrooming of flowing water and deoxydation of water, impede the migration of fish

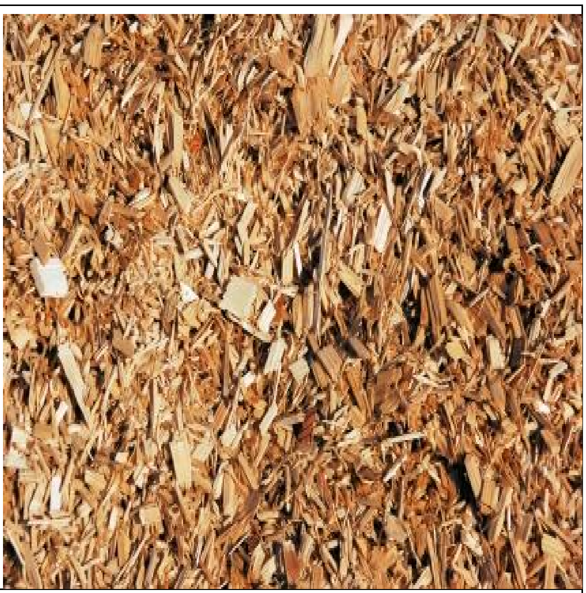
7.5 Biomass energy

Biomass is the entire organic matter existing on Earth, all substances of plant or animal origin biodegradable. remnants from agricultural production are also Biomass, residues from forestry, industrial and municipal wastes. Biomass is the third largest in the world, natural source of energy.

In the table below a brief characteristics of individual types of biomass is presented.

Table 32: Characteristics of certain types of biomass.

Description	Characteristics	Image graphic
Wood briquettes	*caloric ~ 17,5 MJ/kg * ash content < 1,5% * specific gravity - 1,0-1,5 kg/dm^3 *1 kg briquettes is the equivalent of the energy for: - 0,42 kg of fuel oil - 0,48 m^3 of natural gas - 0,76 kg of coal	
Briquettes from straw	* caloric 14-16 MJ/kg * ash content 3-5% * specific gravity < 1 kg/dm^3 *1 kg briquettes is the equivalent of the energy for: - 0,33 kg of fuel oil 0,38 m^3 of natural gas - 0,62 kg of coal	
Pellets	*caloric ~ 18,6 MJ/kg * ash content ~ 1,5% * moisture content < 12% * sulphur content - 0,08% * chloride content - 0,03% *1 kg granules is the equivalent of the energy for: - 0,43 kg of fuel oil - 0,51 m^3 of natural gas - 0,83 kg of coal	

Woodchips	* caloric 10-18 MJ/kg * moisture content - 3—60% * ash content - 0,6-5% * specific gravity - 150-300 kg/dm^3 *1 kg of woodchips is the equivalent of the energy for: - 0,24-0,42 kg of fuel oil - 0,27-0,51 m^3 of natural gas - 0,45-0,81 kg of coal	
Grain	* caloric ~ 17,5 MJ/kg * ash content ~ 0,6-1% * sulphur content ~ 0,02% * chlorine content ~ 0,01% * specific gravity ~ 0,75 kg/dm^3 *1 kg of grain is equivalent to the energy for: - 0,42 kg of fuel oil - 0,49 m^3 of natural gas 0,79 kg of coal	

Source: The magazine "Polish Installer", November 2010

In the case of the combustion of biomass balance of CO^2 emissions is equal to 0. This situation is caused by the fact that during combustion of biomass quantity of carbon dioxide emitted into the air is the same as quantity of carbon dioxide taken by the plants during their growth. Ommited emissions compared with other energy sources is 1,5 t.

Combustion of biomass in inappropriate conditions contributes to emissions of non-CO2 substances harmful to the environment.

The following table shows the projected demand for biomass for energy in Poland (million tonnes):

Table 33: Projected demand for biomass for energy in Poland (million tonnes).

	Biomass*	
	2020 .	2030 .
Power plants	6,3	7,9
Heating	2,0	2,7
Total	8,3	10,6

*dm – dry mass (humidity 0 %)

Source: http://www.vattenfall.pl

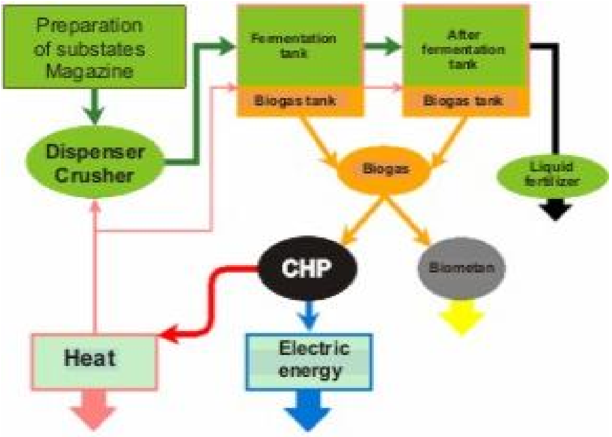
7.6 Biogas energy

Biogas used for energy purposes is created as a result of fermentation:

- of organic waste in landfills;
- animal waste from farms;
- sewage sludge.

Biogas resulting from anaerobic fermentation consists mostly of methane (40%-70%) and carbon dioxide (40-50%). It also includes other gases including nitrogen, hydrogen sulphide, carbon monoxide, ammonia and oxygen.

Graph 58: Diagram of the biogas installation.



Source: http://www.neostar.com.pl

Calorific value of biogas is a result of methane present in biogas. Typical biogas has a calorific values between 19-23 MJ/m3

Photo 5: Agricultural biogas installation.

Source: http://www.ces.com.pl

The benefits deriving from the application of biogas installations:

- producing "green energy";
- reducing greenhouse gas emissions through the use of methane;
- lowering costs associated with storage of waste;
- preventing pollution of the soil and groundwater, surface vessels and rivers;
- getting efficient and easily accessible fertilizer for the plants;
- elimination of smell.

More information about the various renewable energy technologies can be found in the manual "Renewable sources of energy in the Lesser Poland", issued by The Association of Municipalities Polish Network „Energie Cités" (publication available on *www.pnec.org.pl*).

The additional information about geothermal energy one can find in "The Atlas of Hydro Resources and Geothermal Energy of the Western Carpathians" (Kraków, 2011)

8. Renewable Energy technologies existing or available for implementation in the Region

8.1 Solar energy

Solar collectors

Insolation levels in the District of Gorlice can be defined as the average, but it still justifies the application of the technology of gathering energy from solar radiation. Solar collectors are becoming much more popular due to the decreasing costs of such systems and the possibility of obtaining funding for such investments. In the District of Gorlice systems using solar energy (mainly for heating domestic hot water) are placed on a small number of buildings. There is therefore a considerable potential in this area. Examples of solutions in this area are described in the attachments "best practices" for:

- • The individual buildings in the community Białobrzegi;
- The individual buildings in the community Szczawnica;
- • Swimming pool in Końskie;
- • Care and Educational Centre in Żmiąca.

Photovoltaics

The photovoltaic systems are less common-presently. Both high cost and low efficiency of such devices are discouraging. However, it is worth noting that the price of the equipment regularly decreases and their efficiency increases. Solar energy can also be used in hybrid sets (wind energy), for example to power the street lights or traffic lights systems. Examples of applying photovoltaics are described in the attachments "The best practices" for:

- Street lights in the community Jarosław;
- Street lights in Chełmiec;
- Solar power plant in Wierzchosławice.

8.2 Geothermal energy

There is no thorough research concerning the presence of geothermal waters in the Gorlice District. The available researches regard only to the western part of the District (estimated approx. 20% of the surface area of the District has been tested). The available data indicates that regional resources are unevenly distributed and not heterogeneous, which makes their use difficult. In addition, the building clusters are greatly dispersed and the differences in altitude of the location of buildings is significant. Therefore the possibilities of using ,,deep" geothermal energy are minimal, rather for leisure purposes than heating. There is however no impediment in the application of "shallow" geothermal energy, the heat pump, but their use as yet – is marginal. It is estimated that in the District, the number of existing heat pumps does not exceed 10. In this case, scattered architecture may be an advantage, since these systems require a certain amount of space. The pump can be used in both individual buildings and public utilities. Example of applying "shallow" geothermal energy are described in the attachments "The best practices" for:

- Swimming pool in DąbrowaTarnowska;
- Primary School and Secondary School in Białobrzegi;
- Hospital in Końskie;
- Primary School and Secondary School in Miechów.

8.3 Wind energy

The Gorlice District is not rich in wind energy, there are no strong, regular winds. But it is sufficient to sustain a small facility. Currently the District does not have any wind power plants, in the municipality of Lipinki construction of a wind farm "Rozdziele" with an energy output of 4.5 MW is underway. Example descriptions of applying wind power are described in the attachments "The best practices" for:

- Street lights in the Community of Jarosław;
- Street lights in Chełmiec;
- Schools in Jasło.

8.4 Hydropower

The Gorlice District has no significant water resources, there are conditions allowing the set up of several small power plants. In the village of Klimkówka on the river Ropa there is a hydro power plant with a power output of 1,1 MW. In the area of Biecz there is a small hydro power plant (installed capacity of 0,010 MW). In addition, the region is planning the construction of three small hydro power plants:

- MEW Ropica Polska in the area of MPGK Gorlice, in the village Ropica Polska with estimated power output of 100 kW;
- MEW Gorlice Ropa in FM "Glinik" S.A. in Gorlice, with estimated power output of 90 kW;
- MEW Sękówka on the premises of Gorlice Sports and Recreational Centre, with estimated power output of 65 kW.

8.5 Biomass energy

Within the Gorlice District there are no large breeding establishments, there are therefore no economically justified reasons for biogas production, but there are fairly large resources of biomass (agriculture and woods), but they are considerably scattered, which complicates attempts to use it. The hospital in Gorlice has had its boilers fueled by coal replaced with ones fueled by biomass i.e. wood chips. Power output is 5,6 MW.

Example methods of utilising biomass can be found in the annex titled "The best practices" for:

- Production and Service Plant PBWKM in Bochnia;
- Hospital in Gorlice;
- MPWiK in Skarżysko-Kamienna.

8.6 Energy management

The use of systems that use renewable energy sources do not always guarantee that the power demands are fully met. In many cases, it is necessary to use systems powered by RES supported by systems using conventional fuel. In such cases, it is possible to achieve additional savings by the use of systems coordinating the two energy sources. This is a standard solution for solar collector systems powering the hot water production systems. Example descriptions of utilizing this energy can be found in the annex "The best practices" for:

- MGOSiR in DąbrowaTarnowska;
- Hospital in Końskie;
- Nursing home in Starzechowice.

9. Stakeholders analysis – Renewable Energy Sources

Table 34: Photovoltaic - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The producers of photovoltaic cells The ecologists The local authorities The road authorities The managers of buildings		
	medium	The businesses	The electricity distributors	
	low	The households		

Table 35: Solar Thermal - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The producers of solar panels The local authorities The managers of public buildings The ecologists The single-family houses		
	medium	The lenders	The residents of multi-family housing	
	low			The operators of existing gas and electricity networks The sellers of traditional fuels (coal), fuel oil, propane-butane gas)

Table 36: Wind Energy small - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The producers of wind turbines The tourism entrepreneurs The farmers		The persons living close to the investment
	medium	The ecologists	The local authorities The electricity distributors	
	low			

Table 37: Wind Energy Commercial - Matrix for Identifying Stakeholders.

Level of Support

		Supporter	Neutral	Opponent
Power	high	The producers of wind turbines The producers of technology The owners leased the land for wind turbines		Ecologists The persons living close to the investment
	medium	The local authorities	The electricity distributors	
	low			

Table 38: Biomass Agriculture Products - Matrix for Identifying Stakeholders.

Level of Support

		Supporter	Neutral	Opponent
Power	high	The farmers – owners of a large farms The producers of heating equipments		The sellers of traditional fuels (coal)
	medium	The ecologists	The small and medium farmers The local authorities The households	
	low	The managers of local heating plants		

Table 39: Biomass Forestry Products - Matrix for Identifying Stakeholders.

Level of Support

		Supporter	Neutral	Opponent
Power	high	The forest managers The farmers The single-family houses	The sawmills	The sellers of traditional fuels (coal)
	medium	The ecologists	The local authorities	
	low	The managers of local heating plants		

Table 40: Biogas - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The agri-food processing plants The landfill managers The sewage managers The farmers		The persons living close to the investment
	medium	The local authorities	The households The ecologists	
	low			

Table 41: Geothermal and Ambient Heat - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The producers of geothermal equipments The hotels and sport objects managers The ecologists		
	medium			The sellers of traditional fuels (coal) The supplier of gas and electricity for heating
	low	The households		

Table 42: CHP using renewable sources - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The producers of heating The producers ecological energy		
	medium	The ecologists	The local authorities The households	The sellers of traditional fuels (coal)
	low			

Table 43: Hydro Power - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The businesses – producers of energy	The ecologists The anglers	
	medium		The local authorities	The managers of inland waters
	low			

10. Renewable Energy SWOT analysis

10.1 Summary of economic potential

According to the results presented in Chapter 6 “RES potential in the Gorlice Region” and from the point of view of achievable quantative targets for increasing energy production from RES the most attractive are in order:

- wind power
- solar energy - photovoltaic
- solar energy - thermal forestry biomas
- shallow geothermal

Less atractive or quite uninviting are:

- straw
- sawdust
- hydro power
- deep geothermal

10.2 SWOT analysis

10.2.1 Introduction

Strategies of RES have been defined on the basis of energy potential evaluation and then analyzed using SWOT method. SWOT analysis was performed according to the VIS NOVA project methodology, taking into account also the principles applied in the strategic planning of business organizations which are described, among others, in "Key Management Models" by M. van Assen, G. van den Berg and P. Pietersma, Prentice Hall, 2009.

The analysis includes:

- energy potential – conditions described in Chapter 6
- technologies available – pluses and minuses as well as various barriers (economic, technical and awareness) of implementation (Chapters 7 and 8)
- external environment – legal, economic, political and scientific
- stakeholders described in Chapter 9

To determine the priority for each strategy efforts were made to find answers to some key questions

1. Is it possible to increase the level of energy use in the area covered by the strategy to achieve the economic potential?
2. How big is the difference between the current level of energy use and economic potential?
3. What are the main factors determining the possibility of increasing the use of energy? Do we, community organized in the framework of VIS NOVA project, have influence on these factors or these factors are beyond our control and influence?

10.2.2 SWOT analysis of renewable energy development strategy based on straw

STRENGTHS

1. Production and energetic utilisation at the same place.
2. Good solution for energetic self-sufficiency.

WEAKNESSES

1. Fragmented production –large number of small farms.
2. Variable supplies in consecutive years (differences in crop yield, growing other than cereal crops).

3. Special boilers or pre-furnaces are required.
4. Technology suitable for relatively high heat demand (boilers bigger than 30 kW).

OPPORTUNITIES

1. New services of straw processing for a fuel (pellets) available combined with local distribution of such fuel.
2. Improving technologies of combustion as well as bigger automation of feeding and combustion process.

THREATS

1. Slump in cereals production.
2. Alternative farmland utilisation – more profitable than cereals.

Conclusions:

2. Strategy based on energy use of biomass straw is subject to many risks: organizational, economic and technological.
3. Recommended priority: low.

10.2.3 SWOT analysis of renewable energy development strategy based on forestry biomass

STRENGTHS

1. Stable supply from State Forest.
2. Produced locally.
3. Easy to acquire – well known and available technologies.
4. Well known and available technology of combustion.
5. Diversified (technologically and price-wise) market offer of combustion technology.
6. Relatively low production cost of energy for heating purposes.
7. All sort of waste and by-products from wood processing can be used for energetic purposes
8. Better energy conversion through improvements in combustion technology.
9. Wood from private forests also available.

WEAKNESSES Limited possibilities of supplies increase.

1. Intense competition for wood and wood waste – producers of wood boards, pellets, briquetttes and wood chips as well as construction industry and heat supply (individual, small and big heat power plants also for co-firing).
2. Variable price (mainly increase) due to variable demand and stable wood production.
3. Inefficient boilers inappropriate for wood combustion are still used.
4. Low awareness and limited knowledge about efficient wood combustion.

OPPORTUNITIES

1. New cheaper and more efficient technology of wood combustion.
2. Popularization of wood combustion can results in lowering price of boilers and in consequence increase economic benefits of energy from wood.
3. Import of wood and consequently decrease in competition can increase local availability of woods for heating purposes.
4. Introduction of support schemes for wood combustion on local level.

THREATS

1. Privatization of State Forests can destabilize wood supply.
2. Further increase in wooded areas protected by law.

3. Changes in Forest Policy resulting in lowering timber harvesting.

Conclusions:

1. Inability to increase the level of energy use based on forest biomass. The economic potential is set at 326 TJ / year. This potential is in practice as a whole is currently being used. Significantly higher levels of use of forest biomass cannot be expected.
2. There are possibilities to increase efficiency of wood combustion among individual users. This could be done through:
   a. awareness raising – how to efficiently utilize energy of wood.
   b. implementation of support schemes – current work on the Law on RES give grounds for cautious optimism in this regard.
3. Recommended priority: medium.
   Weaknesses (lack of growth) are balanced by the strengths of the (stable supply and promotional value) - hence the proposed medium priority.

10.2.4 SWOT analysis of renewable energy development strategy based on wind power – professional generation

STRENGTHS

1. Unlimited resources available.
2. Very active main stakeholder – entrepreneur.

WEAKNESSES

1. Conflicts with local communities and ecological organisations.
2. Financial benefits transferred outside of the region except local taxes and rents.
3. Complicated and time consuming procedures to connect to national power grid.

OPPORTUNITIES

1. Further increase of wind power industry.
2. Further technology improvements resulting in better acceptance by neighbours.
3. Legal framework forcing Best Available Technology for wind power generation.

THREATS

1. The reduction in State support for wind power.
2. Unfavourable changes in rules for buying energy from big wind farm.

Conclusions:

1. Strategy based on professional wind power generation is subject to high risk of conflict. Do not bring, however, virtually no economic benefits for the region.
2. Recommended priority: low.

10.2.5 SWOT analysis of renewable energy development strategy based on wind power – small wind turbines

STRENGTHS

1. Unlimited resources available.
2. Substantial savings for owners/users of small wind turbines.
3. Wide range of technologies and organizational solutions available.
4. Easy to promote and to increase public avareness.
5. Limited conflicts on very local level.
6. Could be combined with other RES technologies and energy efficiency measures.

WEAKNESSES

1. Limited knowledge about technology, application and financing in the society.
2. Need for expensive wind metering.
3. Connection to the national grid – the same rules like for professional wind power generation.
4. Substantial investment costs.
5. Requires modernization of heating and/or electric system in the building.

OPPORTUNITIES

1. Wider offer on market for technologies.
2. Favourable legal framework for small wind turbines.
3. Support scheme available.

THREATS

1. Worsening of legal framework (mainly environmental restrictions).

Conclusions:

Recommended priority: high.

10.2.6 SWOT analysis of renewable energy development strategy based on solar energy – photothermal conversion

STRENGTHS

1. Unlimited resources available.
2. Susbtantial savings for endusers.
3. Technology accepted by all.
4. Easy to promote and increase public avareness.
5. Wide market offer in terms of technology and organization including financing.
6. Could be combined with other RES techologies and energy efficiency measures.

WEAKNESSES

1. Limited knowledge of be-endusers.
2. Sustantial investment cost.
3. Requires of improvements in heatin system in the building.

OPPORTUNITIES

1. Bigger and better market offer.
2. More distinct State support.

THREATS

1. Non exists.

Conclusions:

Recommended priority: high.

10.2.7 SWOT analysis of renewable energy development strategy based on solar energy – photovoltaic conversion

STRENGTHS

1. Unlimited resources available.
2. Very extensive possible applications and thus easy to promote.
3. Rapid technological progress combined with price decrease of equipment.

4. Common acceptance of the technology.
5. Could be combined with other RES techologies and energy efficiency measures.

WEAKNESSES

1. Limited knowledge of technology.
2. Still too expensive for common use.

OPPORTUNITIES

1. Further technical progress and increase of production.
2. More distinct State support.

THREATS

1. Non exists.

Conclusions:

Recommended priority: high

10.2.8 SWOT analysis of renewable energy development strategy based on hydro power

STRENGTHS

1. Locally available.

WEAKNESSES

1. Small energetic potential.
2. Limited public interest
3. Possibility of conflicts due to location in protected areas.
4. Time consuming pre-investment procedures.
5. Transfer of finacial benefits outside the region.

OPPORTUNITIES

1. Development of techologies less harmful for river ecosystems.

THREATS

1. Increase in ecological and legal restrictions.
2. Unfavourable changes in legal framework.

Conclusions:

Recommended priority: low.

10.2.9 SWOT analysis of renewable energy development strategy based on deep geothermal energy

STRENGTHS

1. Very important as tourist attractions.
2. Easy to promote.

WEAKNESSES

1. Incomplete geological surveys and unfavourable preliminary economic evaluations.

OPPORTUNITIES

1. Discovery of thermal water resources suitable for profitable use for heating purposes.
2. Better financial environment for geothermal undertakings.

THREATS

1. No new surveys available.

Conclusions:

Recommended priority: low.

10.2.10 SWOT analysis of renewable energy development strategy based on shallow geothermal energy – heat pumps

STRENGTHS

1. Unlimited resources available.
2. Progress in techology development and availability.
3. Remarkable economical benefits for end users.
4. Easy to promote.

WEAKNESSES

1. Relative high investment cost limits propagation of this technology.
2. Troublesome preparation of ground source of heat (deep drilling or need for big acreage).

OPPORTUNITIES

1. Increase State support.
2. Price decrease due to technological progress, bigger production and competition among suppliers.

THREATS

1. Non exists.

Conclusions:

Recommended priority: medium.

11. Energy Efficiency – potential in the Region

The analysis is based on statistics provided by GUS, information obtained from the Community offices, information from surveys and interviews, and based on the published literature data.

The assumptions and data to estimate savings can be found earlier (Chapter 5.3). The potential savings in thermo-modernization, modernizing heat sources and managing energy in buildings were based on these numbers.

The basis to estimate savings from the use of energy efficient appliances (WHITE GOODS) is the actual consumption of electricity by households (data from distributors of energy).

The basis to estimate savings in public spaces lighting are the information from the managers of the lighting.

The potential of energy saving for the purposes of this study will be discussed in the following thematic blocks:

- thermo-modernization of buildings,
- energy management in buildings,
- modernization of heat sources in buildings,
- energy efficient equipment and technology in buildings,
- lighting of public space.

11.1 Thermo-modernization of buildings

Heat modernization means reducing the loss of heat through penetration, that is making the outer layers of the building meet the standards of heat loss and reducing loss of heat by ventilation. Since the modernization of heat sources, is one of the elements of the heat insulation, and may be applied with OZE is discussed in a separate chapter.

Table 44: Approximate indicators of demand for heat, depending on the age of the building.

Buildings constructed in the years	The average rate of heat consumption (kWh/m^2a)
up to 1966	240 – 350
1967 – 1985	240 – 280
1985 – 1992	160 – 200
1993 – 1997	120 – 160
after 1998	90 – 120

Heat insulation of individual sections of buildings can result in significant savings in heat demand. Heat loss depends on the type of the building and the condition of the outer layers.

Table 45: An exemplification of heat loss through certain layers.

	roof / flat roof	external walls	window	losses to the ground
Detached single family house with loft	50%	32%	12%	6%
Multi-family building	40%	25%	32%	3%

The data obtained during the analysis of the region`s current state and consultations with local experts suggests that the progress of modernizing buildings which were constructed using outdated methods of insulation is as follows:

- public utility buildings-modernization completed in approximately 90% of buildings;
- private buildings-modernization (total or partial) complete in approximately 60% of buildings.

Evaluation of theoretical potential of energy saving

The analysis above shows that the region has significant potential for saving energy for heating. A full heat modernization may result in – depending on the state of the building - 30% to 60% energy saving. Practically all non insulated buildings may be modernized. The theoretical potential of energy saving in this area is estimated at 370 TJ annually.

Evaluation of the possibilities of energy saving –technical potential

There are no limitations concerning heat modernization of buildings as far as technology and regulations are concerned. Materials for insulation and professional companies are available on the market without major difficulties. Legal regulations require a declaration of heat modernization for buildings up to 12 m high, higher buildings require a construction consent. In specific cases, the modernization may be restricted due to regulations concerning the preservation of monuments of architecture. The limited man power of the local companies may also limit the scale of the enterprise. The technical potential is estimated at 90% of the theoretical potential (337 TJ).

Evaluation of energy saving abilities- economic potential

The ability to conduct heat modernization depends on the financial capacity of the owner of the building. It is possible to apply for a preferential credit (local authorities) and financing from the heat modernization fund (individuals, communities and housing associations, local authorities). The primary constraint of modernization are the financial abilities of the owners of buildings – the costs of the work often go beyond their capacity to pay, and therefore the work is often carried out in stages. The economic potential is estimated at 30% of the theoretical potential (111 TJ).

11.2 Energy management in buildings

Temperature control systems are a standard in modern boilers, and therefore enable cost-effective management of energy. Replacing an outdated boiler usually enhances the efficiency of the heating system. It is assumed that the reduction of temperature in the room by 1°C decreases energy consumption by about 5%. Decreasing the temperature by 2-3°C for 8 hours a day results in comparable savings. Public buildings offer a much greater potential in energy saving, there the temperature may be lowered after closing and holidays. This type of measures may decrease the demand of energy by as much as 15% annually.

Evaluation of the theoretical potential of energy saving

There is a significant potential associated with power management concerning savings, non-residential buildings, public utilities, and objects associated with an economic activity. The potential of energy saving in this area is estimated at 125 TJ annually.

Evaluation of possibilities of saving energy- technical potential

The market offers a wide range of technologies which manage the energy resources. The costs of introducing such a system (it usually involves replacing the old boiler and the c.o. system). New heating equipment is usually much smaller than their older counterparts, which means adapting the boiler rooms to this new technology is not problematic. The community`s lack of awareness of the possibilities power management gives may be a problem - a good idea might be setting an example (preferably local) to show the advantages of using such technologies. The technical potential is estimated at 90% of the theoretical potential (112,5 TJ).

Evaluation of the possibilities to save energy- economic potential

The possibility of introducing energy managing systems depend on the financial abilities of the owner of the building. There is a possibility to apply for preferential loan (local authorities) and a heat modernizing fund (individuals, community and housing, local authorities). The economic potential is estimated at 50% of the theoretical potential (62.5 TJ).

11.3 The modernization of heat sources in buildings

The main reason for the upgrade of heat sources (for heating and for the preparation of hot water) considered in this section is to increase the efficiency and productivity , while maintaining the same type of fuel or, in some cases, to change fuel for renewable. According to the information from the local authority, the majority of sources of heat in the premises of public service has been modernized in recent years and the new boilers (mostly gas) have high efficiency. There is no accurate data on the sources of heat in private buildings, but the collected information suggest that such modernizations – although on a smaller scale – are carried out also. In private buildings the primary source of heat are solid fuels, mainly coal and timber.

Table 46: The efficiency of certain sources of heat, depending on the technology and the age.

Boiler	efficiency
Solid fuel	
Tiled stoves	0,25-0,40
Coal boilers produced before 1980	0,50-0,65
Coal boilers produced after 1980	0,65-0,75
Retort boilers (coal)	0,80-0,85
Liquid fuels (gas, oil)	
Boilers with ventilators	0,75-0,88
Condensing boilers	0,95-1,00
Solid fuels (straw)	
Boilers with manual feeding with power exceeding 100 kW	0,65-0,70
Automatic boilers with power exceeding 100 kW	0,65-0,70

Evaluation of the theoretical potential of energy saving

Potential of energy savings through modernisation of heat sources is difficult to estimate. Public buildings are usually equipped with modern heating systems, and in the case of private buildings, both residential and commercial, data are not available. The potential of energy saving in this area is estimated at 90 TJ annually.

Evaluation of possibilities to save energy – technical potential

The market offers modern heating systems running on any chosen type of fuel. Due to new technologies boilers are generally much smaller than the old ones, and therefore cause no significant problems when installing in the boiler rooms. The technical potential is estimated at 80% of the theoretical potential (72 TJ).

Evaluation of the capability of energy saving- economic potential

The capability to substitute old boilers with modern ones depends on the financial capacity of the owner of the building. There are opportunities to apply for preferential loan (local authorities) and the heating modernization fund (individuals, community and housing, local authorities). The economic potential is estimated at 30% of the theoretical potential (27 TJ).

11.4 Energy efficient equipment and technology in buildings

Electric appliances and lighting systems in a common household are characterized by different energy demands. This depends mainly on the age and technology used in such devices. Modern brown and white goods have a lifespan of several years, and therefore must be regularly replaced by newer devices which meet higher energy demands. This is not the case with lighting systems, "traditional" light bulbs, are still in use, especially when it is advised for technological and energy saving reasons (stairwell, short periods of lighting).

Evaluation of the theoretical potential of energy saving

The potential of energy saving in this area relates mainly to the economic use of household appliances already in possession- unplugging unused devices, and turning off the light in rooms where it is not needed. It is estimated that in the household uses 15% of its energy on lighting, audio video devices use approximately 15%, other appliances - about 70%.

The potential of energy saving in this area is estimated at 10% of the annual demand for electricity in households (approximately 9 MWh) (0,0324 TJ).

Evaluation of possibilities to save energy – technical potential

There are no restrictions on the possibilities of energy saving in this area – energy efficient appliances and energy efficient lighting technologies are widely available. Changing the inefficient habits of the users of the devices may prove problematic. It can be assumed that the technical potential is equal to the theoretical.

Evaluation of the ability of energy saving- economic potential

Achieving savings resulting from the proper usage equipment and lighting generates no costs, it only requires organizational changes. The economic potential is therefore 100% of potential theory.

11.5 Lighting of public space

The local authorities should provide adequate lighting of public space. In recent years one can observe significant changes in the technologies used - still common incandescent and mercury systems are being replaced with sodium and LED systems. Increasingly popular are the hybrid systems (as described in the examples of good practice annexed to this development).

Evaluation of the theoretical potential of energy saving

It is estimated, with about 80% of the luminaries within the Gorlice District has been replaced in recent years. The replacement of the remaining 20% may generate savings of 150 MWh per annum (0,54 TJ)

Evaluation of possibilities of saving energy – technical potential

New technologies are widely available. The technical potential is estimated at 100% of theoretical potential .

Evaluation of the capability of the energy saving - economic potential

The costs of the investment may be barier, particularly in areas where in addition to replacing the luminaire, it is necessary to replace the post or the system of energy supply (e.g. from overhead to the channel). The investment in new street lighting is of fairly rapid return on investment – local authorities should do such modernization. Economic potential is estimated at 100% theoretical potential.

11.6 Summary

Table 47: Summary of potential of areas for energy efficiency improvement (TJ/year).

Potential (TJ)	Heating modernization of buildings	power management of buildings	Replacement of heat sources	Energy efficient equipment and technology	Lighting public space	Total
theoretical	370	125	90	0,0324	0,54	585,57
technical	337	112,5	72	0,0324	0,54	522,07
economic	111	62,5	27	0,0324	0,54	201,07

As one can see from the above statement, the areas with the largest economic potential are:

- heating modernization of buildings,
- energy management in buildings,
- modernization of heat sources.

The other analysed methods of saving energy should also be popularized, despite being of lower potential:

- economical use of electric devices does not generate any costs,
- the costs of modernizing lighting of public space quickly returns, it is also worth mentioning that it increases safety.

In addition to the above-mentioned areas of saving energy there are also other actions resulting in the reduction of the consumption of various forms of energy:

- changes in the organization of traffic in the city (e.g. changes in the operation of traffic lights, etc.) results in smooth traffic, which decreases fuel consumption and reduces air pollution,
- low energy and passive houses,
- promotion of energy efficiency and “green” lifestyle.

12. Stakeholders analysis – Energy Efficiency

Table 46: Heat modernization of buildings - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The managers of buildings The local authority The producers of construction materials The construction companies The producers of ventilation equipment The households The ecologists		The sellers of traditional fuels (coal), fuel oil, propane-butane gas)
	medium	The lenders		
	low			

Table 47: Energy efficient New construction - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The producers of ecological technology The ecologists The investors		
	medium		The local authority	The sellers of energy The sellers of traditional fuels (coal)
	low			

Table 48: The modernization of heat sources in buildings - Matrix for Identifying Stakeholders.

		Level of Support		
		Supporter	Neutral	Opponent
Power	high	The producers of heating equipments The managers of heating plants The managers of buildings The households The ecologists		
	medium	The local authority		The sellers of traditional fuels (coal) and energy
	low			

Table 49: Energy efficient equipment and technology in buildings- Matrix for Identifying Stakeholders.

	Level of Support		
Power	Supporter	Neutral	Opponent
high	The producers of ecological technology The producers of household goods and lighting equipment The managers by buildings The households The ecologists The investors		The sellers of energy
medium	The local authority		The sellers of traditional fuels (coal) and energy
low			

Table 50: Lighting of public space Matrix for Identifying Stakeholders.

	Level of Support		
Power	Supporter	Neutral	Opponent
high	The producers of lighting equipment The managers of buildings The local authority The ecologists		
medium			
low			

13. Energy Efficiency SWOT analysis

13.1 - Introduction

Measure adopted to improve of energy efficiency in the Gorlice District are not regional specific and they are similar to the ones in other regions of the country. The analysis is thus more general than a similar renewable energy sources analysis.

The SWOT analysis includes:

- an analysis of the potential, opportunities and ability to save energy described in Chapter 11,
- external environment – legal, economic, political, scientific and research,
- stakeholders described in Chapter 12.

SWOT analysis should answer the key questions:

1. What are the possibilities of energy saving in each analyzed areas within the Gorlice District?
2. In what areas local authorities can take action?
3. Which external conditions, will encourage energy savings?

13.2 SWOT for energy efficiency strategy through thermo-modernization measures

STRENGTHS

1. Great potential in the region.
2. Common acceptance and popularity.
3. Fast return on the investment.
4. Increase in value of the property.
5. Most of the public building are insulated against cold – good example for local society.
6. Materials and methods easily available.

WEAKNESSES

1. Relatively high cost.
2. Usually financed form own resources.

OPPORTUNITIES

1. Further State support.
2. More demanding regulations in the area of energy efficiency.
3. Awareness increase.
4. More companies offering services and materials for heat insulation.

THREATS

1. More complicated procedures for subsidies and loans.
2. More complicated procedures for construction consent.

Conclusions:

1. The savings (technical) potential arising from thermo-modernization is significant (estimated at 337 TJ/year). Even with the assumptions that it will be used only partially due to technical and economic barriers – this will be the main area of the energy savings.
2. Thermo-modernization of buildings within the District is implemented constantly by owners of the objects mainly by private funds (without grants and concessional loans) This indicates a high awareness of energy savings by building warming.
3. Thermo-modernization of buildings due to its potential and interest in the communities - can bring proportionately the greatest energy savings.
4. Greater availability of external measures could significantly accelerate the process of adapting the building to the legal requirements and standards.

5. Actions of local authority in the field of thermo-modernization is a good example of promotion of energy saving.

Recommended priority: high.

13.3 SWOT for energy efficiency strategy through the use of energy efficient equipment and technologies in buildings

STRENGTHS

1. Energy efficient appliance easily available.
2. Easy access to energy efficient bulbs and LED-lighting.
3. Decreasing prices for equipment and technologies.

WEAKNESSES

1. Limited potential.
2. Low public awareness of energy efficient equipment and technologies.

OPPORTUNITIES

1. Public awareness raising.
2. Energy price increase results in higher demand for energy efficient equipment.
3. Lower prices due to competition of producers and suppliers.
4. Further increase of the requirements and standards for energy efficiency.

THREATS

1. Unrestricted import of less efficient equipment and technologies.
2. Imprecise legislation can make it possible not to act in conformity with energy efficiency regulations (e.g. „heating bulbs”).

Conclusions:

1. Despite the relatively small savings potential the sector can be regarded as significant, because the replacement of old equipment and lighting systems for energy-efficient ones is done “by the way "every time the old ones is exploited.
2. Government action that will facilitate the exchange of these devices is to correctly organize a system of collecting used household goods and bulky wastes.

Recommended priority: medium. Strengths balance the weaknesses.

13.4 SWOT for energy efficiency strategy through energy management in buildings

STRENGTHS

1. Substantial potential of saving energy.
2. Good local examples – project implemented by regional authorities.
3. Group of people and institution deeply engaged in energy management.
4. Easy access to equipment and technologies for energy management.
5. Easy integration with RES.

WEAKNESSES

1. High investment cost in the case of very sophisticated systems

OPPORTUNITIES

1. Public awareness increase.
2. Policy and promotion of energy management in building strongly supported by State and local authorities.
3. Better and cheaper technology available.

THREATS

Non exists

Conclusions:

1. The potential of savings resulting, among others with the introduction of temperature control systems in buildings and its temporary reduction in the District scale was estimated at 112.5 TJ per year. Despite the expected technical and economic barriers, the dissemination of energy management can bring significant savings.
2. A local example of the system's effective functioning can be an important element of energy management popularization.

Recommended priority: high. After installing a system for energy management in the building (costs of investment) expenditure on savings is practically nil. Strengths balance the weaknesses.

13.5 SWOT for energy efficiency strategy through the modernization of heat sources

STRENGTHS

1. New equipment and technology as well as servicing companies available on the market.
2. Advantages related to application of dual-function systems for producing heat and hot water.
3. Technologies based on renewable energy sources could be applied.

WEAKNESSES

1. High investment costs.
2. In case of some technologies (e.g. biomass fuel) modernization of fuel storage is required.

OPPORTUNITIES

1. Availability of subsidies.
2. Promotion of new technologies

THREATS

1. Non exists

Conclusions:

1. The technical potential associated with the exchange of heat sources for devices with higher efficiency in the District was estimated at 72 TJ per year. Due to the significant investment costs we assume that the actions will be implemented gradually over the next few years - in some cases due to desire to achieve savings in other cases due to necessity caused by usage the existing heat sources.
2. Promotional action should focus on popularization of modern heat sources equipped with complex control systems as well as renewable energy sources.

The proposed priority for the strategy – high.

Significant energy savings are possible to achieve. Introduction of renewable energy technologies to the local market is also possible.

13.6 SWOT for energy efficiency strategy through the modernization of lighting of public spaces

STRENGTHS

1. Easy to implementation – easy access to equipment and technologies
2. Immediate positive results in reference to security and standard of public space.
3. Rapid return on investment.
4. Integration with RES (photovoltaic and micro wind turbines) results in public awareness raising as well as give a chance to light areas unconnected to power grid.

WEAKNESSES

1. Limited potential of savings.
2. In some cases modernization of energetic infrastructure is required.

OPPORTUNITIES

1. Continuous State support for energy efficient measures.
2. Popularization of alternative financing via ESCO-type approach.
3. Increasing public demand for better public space.
4. Further technological progress.

THREATS

1. Price increase of equipment and technology.
2. Unfavorable changes in State policy of supporting.

Conclusions:

1. Local authorities responsible for lighting of public spaces gradually upgrade the lighting systems.
2. Rapid advances in technology may cause recently made investments to be outdated in the short term, but will continue to bring the expected benefits.

The proposed priority for the strategy - medium.

Strengths outweigh weaknesses. The small saving potential is caused, mainly due to the fact that investments in this area have been carried out over several years and most of the tasks have already achieved.

14. Possibility of financing the implementation of RES and Energy Efficiency

Finding an appropriate source of financial support for projects related to renewable energy and energy efficiency financing depends on:

- type of RES (solar thermal, photovoltaics, wind, water, biomass, biogas, heat pumps, geothermal energy);
- type of beneficiary (private individuals, entrepreneurs, local authorities or their associations, units of the State budget);
- the scale of investment (size of possible subsidy).

The financial measures to support these investments may come from national and foreign sources and are granted at central or regional levels. These measures are awarded as a subsidy, low interest credit or and equity loan, etc.

For the Local Authorities the most popular source of financing activities related to RES are Regional Operational Programme and Sectoral Operational Programmes.

The implementation of the ROP and SOP corresponds to a system of institutions involved in program management. These are: Managing Authorities – at the management level and Intermediate Bodies and Implementing Authority

14.1 The financing of RES and EE - programmes and institutions

Table 53: Institutions and programs providing funding.

Program / Institution	Type of funded activities / purpose of the program
Małopolski Regional Operational Programme	# investments to reduce emissions from fuel combustion sources, the installation of equipment reducing the particulate and emission, expansion and modernization of District heating, modernization of existing heating systems and energy efficiency # investment in infrastructure for the production and transmission of renewable energy
INFRASTRUKTURA I ŚRODOWISKO NARODOWA STRATEGIA SPÓJNOŚCI The Operational Programme - Infrastructure and Environment	# construction or modernization of electricity generation and CHP - cogeneration # expansion or modernization of distribution networks of high, medium and low voltage to reduce network losses # building or increasing the capacity for electric and heat generation from renewable energy sources (water, sun, wind, biomass, geothermal heat) # facilitate the development of renewable energy generation by construction of connection networks for the electricity from RES # development of transmission and distribution of natural gas, crude oil and petroleum products # development of transmission systems for electricity # construction and development of natural gas storage, and storage of petroleum and petroleum products # construction of natural gas distribution systems in areas not

	supplied with gas and modernization of existing distribution networks # facilitate growth of the industry manufacturing equipment for the production of fuels and renewable energy
The Operational Programme Innovative Economy.	# implementation of the results of R & D # implementation of new technologies (own or acquired) and launch new or improved products or goods on the basis of this technology # counseling and investments necessary for the conduct of business R & D activities, including those directed towards obtaining the status of research and development center # initial investments, including in particular the application of new in the country, highly innovative organizational and technological solutions in production and services, including those leading to the reduction of harmful effects on the environment # initial investments of enterprises from the manufacturing sector, including the application of innovative solutions on a global scale, of great importance to the economy due to the size of investment and number of new jobs associated with these investments # create a large number of jobs in enterprises in the modern sector of services, including shared service centers, for example, R & D centers
Program Rozwoju Obszarów Wiejskich na lata 2007-2013 Rural Development Programme for the years 2007 - 201	# manufacture or distribution of energy from renewable sources (wind, hydro, geothermal, solar, biogas, biomass)
CENTRAL EUROPE COOPERATING FOR SUCCESS. Programme For Central Europe	# increasing the competitiveness of Central Europe by strengthening innovation and accessibility structures # improvement of even and sustainable territorial development through enhancing the quality of the environment and developing attractive cities and regions in Central Europe
ewt POLSKA 2007-2013 European Territorial Co-operation	# to support the cross-border, the transnational and the interregional cooperation
PL-SK 2007-2013 Cross Border Co-operation Programme Poland - Slovak Republic	# construction, modernization of border environmental infrastructure, natural resources, renewable energy and raising its quality systems
INTERREG IVC Programme INTERREG IVC	# innovation, research and technology development # entrepreneurship and SMEs # information society # biodiversity and preservation of natural heritage (including air

	quality) # energy and sustainable transport #cultural heritage and landscape
Norwegian Financial Mechanism and Financial Mechanism of the European Economic Area	# expansion of District heating systems in order to eliminate the sources of low emission # replace obsolete with modern heat sources (including the elimination of outdated coal-fired boiler) # thermo-modernization of public buildings # reducing energy, material and water consumption of products and services by improving the efficiency of production # use of renewable energy # supporting the development of "green jobs" and "green procurement"
Swiss-Polish Co-operation Programme	# support for renewable energy systems, # improving energy efficiency through: the introduction of renewable energy, improvements of urban District heating including boiler houses
Bank for Environmental Protection	# loans for environmental investments (preferential and commercial) # organization of municipal bond issues to fund environmental projects # preferential loans for solar thermal installations for individual customers
Thermomodernization Fund	# reduce energy consumption by housing and municipal buildings # assistance in re-financing and re-payment of loans related to thermo-modernization projects
National Fund for Environmental Protection and Water Management	# loan financing, subsidies and capital financing to achieve the environmental results
Regional Fund for Environmental Protection and Water Management in Kraków	#co-founding for the purchase and installation of solar thermal systems, heat pumps, photovoltaic, biomass boiler rooms, and equipment in the process of recuperation

The allocation of the EU funds for 2014-2020, which can be used for the further development of the region at the moment is not known. However, in the case of national funding is assumed to be continuing.

14.2 Beneficiaries

Table 51: Summary of possible beneficiaries according to sources of financing.

l.p.	Source of financing	Beneficiary				
		Local Authorities	NGO	Businesses	Public Private Partnerships	Individuals
1.	Małopolski Regional Operational Programme	🟦	🟦	🟦	🟦	
2.	Operational Programme - Infrastructure and Environment	🟦	🟦	🟦	🟦	
3.	Operational Programme -Innovative Economy.	🟦	🟦	🟦	🟦	
4.	Rural Development Programme for the years 2007 - 2013	🟦	🟦	🟦	🟦	🟦
5.	Programme For Central Europe	🟦				
6.	European Territorial Co-operation	🟦				
7.	Cross Border Co-operation Programme Poland - Slovak Republic	🟦				
8.	Programme INTERREG IVC	🟦				
9.	Norwegian Financial Mechanism and Financial Mechanism of the European Economic Area	🟦	🟦	🟦	🟦	
10.	Swiss-Polish Co-operation Programme	🟦	🟦	🟦		
11.	Bank for Environmental Protection	🟦	🟦	🟦	🟦	🟦
12.	Thermomodernization Fund	🟦	🟦	🟦	🟦	🟦
13.	National Fund for Environmental Protection and Water Management	🟦	🟦	🟦		
14.	Regional Fund for Environmental Protection and Water Management in Krakow	🟦	🟦	🟦		

14.1 Links

General information	http://www.mrr.gov.pl/fundusze/fundusze_europejskie/strony/funduszeeuropejskie.aspx
Małopolski Regional Operational Programme	http://www.malopolskie.pl/rozwojregionalny/rpoperacyjny/
Operational Programme - Infrastructure and Environment	http://www.pois.gov.pl/
The Operational Programme - Innovative Economy.	http://www.poig.gov.pl/
Rural Development Programme for the years 2007 - 2013	http://www.minrol.gov.pl/pol/Wsparcie-rolnictwa-i-rybolowstwa/PROW-2007-2013
Programme For Central Europe	http://www.interreg.gov.pl/20072013/EWT/transnarodowe/CES/
European Territorial Co-operation	http://www.ewt.gov.pl/WstepDoFunduszyEuropejskich/Strony/czymsafundusze.aspx
Cross Border Co-operation Programme Poland - Slovak Republic	http://pl.plsk.eu/index/
Programme INTERREG IVC	http://www.ewt.gov.pl/wstepdofunduszyeuropejskich/strony/wspolpracamiedzyregionalna.aspx
Norwegian Financial Mechanism and Financial Mechanism of the European Economic Area	http://www.eog.gov.pl/
Swiss-Polish Co-operation Programme	http://www.programszwajcarski.gov.pl/aktualnosci/strony/glowna.aspx

Bank for Environmental Protection	http://www.bosbank.pl/?page=kredyt_z_doplatami_nfosigw
Thermo-modernization Fund	http://www.bgk.com.pl/fundusz-termomodernizacji-i-remontow-2/premia-termomodernizacyjna
National Fund for Environmental Protection and Water Management	http://www.nfosigw.gov.pl/
Regional Fund for Environmental Protection and Water Management in Krakow	http://www.wfosigw.pl/ http://wfos.krakow.pl/

15. Recommendations

The following table provides a summary of the results of the analyzes conducted for each strategy based on:

- SWOT analysis ,
- authors expertise in the area of RES and energy efficiency,
- results of discussions with experts.

Were taken into account the following parameters and given the rank (5 – best score, 1 – worst):

- organization aspect – how complicate and time consuming is implementation of the strategy,
- educational and promotional aspect – influence on public awareness rising,
- social aspect – potential public interest and participation,
- financial aspect – financial outlays and sourcing of financing.

For purposes of this analysis we assume that the optimal strategy should be characterized by the following parameters:

- implemented within short period of time (5),
- easy to implement (5),
- with high educational and public awareness raising potential (5),
- with high public paticipation (5),
- minimal financial requirements (5),
- with easy acces to financial sources (5).

Table 52: Analyse of strategies.

Strategy	Time of implementation	The complexity of implementing	Educational value	Public interest	Financial outlays	Access to financing	Total score
Weight	*1*	*1*	*1*	*1*	*1*	*1*	
RES strategies							
Forestry biomass	2	2	3	4	3	1	15
Sawdust	3	1	2	1	2	2	11
Straw	3	2	3	2	2	2	14
Professional wind turbines	2	1	2	1	1	3	10
Small wind turbines	4	3	4	3	3	3	20
Solar - thermal	3	3	5	5	4	4	24
Solar – photovoltaic	3	3	5	4	3	4	22
Hydro power	2	1	2	1	1	2	9
Deep geothermal	1	1	3	4	1	1	11
Shallow geothermal	3	3	4	3	3	3	19
Energy Efficiency strategies							
Thermo-modernization	3	5	4	5	2	3	22
Energy management	4	4	5	4	4	3	24
Modernization of heat sources	3	3	4	3	2	3	18
Energy efficient equipment	4	5	4	4	3	1	21
Lighting of public space	4	4	4	5	4	4	25

Based on data presented in the table above, the SWOT analysis and analysis of the potential energy gained by the implementation of the strategy we propose to adopt as the leading all strategies related to improving energy efficiency, complemented by compatible strategies involving the production of renewable energy in the place of use (i.e. solar, photovoltaic, small wind turbines and heat pumps).

The proposed strategy may take the name:

THE STRATEGY OF ENERGY EFFICIENCY IMPROVEMENT

COMBINED WITH

THE PRODUCTION OF RENEWABLE ENERGY IN THE PLACE OF ITS USE.

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17. Attachments