BULGARIA

Renewable Energy Country Profile

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Strategic Assessment of the Potential for Renewable Energy in the EBRD Countries of Operation, Stage 1

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Note:
These profiles are a work in progress. The profiles are undergoing continual updating for technical content, formatting, grammar, and other issues. If you have any questions, correction, or comments please contact:

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1. Overview of Electricity Supply

Bulgaria achieved its independence from communist rule in 1990 when it held its first multiparty elections since the Second World War. The people initially elected a socialist government and experienced uncertain economic conditions that culminated in the economic downturn of 1996 and the subsequent collapse of the socialist government. Since this time, Bulgaria has observed macroeconomic stabilization and consistent growth fueled by political and economic reforms of the new government. The GDP growth in 2001 was 4.5 percent, with foreign direct investment rising to $641 million, Table 1.

Bulgaria's electricity sector has helped to stabilize and grow the economy throughout the 1990's. Currently, there is about 12,668 MW of installed capacity including thermal, nuclear, and hydroelectric resources. Table 1 provides additional information on the electric generation asset mix in Bulgaria.

Table 1. Bulgaria Electricity Overview (EBRD 2001, EBRD 2002, US DOE 2002).

General information			
Population, millions		8.10	
Land area, thousand Ha		11,055	
Macroeconomic Information (2001)			
GDP, billion US$		12.1	
Real GDP growth rate, percent		4.5%	
Foreign direct investment (net), million US$		641.00	
EU accession status		EU association agreement signed Mar. 1993	
Electricity sector			
EBRD electric power transition indicator		3+	
Electricity tariff, US¢/kWh (year of data)		2.8 (1999)	
Collection rate, percent (year of data)		112% (1999)	
Load utilization factor, percent (2000)			
Electricity disposition, billion kWh (2000)			
Generation		38.8	
Consumption		34.4	
Exports		3.2	
Imports		1.5	
Generation capacity mix (2000)	No. of Plants	Capacity (MWe)	Percent of Total
Nuclear	N/A	3,760	31%
Thermal	N/A	6,550	54.1%
Hydro	N/A	1,800	14.9%
Other renewables	--	--	--
Total	N/A	12,110	100%

The existing generation assets have been sufficient to supply domestic demand and have created a significant export market for electricity. In 2000, Bulgaria generated 38.8 billion kWh, while exporting over 3.2 billion kWh to its neighbors in Southeastern Europe. Despite the current excess of generating capacity, Bulgaria is actively seeking outside investment to expand, as 40 percent of the current generation is scheduled for retirement by 2010. Figure 1 details the electricity balance for Bulgaria for the past decade.

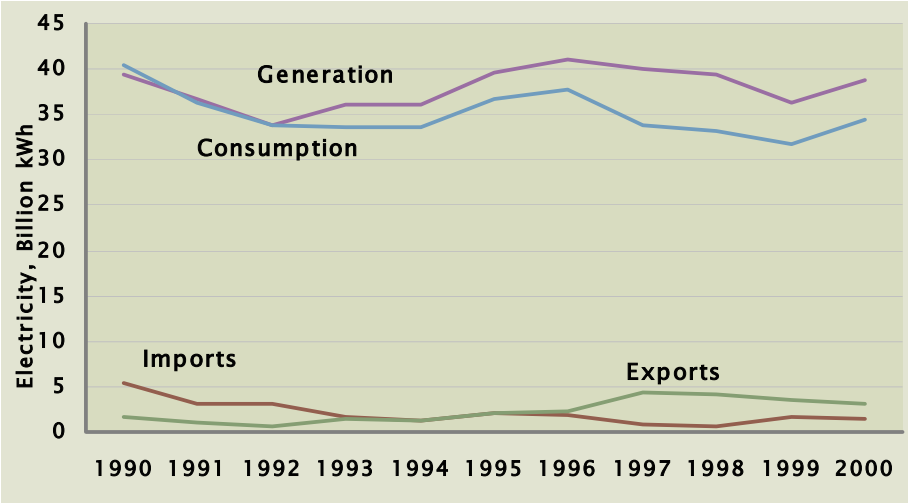

Figure 1. Bulgaria Electricity Market Trends (US DOE 2002a).

The government has proceeded more rapidly with restructuring and liberalization of the energy industry than most of its neighbors in Eastern Europe. With the passage of the Energy and Energy Efficiency Act of July 1999, the following changes and goals have been initiated:

- Improving efficiency
- Unbundling monopoly structures
- Promoting privatization
- Attracting foreign investment
- Establishment of a State Energy Regulatory Agency

The State Energy Regulatory Agency began operation with the ability to issue licenses and set electricity and natural gas prices. The agency has since suggested amendments to increase its power to implement structural reforms in the energy industry. Also under the agency, Nationalna Elektricheska Kompania (NEK) was split into six independent generators, a national transmission system operator, and seven regional distribution system operators. Additionally, as of the beginning of 2002, the natural gas market was partially deregulated by allowing large users and distributors to negotiate directly with suppliers. Steps towards the deregulation of the electricity market will likely follow.

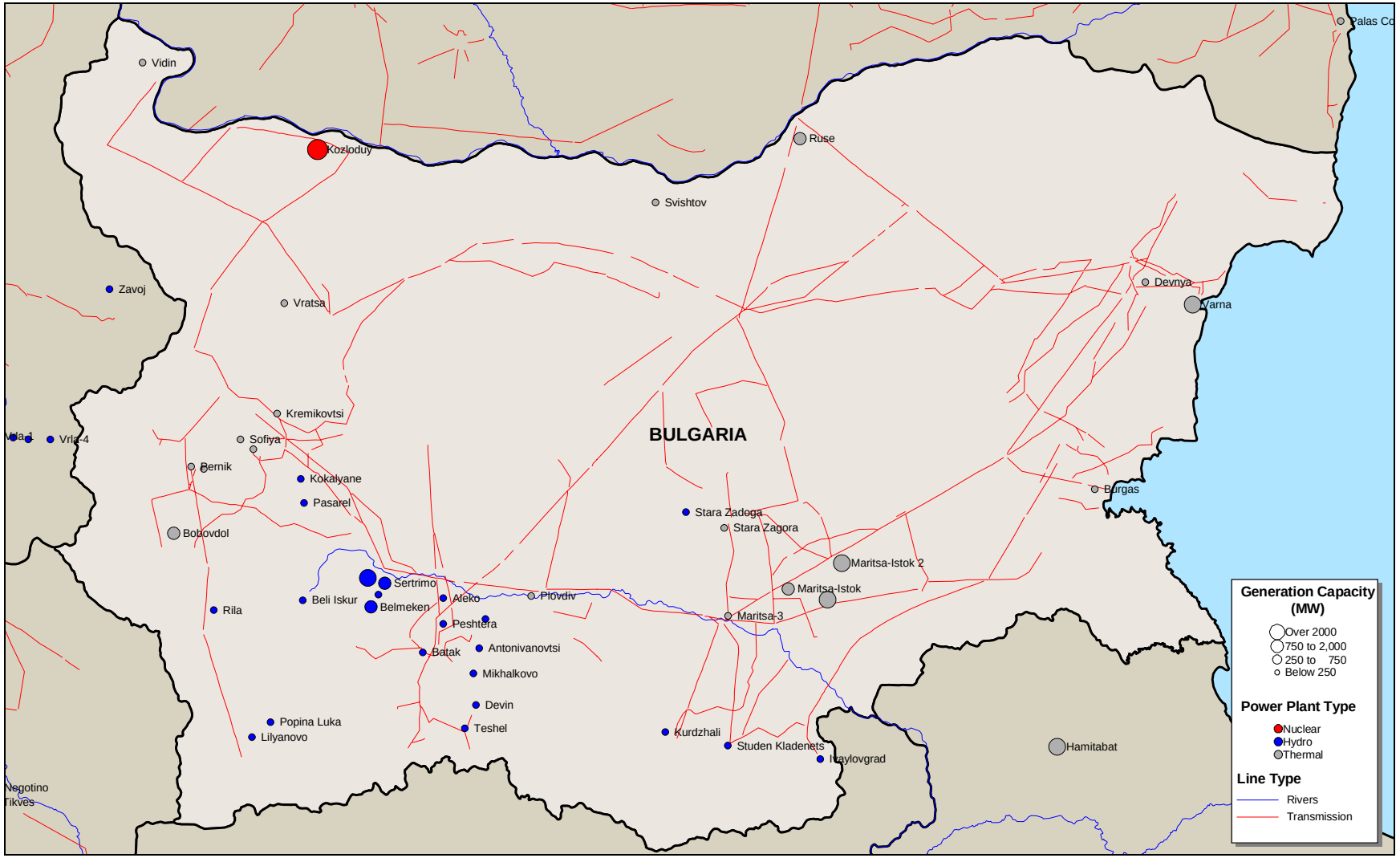

Figure 2. Bulgaria Electricity System Map.

2. Wind Resources

Current Status of Wind Energy (Wind Power Monthly; Ivanov, 2002; IEA, 2000)

There are no operational wind energy power plants. However, 100 years ago 300 wind mills were in operation in Northeast Bulgaria and at the Black Sea coast. Some of these old wind mills are still used for grinding wheat or other grains, as well as water pumping. The total numbers of such turbines, or the current operating conditions, are not known.

A country wide wind-atlas is available, where three main areas with annual average wind speeds in excess of 9 m/s, two areas with more than 7 m/s and several areas with wind speeds between 4.5 - 7 m/s were identified. Since all these data were measured at 10 m above ground, the likelihood is very high that the wind speed will be in the range of 5.5 to 13 m/s at 50 m above ground.

Bulgarian law does not seem to have any provision for renewables; no feed-in tariff has been announced.

No industry association or manufacturer was identified. However, Technical University of Varna had built a 100 kW turbine in 1990.

One developing project with 24.7 MW (Private EKO-EL-2002 Ltd. Project at Peak Murgash) with 19 Nordex 1.3 MW turbines was identified. The average wind speed at this site is 10.3 m/s at 10 m above ground, in 1999. Estimated completion date of this project is 2005. Estimated production figures were not available, but with such wind speeds this project could produce 80 GWh/year (> 36 percent net capacity factor, based on an average air density 1.0334 kg/m^3, k=2).

The wind conditions are excellent for this project. Yet, the reported completion date of 2005 indicates that the project is not in an advanced state. The main set back seems to be lack of legal and financial frame work.

Technically Bulgaria has a very good potential for wind energy development.

Wind Energy Resource Potential (Wind Power Monthly; Ivanov et al., 1982)

The country-level wind map and most of the information in this report was provided by Assoc. Prof. Dr. Peter Ivanov of the National Institute of Meteorology and Hydrology at the Bulgarian Academy of Sciences in Sofia. The wind speed data seems to originate from meteorological station data (all at 10 m above ground). The wind map shows several well-defined areas with high potential.

In the above mentioned study the wind energy resource potential of Bulgaria is estimated at 2,200 – 3,400 MW.

Under these circumstances we would rate the technical wind energy resource potential of Bulgaria as very good.

Identification of Areas/Projects with High Potential for Wind Energy

The most promising sites are the northern Black Sea Coast, the central mountain range and the Rhodop mountains in the southwest.

Figure 3. Bulgaria Wind Atlas.

Table 2. Bulgaria Areas/Projects with High Potential for Wind Energy.*

Project Name and Location	Size (MW)	Description
In the central Mountainous region and on the Black Sea		Average wind speed of 7 m/s recorded in these areas (8.8 m/s)
Peak Musala, Southwest		Wind speed 7.6m/s (9.5 m/s)
Peak Botev, Central Bulgaria		Wind speed 9.1m/s (> 11 m/s)
Peak Cherni vrah, Near Sofia.		Wind speed 9.3m/s (> 11 m/s)
Peak Murgash, North of Sofia	24.7 MW	Wind speed 10.3m/s (>12 m/s)
Ahtopol, East, near by Black Sea		Wind speed 4.6m/s (5.8 m/s)
Obzor, East, near by Black Sea		Wind speed 4.6m/s (5.8 m/s)
Emine, East, near by Black Sea		Wind speed 4.6m/s (5.8 m/s)
Cape Kaliakra, Northeast, near by Black Sea		Wind speed 6.7m/s (8.4 m/s)

*Note: Measured wind speeds at 10 m above ground, at 50m estimated by 1/7 power law in parenthesis.

Barriers/Incentives for Wind Energy

As of today there are no specific incentives for the implementation of wind projects in Bulgaria. Specific barriers to the implementation of wind projects in Bulgaria include, lack of:

- Legal frames and recommendations: The Law for prices, Law for concessions and Law for investments are very important for wind energy development.

- Special, guaranteed feed-in tariff to be paid by the National Electric Company (NEC) and lack of long-term contracts.
- Regulations and standards at the Ministry of Energy for wind energy development in Bulgaria.
- Finances and funds for RES

The following countermeasures are recommended by Dr. Ivanov to help combat these barriers:

- The initial capital to be ensured by support of EBRD, European Commission, World Bank, different funds such as GEF, IFC, UNDP, PHARE and others. The basic announcement must be above all from two sources:
  - State subsidies for assistance to realization of expected benefits in the field of conservation of the environment and climate change, currency exchange, employment, etc.
  - Laying a tax on consumers of energy from classical sources, which pollute the environment.
- Priority financing. The presence of an open energy market allows creation of priority financing for wind energy, and enables companies to make use of it.
- Local investments. Local investments have crucial significance for wind energy development.
- Foreign investments. Central and local administration must encourage foreign investments that can bring necessary capital and transfer of modern technologies.
- License and concede of rights. One good possibility for wind energy development is utilization of technologies by buying of licenses.
- Public opinion and education. A public education effort and development of public opinion in favor of wind energy development is necessary.
- Education. Programs for primary, secondary and higher education must be adapted for acquaintance of students with possibilities and expected advantages from wind energy.
- Professional training. Introducing of especial programs for training in institutions of higher technical education and more specifically in Technical Universities in Sofia, Varna, Gabrovo, Burgas, as well as the specialists from the Bulgarian Academy of Sciences.
- Local administration. Local administration will have increasing authority and responsibilities in Bulgaria. They may influence investment insurance, concession permission, licensing, environmental assessment, publicity and other public relations.
- National Federation of Wind Energy. It is necessary to create a National Federation of Wind Energy whos aim is to unify efforts of all parties concerned with wind energy development.
- Development of demonstration projects.

Table 3. Bulgaria Wind Energy Profile.

Current status of wind energy	
Installed capacity	0 MW
Projects under construction	N/A
Supporting regulations?	N/A
Industry association?	EUC "Energy, Nature, Balkan", TU Varna, Bulgaria.
Wind energy resource potential	
Level of information available	Very Good
Highest wind class	Class 7 (> 1,000 W/m², 10.3 m/s at 10m, Peak Murgash 1687 m a.s.l.)
Country-level wind atlas available?	Yes
Estimated potential (MPWD)	N/A
Estimated potential %2 of consumption	250 MW
Estimated potential (Interwind)	2,200 – 3,400 MW
Target established?	Yes, 57 MW or 341 GWh/y by the year 2010
High wind speed locations	▪ Northeast, Black Sea Coast ▪ Central mountain range ▪ Southwest, Rhodop mountains
Identification of areas/projects with high potential for wind energy	
Recommended strategic assessments	Appraisal of legal and economical frame work
Identified areas/projects	24.7 MW Project at Peak Murgash
Incentives/barriers for wind energy	
Significant incentives	None
Significant barriers	Lack of legal and economical frame work
Overall Prospects	**Good.** Bulgaria is one of the top countries for wind energy development. In spite of lacking legal and economical framework, overall prospects in Bulgaria are good because there is state of the art information about the resource potential, local developers have started work and the country has large potential for wind energy development.

3. Solar Resources

Current Status of Solar Energy

Bulgaria is located in a geographic region that is amenable to the utilization of solar energy. The annual mean radiation for the country is 4.2 kWh/m^2/day (Source: Commission of the European Communities). A sizeable portion of the country enjoys medium levels of solar radiation. In the years between 1977 – 1990, the Bulgarian government developed an energy efficiency program for the utilization of solar collectors in many of the State owned hotel and holiday villages for hot water heating purposes. This amounted to the installation of some 50,000 m^2 of collectors or about 17.5MWt, located mainly along the Black Sea costal regions. Today the total installed capacity of collectors amounts to some 59.775 m^2 (Sofia Energy Center, 2000), which are also mainly utilized for hot water heating. Table 4 depicts the current breakdown of the regions in Bulgaria where solar projects have been initiated and the installed capacity. Additional pilot and educational type projects for domestic hot water heating in some of the larger hotels under the PHARE program have yielded successful results, although there has not been a large increase in such projects. Other than experimental and prototypical photovoltaic projects, very little has been done in implementing solar energy projects.

Table 4. Total Installed Capacity of Solar Collectors for Hot Water Heating (Sofia Energy Center).

Region	Installed Capacity, m^2	Total Percentage of Installed Capacity
Sofia – town	2,200	4%
Burgas	25,100	41%
Varna	9725	16%
Lovetch	1450	2%
Montana	950	2%
Plovdiv	6,300	11%
Russe	950	2%
Sofia – region	6,800	11%
Haskovo	6,300	11%
Total	**59,775 m²**	**100 %**

Solar Energy Resource Potential

The solar irradiation in Bulgaria varies greatly dependant upon season. Table 5 depicts the monthly variances of solar irradiation from select stations within Bulgaria. Data collected from the 44 meteorological stations throughout the country state that the mean average day/night temperatures varies between 9°C – 13.5°C, while annual average daily temperatures varies between 12°C – 16°C. Wind velocity for most regions of Bulgaria is between 1 – 2.5 m/s. Considering the geographical location of Bulgaria (41° – 43° Latitude)

the maximum possible hours of sunlight per year amount to approximately 4,448 (Thermoconsult, 2002).

The Sofia Energy Center under the auspices of the FEMOPET program estimated the total theoretical potential for solar energy in Bulgaria to be 12.955 x 10^9 toe. They further estimated that the technical potential for photovoltaic panels to be 53,000 toe, active thermal solar systems to be 161,000 toe and passive thermal solar energy systems to be 33,000 toe.

While there are some private sector companies interested in solar energy, such as Energoproekt, AMEK, Energy and Ecology Ltd., and Thermoconsult, that have done preliminary research and/or pilot project implementation, it appears that the only feasible uses would be for hot water production or warm air solar heating. Warm air solar heating may be utilized in a broad range of agricultural and forestry applications such as for crop dryers and wood dryers.

Table 5. Monthly Solar Irradiation for Select Regions of Bulgaria in kWh/m²/day (UMASS at Lowell)

			Month												
Location	Latitude	Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Polianovgra	42.52 N	26.85 E	1.8	3.24	3.65	4.95	6.42	6.42	6.82	6.06	5.01	3.37	1.98	1.74	4.28
Sofia Observatory	42.82 N	23.38 E	1.26	2.67	3.18	3.87	4.97	5.8	6.45	5.56	3.95	2.63	1.36	1.07	3.57
Sommet Stalin	42.18 N	23.58 E	1.27	2.74	4.11	4.58	4.44	3.96	4.93	4.93	3.95	3.03	2.13	1.53	3.46
Tcherni-Vrah	42.57 N	23.28 E	2.49	4.21	4.81	5.6	5.83	6.03	7.52	6.66	5.04	4.36	2.78	2.12	4.79
Tchirpan	42.20 N	25.33 E	1.6	3.28	3.93	4.51	6.49	6.55	7.22	6.51	4.94	3.52	2.06	1.35	4.32
Varna	43.20 N	27.92 E	1.55	2.64	3.28	3.88	4.83	5.47	5.47	5.94	4.49	7.87	1.52	1.26	4.02

Identification of Areas/Projects with High Potential for Solar Energy

There are a fair number of opportunities for solar energy development in Bulgaria, mainly for hot water production or warm air solar heating purposes. A variety of sectors could capitalize on solar energy projects such as agricultural and livestock farms, tourism, food and beverage industry (i.e. vineyards), as well as residential establishments. It is believed that the economic factors related to photovoltaic panels do not justify large scale implementation.

Barriers/Incentives for Solar Energy

Specific incentives for the implementation of solar projects in Bulgaria include:

- The government's desire to rely more on the country's own fuel sources rather than the current quantities of imported fuel (70 percent of total fuel consumption is imported);
- Government supported incentives for investments in solar projects:
  - Reduction of customs duties for imported items;
  - Reduction in taxes.

Specific barriers to the implementation of solar projects in Bulgaria include:

- The current low cost of heat and electricity may make the overall capital costs of solar energy not economically advantageous;
- Lack of dedicated funds supporting renewable energy projects;
- No clearly defined governmental protocol on the use of solar resources, the lack of the creation of the talked about "Action Plan" for renewable energy use.

Table 6. Bulgaria Solar Energy Profile.

Current status of solar energy	
Installed capacity	Installed capacity of solar collector panels is 59,775 m^2
Projects under construction	N/A.
Supporting regulations?	No.
Industry association?	Yes. Bulgarian Section of the International Solar Energy Society.
Solar energy resource potential	
Level of information available	Good
High range of solar insolation	2.5 kWh/m^2/day (yearly average)
Country-level solar atlas available?	Yes. In addition, there is meteorological data taken from 44 stations throughout Bulgaria over the last 52 years.
Target established?	The government has not set any targets for solar energy utilization.
High solar insolation locations	▪ Varna Region (Black Sea Coast) ▪ Bourgas Region (Black Sea Cost)
Identification of areas/projects with high potential for solar energy	
Recommended strategic assessments	Specific Project Identification and Development (Hot Water or Warm Air Solar Heating).
Identified areas/projects	N/A
Incentives/barriers for solar energy	
Significant incentives	▪ Utilization of domestic resources ▪ Reduced customs duties for imported solar equipment ▪ Reduced taxes on solar projects
Significant barriers	▪ Low heat and electricity tariffs ▪ Lack of dedicated renewable energy funding ▪ No clearly defined government protocol or "Action Plan"
Overall Prospects	**Fair – Good**. While the country does lie in an area of favorable solar insolation, there really has not been a large interest taken in the development of such projects other than those pilot, experimental, and prototypical projects funded by a few institutions and NGO's. It is also realized that this could be due in part to the lack of knowledge and education regarding solar energy.

4. Geothermal Resources

Current Status of Geothermal Energy

Bulgaria has a sizable reserve of geothermal energy and is rich in low enthalpy geothermal waters. The country has been utilizing approximately 30 percent of its total potential, or about 107.2 MWt producing some 1.637 TJ/yr of energy per year, for use in space heating, greenhouses, drinking water, and for balneology purposes (Geothrmie, 2000). Figure 4 exemplifies the recent usage ratios of the country's geothermal resources. At the present there are no geothermal reserve sites that generate power. There exist approximately 1000 thermal springs and aquifers in Bulgaria, and generally those identified in the southern regions consist of relatively shallow hot springs, while the northern regions have been developed only through deep well borings. Drill depths for those discovered and evaluated resources in the southern regions range in depth from 100 – 1500 m, while the northern regions range from 100 – 5000 m in depth (Bojadgieva, et. al, 2000). The majority of these deep well borings have been implemented and financed over the years by the government, which may have a lowering effect on the overall primary and developmental costs if private sector development of the reservoirs is sought.

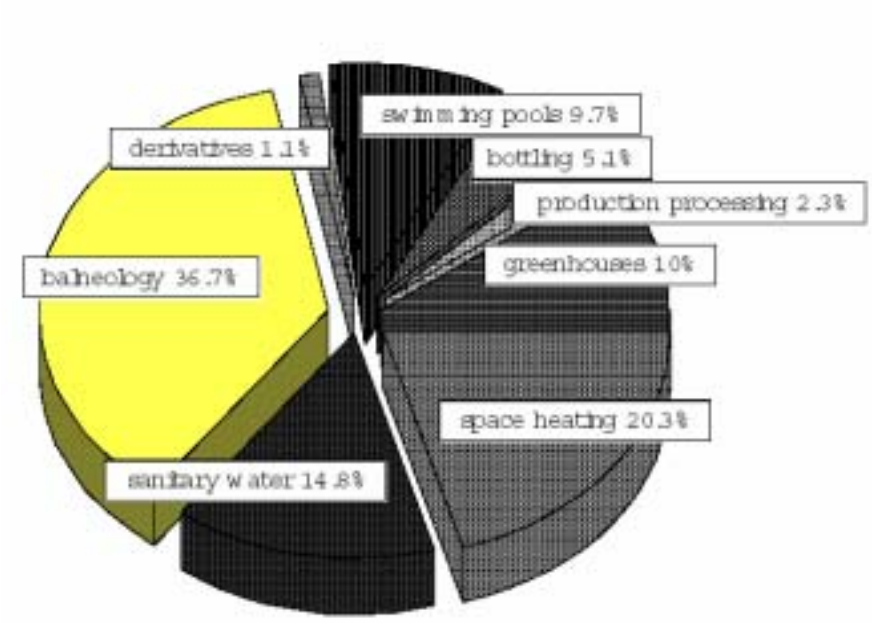

Figure 4. Current Utilization of Geothermal Resources (Bojadgieva, et. al, 2000).

There are a number of state organizations that have performed research into the exploitation of Bulgaria's resources and all activities regarding the use of the reservoirs for energy purposes is channeled through governmental agencies such as the Ministry of Energy and Energy Resources (MEER), State Energy Regulatory Commission (SERC), State Energy Efficiency Agency (SEEA), and the Ministry of Environment and Waters. Recent legislative reorganizations have led to the possibility of foreign investment to develop geothermal sites. While there is not specific legislation regarding the exploitation of geothermal reservoirs

there are, however, a series of regulations which dictate the relevant permits and licenses as well as the requirements for developing geothermal reservoirs for energy purposes (INEEL, 2001)). These laws being:

- **Law on Waters** – places the right for geothermal exploitation solely on the State, of which is transferable to approved entities for commercial purposes. The law is currently in the process of being amended to comply with EU directives;
- **Law on Concessions** – dictates the requirements and criteria for assuming the rights to exploitation for commercial purposes
- **Energy and Energy Efficiency Act** – dictates the licensing and permitting requirements for geothermal sites which will be utilized for energy purposes;
- **Territorial Structure Law** – includes the regulations for construction of energy supply networks and equipment- thermal pipelines, indoor heating installations.
- **Public Health Act** – places the managing and overall supervision of all state owned geothermal reservoirs onto the Ministry of Environment and Waters.

Geothermal Energy Resource Potential

There are a variety of geothermal reservoirs in Bulgaria due to the sharp contrast in geologic structure of the country. Geologically, Bulgaria has evolved into a complex mosaic of platforms and orogenic structures, with deep tectonic faults, lithofacial, and magmata contrasts with varying characteristics. Evaluations of the geological structure of Bulgaria and the groupings associated to the varying characteristics have divided the country into five separate geothermal regions: (INEEL, 2001).

- The Moesian Platform and Balkan Foreland reservoirs – Stems from the Black Sea to the east and occupies part of Romania as it traverses to the northwest. A sizeable amount of commercial activity currently occurs within this reservoir;
- The Malm - Valanginian reservoirs – covers an approximate 15,000 km^2 and includes the Dobrudja (Dubric) region. The reservoirs have a temperature range of 25°C - 75°C;
- The Triassic (Anisian) reservoirs – Located in the lower southwest region of Bulgaria, contains highly mineralized thermal waters and brine;
- The Devonian (Givetian) reservoirs – Located in the northwestern region of Bulgaria, contains highly mineralized thermal waters and brine;
- The Srednogorie and the Rhodopian Massif reservoirs – Located in the western through the southeast regions of Bulgaria, includes the Maritsa River basin as well as the Plovdiv regions. The region contains very low mineralized thermal waters, typically with nitric / nitric-oxide, and temperatures ranging from 25-100°C.

Figure 5 identifies those areas in where geothermal projects have been completed up through the end of 2000.

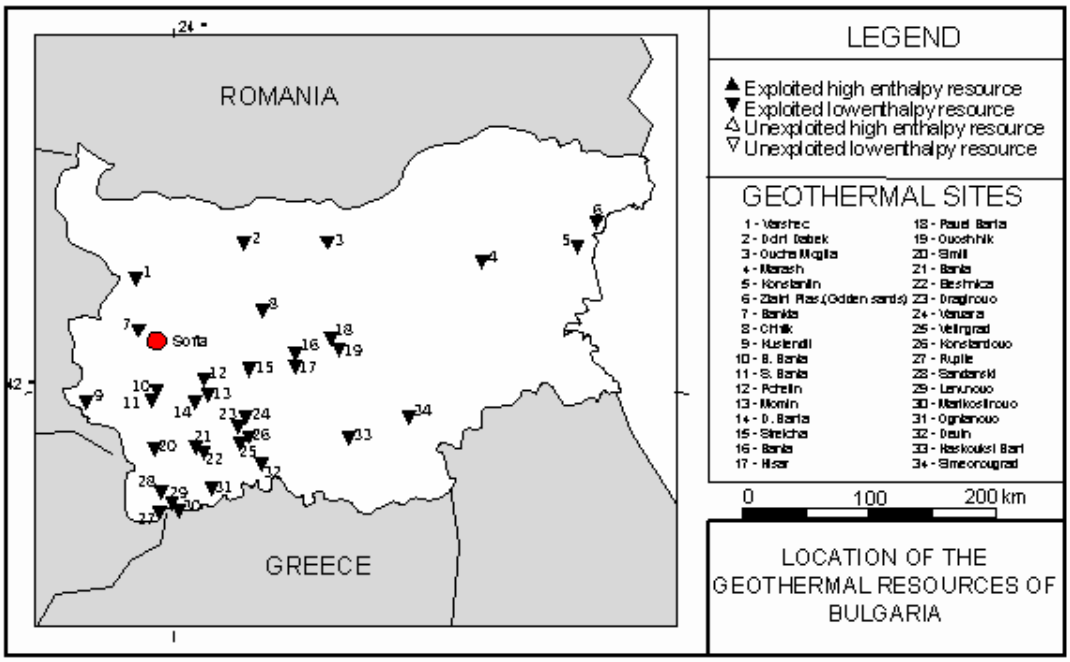

Figure 5. Bulgaria Geothermal Sites – as of 2000 (http://www.geothermie.de/egec-geothernet/ci_europe/bulgaria/basic_informations_2000_bulgaria.htm)

In 1998, the Geological Institute of the Bulgarian Academy for Sciences, under the guidance of the Ministry of Environment and Waters completed a re-assessment of the geothermal resources from 162 known fields, of which 103 are under the protection and control of the Ministry of Public Health and. The findings of the re-assessment concluded the following:

- Water temperature of the evaluated reservoirs ranges between 20°C and 100°C;
- The total flow rate of sub-thermal (T< 20°C) and thermal waters (T> 20°C) flow up to 4600l/s, of which 3000 l/s is the average flow rate for thermal waters;
- Approximately 33 percent of the total evaluated reservoirs range between 20°C - 30°C;
- Approximately 43 percent of the total evaluated reservoirs range between 40°C - 60°C;

Further studies have estimated that the overall potential in unexploited, proven reserves to be approximately 440 MWt or 14.122 TJ/yr of thermal energy. Additional estimates as to the overall potential of unexploited, probable, and possible resources to be in the neighborhood of 1800 MWt (International Geothermal Association, 2002).

Although at the present Bulgaria does not generate any power from geothermal sources, it has been estimated by the Geothermal Energy Association that the country's estimated power generation potential to be 200MWe.

Investigations by the Sofia Energy Center under the FEMOPET program have led to estimates that the theoretical potential of geothermal sources in Bulgaria to be 482,000 toe per annum, with the technical potential being 95,000 toe per annum.

Identification of Areas/Projects with High Potential for Geothermal Energy

There are good opportunities for geothermal development in Bulgaria. Table 7 lists the regions of Bulgaria with high potential for geothermal energy development.

Table 7. Bulgaria Areas/Projects with High Potential for Geothermal Energy.

Location	Size (MW)	Description
Lom Depression Region	N/A	Located in the Moesian Platform and Balkan Foreland reservoirs, the thermal waters have been recorded to be 115-120°C at a depth of 3km.
Rila – Rhodope Region	N/A	Located in the Rhodopian Massif reservoirs, the thermal waters have been recorded to be 70-80°C at a depth of 3km.

Barriers/Incentives for Geothermal Energy

Incentives for the implementation of geothermal projects in Bulgaria are very good and include:

- Government supported incentives for investment in geothermal projects:
  - Reduction of customs duties for imported items;
  - Free utilization of existing wells;
  - Reduction in Value Added Tax (VAT) by 2 percent;
  - Reduction in income tax by 3 percent;
  - Negotiable reductions in other taxes which apply.
- Implementation of the "*Ordinance on Setting and Applying Prices and Rates of Electric Energy*". Ordinance states that energy generated from renewable energy sources will be given preferential pricing, but moreover, transmission and distribution entities will be required to purchase all renewable energy produced at a fixed rate;
- The government's desire to rely more on the country's own fuel sources rather than the current quantities of imported fuel (70 percent of total fuel consumption is imported);
- Achieving the European Union's "*Short-Term Energy Criteria*" of an 8-10 percent share of renewable energy sources of the total energy demand by 2020.

Specific barriers to the implementation of geothermal projects in Bulgaria include:

- Rigid and heavy bureaucratic system of permissions and license issuing (for larger installed capacities - more than 1 MW for heat production and more than 5 MW electricity production as stated in the *Energy and Energy Efficiency Act*);

- The current low cost of heat and electricity may make the overall capital costs not economically advantageous;
- Lack of dedicated funds supporting renewable energy projects;
- New geothermal regulations are still relatively new and untested;
- No clearly defined governmental protocol on the use of geothermal resources, the lack of the creation of the talked about "*Action Plan*" for renewable energy use;
- Establishing interconnections with the existing grid system / distance of some possible project areas to interconnection points;
- Current condition of existing wells is in poor shape, many may need to be re-drilled.

Table 8. Bulgaria Geothermal Energy Profile.

Current status of geothermal energy	
Installed capacity (electric)	There are no electric projects installed.
Installed capacity (thermal)	107.2 MWt located throughout the country. Main uses are for balneology and space heating purposes.
Projects under construction (electric)	There are no electric projects under construction.
Supporting regulations?	Yes. While actual legislation regarding geothermal exploitation does not exist there are numerous supporting regulations which must be complied with prior to implementation (i.e. Law on Waters, Law on Concessions, Energy and Energy Efficiency Act, etc.).
Industry association?	No. Although there are universities with geological departments that hold an active interest geothermal energy.
Geothermal energy resource potential	
Level of information available	Good
Country geothermal atlas available?	Yes. Sufficient data and reports regarding the condition and potentials of the existing wells, as well as those locations in where unproven sources exist can be obtained.
Estimated potential (electric)	200 MWe
Target established?	No.
High enthalpy geothermal locations	▪ Lom Depression Region; ▪ Struma Valley Region; ▪ Rila / Rhodope Region.
Identification of areas/projects with high potential for geothermal energy	
Recommended strategic assessments	▪ Assessment of the existing situation of wells in areas where energy development can occur and the steps necessary for upgrading the wells for full exploitation; ▪ Review of existing studies performed for identification and development of an action plan for the potential sites of commercial geothermal applications; ▪ Preliminary identification of those regions where it is believed additional reserves can be obtained.
Identified areas/projects (electric)	New Construction: ~3MWe +100 MWt, Cogeneration System, Struma Valley, project not fully developed. In addition, for the 162 existing wells, the following works have been performed: -68 Preliminary Identification Reports;

	-18 Pre-Feasibility Studies; -28 Feasibility Studies. Specific data regarding the above studies has not been obtained.
Incentives/barriers for geothermal	
Significant incentives	▪ Reduction of government taxes and customs duties for geothermal projects ▪ Free use of existing wells ▪ Implementation of preferential pricing and mandatory buy-back policies ▪ Utilization of domestic resources ▪ Achieving EU 8-10% renewable energy criteria by 2020
Significant barriers	▪ Rigid and heavy bureaucratic system of permissions and licensing ▪ Low heat and electricity tariffs ▪ Lack of dedicated renewable energy funding ▪ New geothermal regulations are relatively untested ▪ No clearly defined government protocol or "Action Plan" ▪ Establishing interconnections with existing grid system / distance of some possible projects to interconnection points ▪ Current condition of existing wells is poor, many may need to be re-drilled.
Overall Prospects	**Good**. While there does exist a potential for exploitation of the country's geothermal resources for energy purposes, it appears that district heating might be the area where moderate development could occur. Through further and more detailed evaluations of the existing studies and the identification and exploratory work on those unproven reserves, energy production or district heating projects could be implemented.

5. Biomass Resources

Current Status of Biomass Energy

There exists a large potential to utilize biomass as an energy source in Bulgaria. Bulgaria has a total land area of approximately 110,000 km^2, of which some 6,200,000 ha, or approximately 60 percent of the overall land area, consists of arable and agriculture lands, and 3,903,000 ha, or approximately 30 percent, is forest cover. While information regarding the use and potential of biomass has been limited, there have been recent developments through pilot projects and preliminary evaluations that do begin to highlight Bulgaria's full potential.

Next to the country's hydro resources, biomass accounts for a sizable share of Bulgaria's final energy consumption, approximately 3.7 percent or 409,000 toe of the calculated 10,918,000 toe total consumption (Sofia Energy Center, 2002). Due to the lack of reliable nationwide assessments and data, it is estimated that in practice this number is much larger. The majority of the biomass energy consumption exists mainly in the rural areas, where fuelwood, followed by the residential consumption of wood briquettes produced from forestry wastes and sawmill byproducts amount to approximately 2 million m^3 per annum. Figure 6 identifies those regions where biomass projects have already been implemented by industry and that are currently in use.

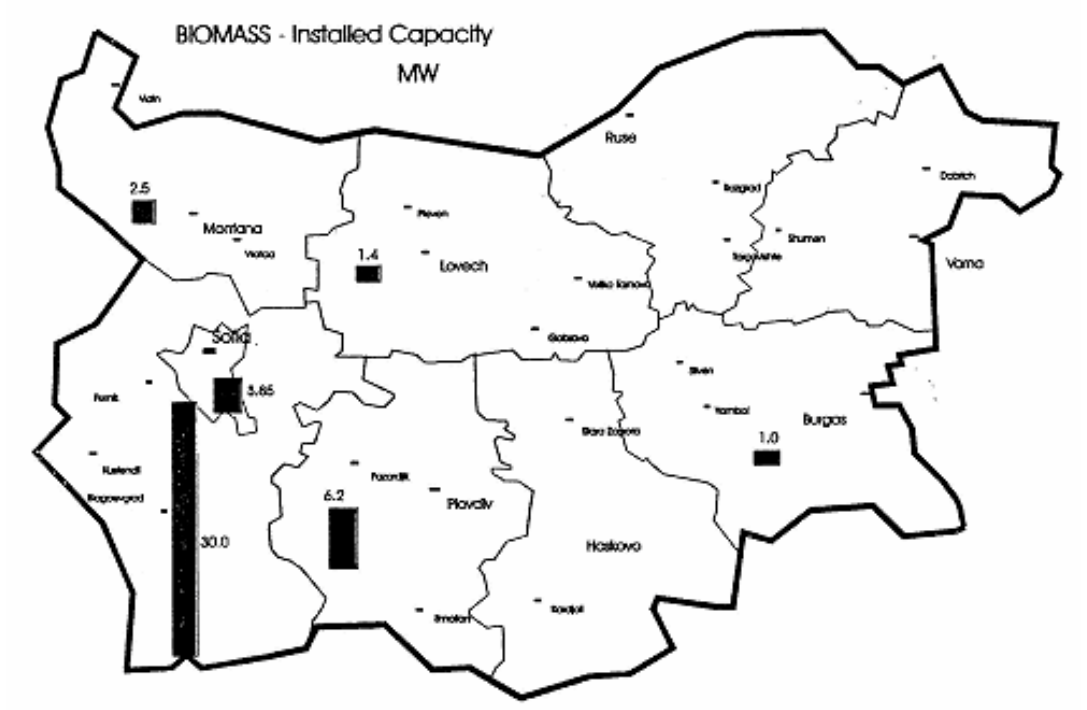

Figure 6. Installed Biomass Capacity of Bulgaria (Energy and Ecology Ltd, 1998 National Energy Efficiency Program).

In addition, wastes generated from agricultural and farming activities are produced in large quantities and exploitation of these wastes can prove to be significant source for energy generation. As the land of Bulgaria is rich and fertile, farming activities occur throughout the various regions, although the majority of the farms are relatively small, independently owned entities. Currently, many organizations from the private and not-for-profit sectors such as Thermoconsult, EE Systems, Energoproekt and the Bulgarian Biomass Association have been actively performing research as to the feasibility and full potential of utilization of such wastes.

Local universities such as the Agricultural University of Plovdiv and the Forestry University of Sofia have also spearheaded research into biomass utilization and now have curriculum as well as detailed research activities concentrated on the uses of biomass. There have also been numerous not for profit and non-governmental organizations that have sprouted up in recent years. Organizations such as Sofia Energy Center whose involvement in OPET (Balkan Organizations for the Promotion of Energy Technologies) and FEMOPET (Follow Member of the Network of Organizations for Promotion of Energy Technologies), EnEffect, as well as the Black Sea Regional Energy Centre (BSREC) all maintain a significant interest into the development of biomass resources.

Biomass Energy Resource Potential

As part of the National Energy Strategy till' 2020, utilization of the country's renewable energy sources will be emphasized, as the push for a reduction of the reliance on foreign imported fuels will take precedence. In addition, the development and approval of the Energy and Energy Efficiency Act by the State Agency of the Ministry of Energy and Energy Resources (MEER) has also set the groundwork for the promotion and development of renewable energy projects in the upcoming years. It has also been stated that a National Energy Efficiency Review is in the developmental stage which will subsequently result in the drafting of an Action Plan that concentrates on the use of renewable energy sources. The Ministry of Environment and Waters has also been designated with certain responsibilities regarding the utilization of renewable energy resources that coincide with the reduction of environmental pollution.

It is through these and other legislative instruments that the government has also made special allowances and incentives for the promotion of renewable energy project, which are noted in the proceeding sections. As Bulgaria is a candidate for EU membership it should be noted that the European "short strategy" concerning the achievement of an 8-10 percent share of renewable energy use of the total energy demand by 2020 may also apply.

In recent years there have been a number of studies and conferences that highlight the potential of Bulgaria's biomass availability. While the results have appeared to have been promising, the major pitfall for real forward progression has been the lack of funding for detailed research.

Estimates by the Sofia Energy Center state that the theoretical potential of biomass to be 3,608,000 toe per annum. Calculations for the technical potential of biomass with a time horizon of 2010 have yielded a potential of 380,.000 toe. The results of which do not consider consumption for rural residential heating and cooking purposes. In another study under the EU's PHARE Program (Sofia Energy Center, 2002), it has been estimated that the total yearly potential for biomass generation is as follows:

- Fuelwood: 2,146,761 tons
- Woody Waste: 942,232 tons
- Agricultural Solid Waste: 4,912,000 tons
- Agricultural Liquid Waste: 494,860,000 m^3 (as biogas)
- Biofuel: 60,000 tons
- Energy Crops: 2,000,000 tons

In addition to the figures mentioned above, Table 9 provides an overview and identification of various sectors and the estimated potential of each:

Table 9. Bulgaria Biomass Potential by Sector.

Sector	Potential	Remarks
BIOMASS FROM SANITARY WOOD HARVESTING		
Existing energy potential	~ 68 ,61,000 MWh/yr	Estimated on the basis of: - forested area: 3 329 000 ha - sanitary harvesting rate: 1% per year - efficiency of burning equipment: 75%
BIOMASS FROM ENERGY CROPS		
Existing energy potential	N/A	Sufficient studies have not been completed
BIOMASS FROM INDUSTRIAL WASTES		
Existing energy potential - wood processing industry	~ 1,100,000 MWh/yr	Estimated on the basis of: - harvested wood material - manufactured wood products - imported wood material - exported wood material
Utilized energy potential - wood processing industry	~ 960,000 MWh/yr	Estimated on the basis of the information for wood waste utilization from the larger wood processors
Existing energy potential - other industries	no information available	Sufficient studies have not been completed
BIOMASS FROM LANDFILL BIOGAS		
Existing energy potential	N/A	Sufficient studies have not been completed
BIOMASS FROM ANIMAL WASTES		
Existing energy potential		Estimated on the basis of:
electricity	~ 1,587,000 MWh/yr	- biogas installations 3-10% solids concentration
heat	~ 2,268,100 MWh/yr	- including animals in private farms (small and large scale)
Notes: 1- Data courtesy of Thermoconsult of Sofia 2-The above calculations are estimated potentials. It is necessary to further evaluate the true potential through more detailed studies.		

For Bulgaria, it is very often the case that despite the sizable timber, paper and pulp industries, very little has been done to efficiently exploit the full potential of these resources. It is not uncommon for wastes generated from these industries to accumulate in adjacent areas where degradation and environmental damage occurs. In one pilot study funded by the World Bank under the Prototype Carbon Fund of the UNFCCC, a pulp, cellulose and rayon plant has evaluated the use of woody wastes generated on site to replace a portion of the coal the facility currently utilizes. The preliminary evaluation has yielded that the project is feasible and further steps towards implementation are currently underway. Further studies have also been underway regarding briquetting of woody wastes generated from similar type facilities and the results have been promising.

For Bulgaria, it is very often the case that despite the sizable timber, paper and pulp industries, very little has been done to efficiently exploit the full potential of these resources. It is not uncommon for wastes generated from these industries to accumulate in adjacent areas where degradation and environmental damage occurs. In one pilot study funded by the World Bank under the Prototype Carbon Fund of the UNFCCC, a pulp, cellulose and rayon plant has evaluated the use of woody wastes generated on site to replace a portion of the coal the facility currently utilizes. The preliminary evaluation has yielded that the project is feasible and further steps towards implementation are currently underway. Further studies have also been underway regarding briquetting of woody wastes generated from similar type facilities and the results have been promising.

In addition to woody wastes, the country has the possibility to capitalize on the generation of landfill biogas and other biogas sources. The 1997 Law on Reduction of Adverse Environmental Effects of Wastes, set mitigation measures for the reduction in the amount of methane and other Green House Gases (GHG's) from landfills, which may soon be an instrument in the utilization of such off-gas for energy generation. It has been calculated that the number of legal landfills is approximately 720 with the country generating over 3 million tons of municipal solid waste (MSW) per annum. While there has not been significant research performed on the exploitation of landfill biogas as an energy source, there has been initial research performed on 44 organized municipal landfills with regard to the reduction of GHG's (USDOE, 1997). In addition, Figure 7 below provides an idea as to the concentration and size of such landfills. Further investigation into the results of such studies would serve as a good starting point in the preliminary evaluation of the landfill biogas potential. To date there has been one pilot landfill biogas feasibility study conducted at the Bratovo Landfill in the Bourgas Region and sponsored by the EcoLinks Grant Support Program. The preliminary finding of this study suggests that the potential for landfill biogas utilization does exist and is an area that could be further evaluated.

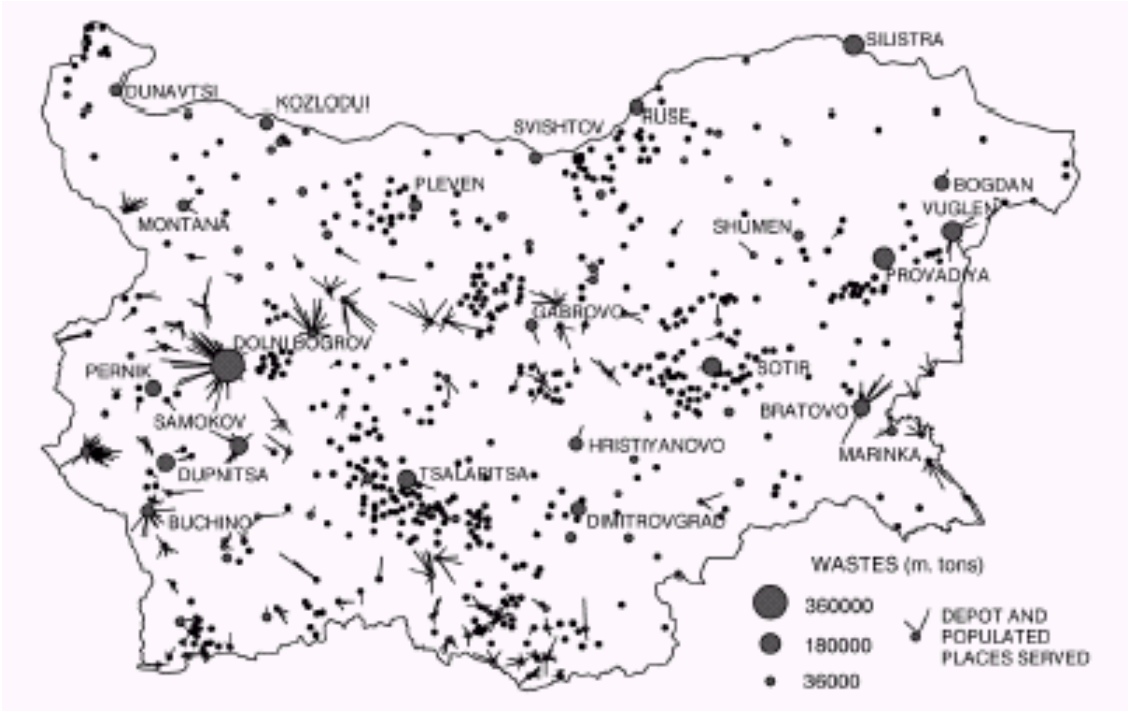

Figure 7. Household Waste at Landfills Served By Organized Disposal, 1996 (US DOE, 1997).

It should also be noted that currently the majority of agriculture waste generated is sent to local MSW landfills. The sorting and collection of this waste stream could prove to be a valuable fuel source, although little has research has been done.

Another area of consideration should be directed to the use of energy crop farms. With approximately 20 percent of the country's agricultural land contaminated with heavy metals from previous industrial activities (P. Shegunova, 2001), the land currently lies barren and is not utilized. Although remediation efforts have been conceptualized and in some areas underway, it will be a number of years before the land can be reclaimed. Through the planting and harvesting of known species of high calorific value crops suitable to Bulgaria's climatic environment a significant potential for energy generation exists. While it is believed that to date little has been done in the form of feasibility studies, there has been academic research into such projects that could prove to be a good starting point for project identification.

Table 10 shows agricultural and forestry statistics for Bulgaria.

Table 10. Bulgaria Biomass Resource Data (FAO 2002a, FAO 2002b).

Biomass resource type	Total production, units	Production density, (unit) / 1000 Ha
Primary crop production, tonne	(avg. 1999-2001, tonne)	(tonne /1000 Ha)
Total primary crops (rank among COO)	11,324,104 (14)	1,024 (17)
Top 10 primary crops		
Wheat	3,070,667	278
Alfalfa for Forage & Silage	2,000,000	181
Maize	1,112,000	101
Barley	719,333	65
Maize for Forage & Silage	616,485	56
Potatoes	471,333	43
Sunflower Seed	446,333	40
Tomatoes	408,667	37
Grapes	405,691	37
Grasses (misc), Forage & Silage	310,000	28
Animal units, number	(number)	(number / 1000 Ha)
Cattle	676,500	61
Poultry	15,324,000	1,386
Pigs	1,616,500	146
Equivalent animal units	1,476,340	134
Forest products, cubic meters	(avg 1999-2000, cu meters)	(cubic meters /1000 Ha)
Wood fuel and charcoal	1,607,000	145
Wood residues	2,000	0

Identification of Areas/Projects with High Potential for Biomass Energy

There are very good opportunities for biomass development in Bulgaria, although it is believed that with the exception of the projects mentioned above, specific projects have yet to be identified.

Barriers/Incentives for Biomass Energy

Specific incentives for the implementation of biomass projects in Bulgaria include:

- Implementation of the "*Ordinance on Setting and Applying Prices and Rates of Electric Energy*". Ordinance states that energy generated from renewable energy sources (RES) will be given preferential pricing, but moreover transmission and distribution entities will be required to purchase all renewable energy produced;
- Governmental incentives for foreign investment;
- Governments desire to rely more on the country's own fuel sources rather than the current quantities of imported fuel (70% of total fuel consumption is imported);
- Achieving the European Union's "*Short-Term Energy Criteria*" of an 8-10 percent share of renewable energy sources of the total energy demand by 2020.

Specific barriers to the implementation of biomass projects in Bulgaria include:

- Lack of technical norms for the production of the necessary equipment including different types of boilers; pressure parts, construction materials, ancillaries, wood fuel (chips, briquettes, pellets) and agricultural waste burning standards;
- Rigid and heavy bureaucratic system of permissions and license issuing (for larger installed capacities - more than 1 MW for heat production and more than 5 MW electricity production as stated in the *Energy and Energy Efficiency Act*);
- Capital costs associated with biomass project implementation and the lack of financial incentives as well as current low cost of electricity may not make it economically advantageous;
- Lack of dedicated funds supporting renewable energy projects;
- Developing access to environmental funds and energy efficiency funds;
- Standardized application procedures for bankable renewable projects, lack of country profiles;
- Establishing interconnections with the existing grid system / distance of some possible project areas to interconnection points;
- Lack of reliable estimates as to the actual production of landfill biogas;
- Current land ownership structure, which consists of mainly small farms, of which projects may not be economically advantageous considering the capital costs of biomass projects;
- Unwillingness and lack of education of local industries, the need for pilot projects;
- No clearly defined governmental protocol on the use of biomass, the lack of the creation of the talked about "*Action Plan*" for renewable energy use.

Table 11. Bulgaria Biomass Energy Profile.

Current status of biomass energy	
Installed capacity	An estimated total of 963 MW_{th} is currently being generated from wood residue projects located sporadically throughout the country.
Projects under construction	14 MW, Svilosa Biomass Project, Location : Svishtov
Supporting regulations?	Currently there are no specific regulations regarding the use of biomass, although the development of a National Action Plan is in the works. The National Action Plan will set the foundation for the promotion of biomass and other renewable energy projects.
Industry association?	Bulgarian Biomass Association (BBA) – Agricultural University at Plovdiv
Biomass energy resource potential	
Level of information available	Fair-Good
Country-level biomass investigations available?	Yes. There have been a number of small scale research and pilot projects, as well as general country overviews concerning the biomass potentials funded by many international developmental banks and the European Union.
Estimated potential	▪ 3,608,000 toe, gross (theoretical) potential; ▪ 380,000 toe, technical potential (by 2010 and not considering residential heating and cooking purposes).

Target established?	No. There have not been any clearly defined targets regarding the use of biomass.
High density biomass areas	▪ Danubian Plain; ▪ Thracian Region; ▪ North Bulgarian Region; ▪ Stranja Region; ▪ West Bulgarian Region; ▪ Black Sea Coast; ▪ Southwest Bulgarian Region; ▪ Doubrudja Region.
Identification of areas/projects with high potential for biomass energy	
Recommended strategic assessments	▪ Potential of agriculture wastes as a fuel source, specific project identification; ▪ Identification and assessment of contaminated land areas and appropriate crops for energy crop farming; ▪ Identification of specific areas and evaluation of livestock waste for energy; ▪ Landfill biogas potential of selected larger landfills;
Identified areas/projects	N/A
Incentives/barriers for biomass energy	
Significant incentives	▪ Implementation of preferential pricing and mandatory buy-back policies ▪ Governmental incentives for foreign investment; ▪ Utilization of domestic resources ▪ Achieving EU 8-10% renewable energy criteria by 2020
Significant barriers	▪ Lack of technical norms and standards for the production of equipment and wood fuel (chips, briquettes, pellets) ▪ Heavy bureaucratic system of permissions and licensing ▪ High capital costs, low heat and electricity tariffs, lack of financial incentives ▪ Lack of dedicated renewable energy funding ▪ Developing clear access to environmental funds and energy efficiency funds; ▪ Standardized application procedures for bankable renewable projects, lack of country profiles; ▪ Establishing interconnections with existing grid system / distance of some possible projects to interconnection points ▪ Lack of reliable landfill biogas production estimates ▪ Current land ownership structure, which consists of mainly small farms, lacking economies of scale ▪ No clearly defined government protocol or "Action Plan" ▪ Unwillingness and lack of education of local industries, the need for pilot projects.
Overall Prospects	**Very Good**. Considering that approximately 90% of the country's land is arable, agricultural land, or forests, the potential for the development of biomass projects is very good. While there has been recent interest in the development of such projects, there have not been clearly defined strategies for full exploitation. Through further studies and more detailed evaluations the country's full biomass potential can be better understood.

6. Hydroelectric Resources

Current Status of Hydroelectric Energy

Bulgaria has been utilizing the hydrologic potential of the country's watercourses for over two centuries. The country currently has a total of 1,937 MWe of installed capacity which is mainly generated by the larger commercial hydroelectric power plants (HPP's), while a total of 63 MWe is generated from small and micro HPP's (Sofia Energy Cneter, 2002). This installed hydroelectric capacity equates to approximately 15 percent of the total installed commercial capacity for the country (US DOE 2002c). However, many of the existing HPP's are over 30 years of age and are in need of some sort of rehabilitation to be restored to their true peak capacities.

The country's geography consists of mountainous terrain coupled with fertile valleys and plains. Table 12 indicates the hypsometry of Bulgaria. Considering that the average altitude is 470 m asl and the annual precipitation being 672 mm, it is not surprising that there are over 526 rivers in Bulgaria that are more than 2.6 km in length. All of which flow into three main drainage basins: The Danube Watershed, The Black Sea Basin, and the Aegean Sea Basin. The longest river is the Iskar which flows for 368 km and ultimately discharges into the Danube Watershed. Total yearly fluvial runoff from the country's inland rivers during a normal year is approximately 20.2×10^9 m^3 while for a very dry year it can be as low as 9.3×10^9 m^3 (Center for Integrated Regional Assessment, 2000). The total yearly water consumption of the country is approximately 10.6×10^9 m^3, of which 31 percent is utilized for irrigation, 16 percent for potable and domestic purposes, 19 percent for hydroelectric, 26 percent for conditionally pure water for the economy, and 8 percent for other purposes.

Table 12. Hypsometry of Bulgaria (Center for Integrated Regional Assessment, 2000).

Altitude Above Mean Sea Level (m)	Percentage of Land Area (%)
0 – 200	31.1
200 – 500	34.5
500 – 1000	21.5
1000 – 2000	11.7
> 2000	1.2

The Bulgarian government has placed great emphasis on the development of the country's hydrological resources in an effort to limit the dependence on foreign imports of fuel. Resulting from the adoption of the 1999 *Energy and Energy Efficiency Act*, the basic legislative framework for the creation of a market oriented power sector was developed. An outcome of this is the target to privatize much of the power generation capabilities of the country. In all, approximately 63 small and micro HPP's are located on the National Energy Company's (NEK) property, and in 1998 the first attempts to privatize 22 HPP's went underway with difficulty. Within the past year it appeared that the difficulties had, for the most part, passed and it now appears that most of the 63 have been targeted for privatization by 2005 (D. Tafrov, 2001). The Bulgarian government in recent years has also initiated new

licensing schemes as part of the project development process. In addition to the environmental impact assessment laws set for by the Ministry of Environment and Waters, a project developer is required to adhere to the following regulations when developing a commercial hydroelectric power project:

- **Law on Waters** – the State dictates the commercial uses for all the country's watercourses. The law is currently in the process of being amended to comply with EU directives;
- **Law on Concessions** – dictates the requirements and criteria for assuming the rights for utilization of watercourses for commercial purposes;
- **Energy and Energy Efficiency Act** – dictates the licensing and permitting requirements for hydro sites which will be utilized for commercial energy purposes;
- **Territorial Structure Law** – includes the regulations for construction of energy supply networks.

There are a few private sector companies who are actively involved in the development of small and micro HPP's such as Energoproekt, Hydro Ltd., AMEK, and ESD of Bulgaria. While the country does not have a hydro association, there are several organizations created on a municipal level who have taken an active interest in renewable energy sources. Municipal organizations such as the Plovdiv Energy Agency, as well as the Regional Energy Center's at Lovetch , Russe, and Haskovo are just to name a few.

Hydroelectric Energy Resource Potential

The Bulgarian government believes that in upcoming years there will be a great interest on the part of investors in the field of hydroelectric power, specifically small and micro HPP projects. As part of the *National Energy Strategy till' 2020*, the State envisages efficient water resource utilization as one of its main objectives. The State views that this can be achieved in two ways: through the privatization and rehabilitation of existing HPP's and the construction of new HPP's (D. Tafrov, 2001). This brings about relatively good opportunities for the development of new facilities or the rehabilitation of the existing HPP's. Recent studies have indicated that approximately 35 percent of the hydroelectric capabilities of the country have already been developed. Further estimations have put the new opportunities for HPP construction to an annual output 10,000 GWh, much of which may be in the form of small HPP's (D. Tafrov, 2001).

The Sofia Energy Center places the total theoretical potential of HPP's with less than 2 MWe of installed capacity at 133,000 toe per annum. Additional estimates put forth in the 2nd Edition of the UNFCCC Climate Change Report for Bulgaria have stated that micro HPP's can reach a total installed capacity of 212 MWe by the year 2020.

Identification of Areas/Projects with High Potential for Hydroelectric Energy

There are a number of existing and potential projects that the State either has conceptual / initial studies or pre-feasibility studies already completed, and is looking for investors to proceed with the development of such projects. Considering this, there are very

good opportunities for further hydro development in Bulgaria. Table 13 lists the main areas in Bulgaria with high potential for hydro energy development.

Table 13. Bulgaria Areas/Projects with High Potential for Hydroelectric Energy.

Project Name and Location	Size (MW)	Description
Iskar River Valley	Total: 155	Estimates state that a total of 155 MWe can be developed from a series of 49 plants commencing from the town of Novi Iskar to the discharge into the Danube River Basin.
Strouma River Valley	Total: 59	Estimates state that a total of 59 MWe can be developed from a series of 27 low pressure plants throughout the river valley.
Various Locations	N/A	As there are over 526 rivers with a total land area of 110 mm km^2, and an average elevation of 470m asl, numerous possibilities could be explored, especially when considering micro HPP's.

Barriers/Incentives for Hydroelectric Energy

Specific incentives for the implementation of new hydroelectric projects in Bulgaria include:

- Government supported incentives for investment in HPP's:
  - Reduction of customs duties for imported items;
  - Reduction in taxes.
- Implementation of the "*Ordinance on Setting and Applying Prices and Rates of Electric Energy*" described previously;
- The government's desire to rely more on the country's own resources for fuel rather than the current quantities of imported fuel (70 percent of total fuel consumption is imported);
- Creation of employment opportunities in areas where there are high levels of unemployment.

Specific barriers to the implementation of new hydroelectric projects in Bulgaria include:

- Rigid and heavy bureaucratic system of permissions and license issuing (for larger installed capacities - more than 5 MW electricity production as stated in the Energy and Energy Efficiency Act);
- Establishing interconnections with the existing grid system / distance of some possible project areas to interconnection points;

Table 14. Bulgaria Hydro Energy Profile.

Current status of small to medium hydro	
Installed capacity (small < 30 MW) Installed capacity (medium 30-100 MW)	There are over 62 small to medium sized HPP's in Bulgaria. In addition there are an estimated 49 HPP's with output <2MWe.
Projects under construction (small < 30 MW) Projects under construction (medium 30-100 MW)	There has been feasibility studies performed on numerous sites along the Iskar and Strouma rivers for small HPP's, although further project implementation or construction has not yet begun.
Supporting regulations?	Yes. The main regulations relevant for hydro development are the Energy and Energy Efficiency Act; Law of Waters; Concession Law; Territorial Structure Law; and Environmental Impact Assessment Law.
Industry association?	No.
Hydro energy resource potential	
Level of information available	Fair - Good.
Country-level hydro atlas available?	Yes.
Estimated potential	▪ 10,000 GWh, annual potential by 2020 (considers: small-medium-large HPP'S); ▪ 212MW, technical potential micro HPP's (<2MW) by 2020.
Target established?	No. Although the State has expressed that total annual capacity of installed hydro could be approximately 10,000 GWh by 2020. Currently it is approximately 3,300 GWh (1999).
Identification of areas/projects with high potential for hydro energy	
Recommended strategic assessments	▪ Assessment of micro-HPP potential of Bulgarian rivers; ▪ Assessment of the necessary rehabilitation efforts required to increase the output and efficiency of medium, small, and micro HPP's.
Identified areas/projects	▪ Iskar River Valley – est. 155 MWe ▪ Strouma River Vallery – est. 59 MWe ▪ Various Locations – N/A
Incentives/barriers for hydro energy	
Significant incentives	▪ Reduction of government taxes and customs duties ▪ Implementation of preferential pricing and mandatory buy-back policies ▪ Utilization of domestic resources ▪ Creation of employment in targeted areas
Significant barriers	▪ Heavy bureaucratic system of permissions and licensing ▪ Establishing interconnections with existing grid system / distance of some possible projects to interconnection points
Overall Prospects	**Very Good**. Considering that the State has made it a priority to lessen its dependence on imported fuel and the fact that the country dos not have an abundance of traditional indigenous fossil fuels, the potential for the development of hydro projects seems to be very good.

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