

# FYR Macedonia

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### 1. Overview of Electricity Supply

The Former Yugoslav Republic of Macedonia (FYR Macedonia) is a landlocked country slightly larger than the state of Vermont. It is located on a major transportation corridor from Western and Central Europe to the Aegean Sea, and from Southern Europe to Western Europe. FYR Macedonia shares borders with Albania, Bulgaria, Greece, Serbia (Kosovo), and Montenegro.

The installed power generation capacity in Macedonia is approximately 1,649 MW, comprising of about 62 percent thermal and 38 percent hydro. There are seven large hydro plants in Macedonia with combined capacity of 530 MW, and several small hydro plants with total capacity around 90 MW.

The restructuring of the electricity market in the Macedonia is co-ordinated according to the terms and principles set forth in the EU Electricity Directive and the recent Athens Memorandum for establishment of a regional electricity market among the SE European countries. The initial new market model is under consideration along with an action program for development and introduction of new codes, rules and regulations required.

The Energy Regulatory Commission has been founded by the Macedonian Parliament in June 2003 as an independent body. The main duties of this commission will be: structuring and establishing the prices of regulated energy and services in the energy sector; quality regulation of services and definition of the conditions for access to the public energy infrastructure, introduction of licenses, setting up tariffs and regime for a regulated approach to capacity engagement; dispute settlement between

companies or other parties regarding the shared energy resources and services that are under regulated regime, etc.

The following table provides summary information about Macedonia.

<b>Demographical Information</b>	
Population, millions (2009)	2.07
Land area, thousand sq km (2009)	25.3
<b>Macroeconomic Information (2008)</b>	
GDP, billion US\$	18.5
Real GDP growth rate, percent	4.6
Foreign direct investment (net), million US\$ (2007)	NA
<b>Electricity disposition, billion kWh (2005)</b>	
Generation	6.60
Consumption	6.61
Exports	0.00
Imports	1.60
<b>Generation capacity, GW (2005)</b>	
Nuclear	0.00
Thermal	1.01
Hydro	0.52
Other renewables	0.00
<b>Total</b>	<b>1.53</b>
<i>Sources: CIA World Factbook, U.S. Energy Information Administration, United Nations Conference on Trade and Development.</i>	

**FYR Macedonia Country Summary Table**

The following figure displays the transmission system in Macedonia.

## Macedonia's Transmission System



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## 2. Energy Policy, Barriers and Incentives

Unfortunately, in Macedonia there is a lack of supportive legislation for sustainable energy. However, like most countries in Eastern Europe, Macedonia is aspiring to join the EU, and has followed a policy that is compatible with EU objectives. Basic legislation concerning the environment and energy exists (Rantasa, 2008):

- Law on Energy (2006)- strategy for renewable energy resources over 10 year period
- Law for Founding Energy Agency
- National Environmental Action Plan II

- Law on Environment

Macedonia's National Development Strategy focuses on the following objectives:

- Speeding up privatization, restructuring the economy and the energy sector, and opening up to foreign investment
- Promoting energy conservation and efficiency
- Shifting from electricity to gas heating: The target for 2000 has entailed adoption of natural gas as a medium of heating for 120,000 households
- Eliminating energy subsidies so prices to reflect true costs
- Establishing a Regulatory Agency and Framework concerning the pricing system of purchases from independent power producers or the prices the independent power producers would pay for using the transmission network of (ESM)– the public Electricity Supply Company

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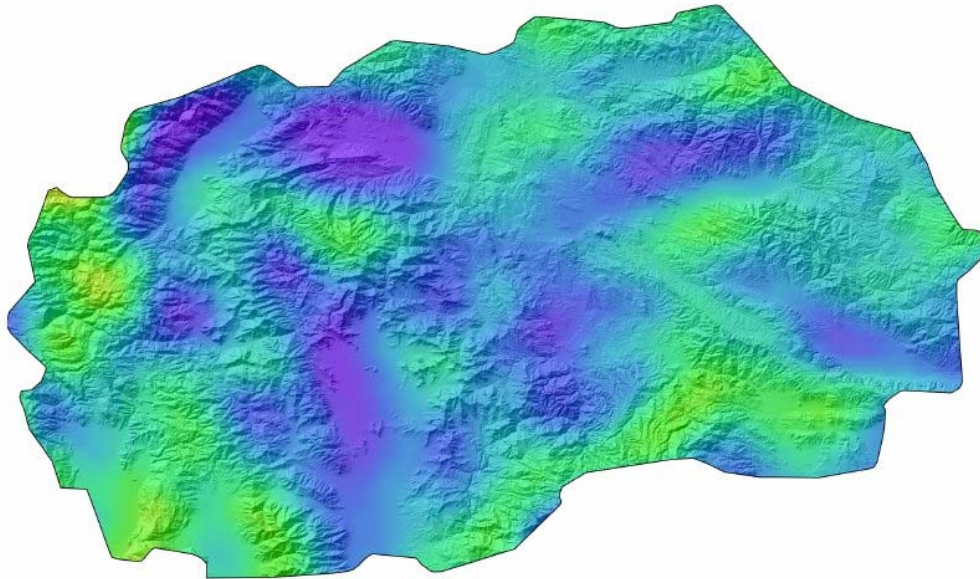
### 3. *Wind*

The Electrical Power Company of Macedonia, ESM is interested in developing a measurement program to determine the potential for wind energy in Macedonia. Such a program would need to be put in place before it would be possible to estimate the financial viability of wind power in Macedonia.

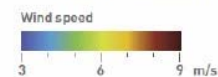
Currently, there is no direct information on wind energy available in this country. However, in the neighboring Greece 336.7 MW of the licenses granted were for Macedonia-Thrace. Furthermore there is an interconnection between both countries, and Greece would be interested to buy wind power from FYR of Macedonia.

In 2007, the Government of Norway funded a program in which four locations were chosen as potential wind turbine installation sites. Further studies to evaluate Macedonia's wind potential are yet to be undertaken (Colovic, 2008). Recently, foreign investors have taken interest in Macedonia's wind power potential. A few wind farm installations have been proposed (Balkan Insight, 2008).

## Macedonia Wind Map at 80m



5km Wind Map at 80m



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### 4. Biomass

Macedonia currently acquires a reasonable amount of energy from biomass fuels. The country's official energy balance shows that in 2000 the total primary production of wood amounted to 8.7 TJ having a gross energy value of 8.6 TJ. Gross inland consumption was slightly higher, about 8.9 million TJ due to small quantities of imports.

Allowing for relatively small quantities of wood as energy input in heating plants the net final energy consumption amounted to 8.55 million TJ. By far the biggest users were households with about 7.6 million TJ.

The final wood-derived energy consumption of 8.5 million TJ in the year 2002 was equal to nearly 13 percent of the country's total final energy consumption.

While the use of wood as a fire fuel in the traditional form is not likely to increase, there are prospects for a better utilization of forest output for energy purposes. Better forest practices, reforestation, planting of deserted or marginal land could make a contribution, be it relatively small, to the further development of this sector. Moreover, as burning wood in the traditional way is quite polluting, there will be pressures for switching to other cleaner sources of energy, which would release fuel wood resources. This however, will be a slow process.

As far as exploitation of the residues of field crops, fruit tree plantations and livestock activities are concerned, there should be a significant potential for their collection and utilization, along with waste (incl. manures from intensive farms). This could be done through incineration or anaerobic digestion technologies. Special studies and surveys will have to be carried out to determine location, logistics, size of units, economics and viability. One study suggests the technical potential of biomass in FYR Macedonia is estimated at 3,361 GWh (Colovic, 2008).

<b>Biomass resource type</b>	<b>Total production</b>	<b>Production density</b>
<b>Percent of total land area covered by</b>		
Forests	29%	
Shrublands, savanna, and grasslands	0%	
Cropland and crop/natural vegetation mosaic	68%	
Urban and built-up areas	0%	
Sparse or barren vegetation; snow and ice	0%	
Wetlands and water bodies	2%	
<b>Primary crop production, tonne</b>	(avg. 1999-2001, tonne)	(tonne /1000 Ha)
Total primary crops (rank among COO)	2,354,688 (27)	926 (18)
Top 10 primary crops		
Alfalfa for Forage & Silage	413,000	162
Wheat	307,606	121
Grapes	241,400	95
Potatoes	168,333	66
Maize	148,510	58
Tomatoes	129,800	51
Watermelons	120,000	47
Barley	109,167	43
Chillies & Peppers, Green	109,000	43
Cabbages	71,733	28
<b>Animal units, number</b>	(number)	(number / 1000 Ha)
Cattle	285,000	112
Poultry	3,344,000	1,315
Pigs	198,420	78
Equivalent animal units	397,808	156
<b>Annual roundwood production</b>	(1996-98, 000 m <sup>3</sup> )	(m <sup>3</sup> / Ha)
Total	774	304.4
Fuel	616	242.2
Industrial	158	62.1
Wood-based panels	2	0.8
	(1996-98, 000 metric tons)	(metric tons / Ha)
Paper and paperboard	15	5.9
Recovered paper	2	0.8

### FYR Macedonia Biomass Resource Data

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## 5. Solar

Solar radiation in FYR Macedonia as well as in Serbia, Slovenia, Croatia and Bosnia/Herzegovina are amongst the highest in Europe. Macedonia has a potential to produce 10 GWh of solar energy per year (Colovic, 2008).

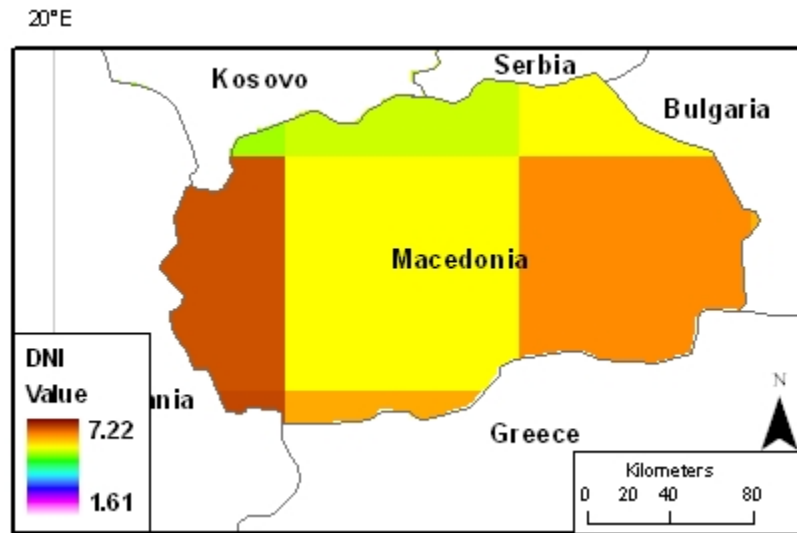
The most favorable areas record a large number of sunshine hours. The yearly ratio of actual irradiation to the total possible irradiation reaches approximately 50 percent for former Yugoslavia as a whole. This ratio is approximately 45 percent for the mountainous central regions due to the prevailing weather pattern.

The primary form of solar energy and technology used are flat plate collectors for heating houses and some commercial and public premises. But their contribution to the total energy consumption is insignificant (less than 1 percent). Additionally, it is not expected that this figure will increase substantially in the near future, as new consumption could mainly come from new entrants to the market i.e. of new buildings or installations.

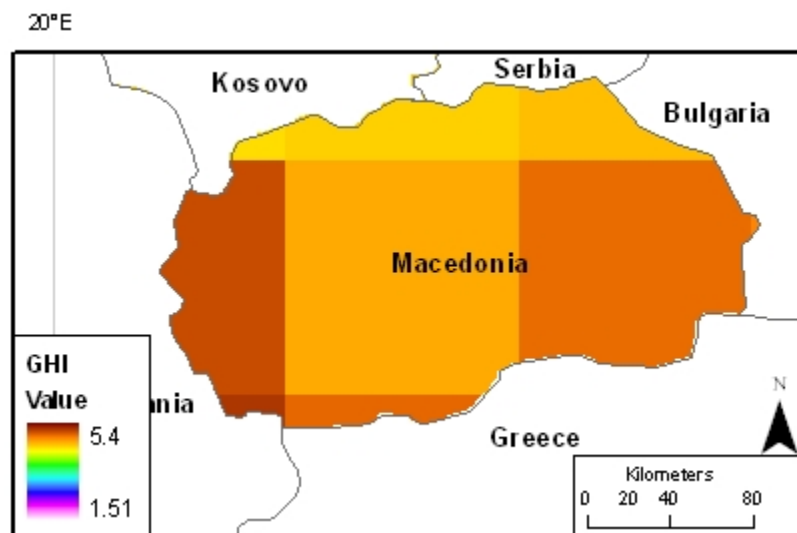
Likewise, electricity production from solar photovoltaic sources will be restricted to research or remote locations, primarily for telecommunications. This is due to the difficult economics for photovoltaics.

The following figures display the direct normal and global horizontal irradiation values for FYR Macedonia. Macedonia has great solar resource in the western portion of the country. The rest of the country could also be well suited for utilizing solar potential.

### Direct Normal Irradiation Values



### Global Horizontal Irradiation Values



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## 6. Geothermal

The country contains six geotectonic zones: the Cukali-Krasta zone, the West Macedonian zone, the Pelagonian horst anticlinorium, the Vardarian zone, the Serbo-Macedonian massif, and the Kraisthride zone. Geothermal manifestations are mainly connected to the Vardarian zone where the earth's crust is about 32 km.

FYR Macedonia derives useful energy in the form of heat from its geothermal wells. At present its geothermal water is used for heating greenhouses, residential houses, swimming pools and in balneology. No electricity is produced from geothermal

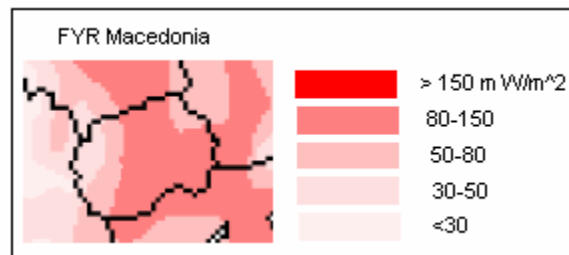
energy. As of 2005, Macedonia had an installed capacity of 62.3 MWt producing 599 TJ/yr or 166 GWh/yr.

From 2000-2005 the geothermal development in the country was stagnant. During this time period, there were no new investments in exploration or project development.

The main geothermal systems are located in the East and North East of the country (see map below) in the crystalline rocks of Macedonian-Serbian massive. The systems are characterized by low TDS and low corrosion activity. There are 18 different geothermal fields in the country. A number of geothermal areas composed of separate fields have been identified with more than 50 prospecting and operating wells with a depth from 40 to 2,100 m at temperatures of 20-79 °C.

The following figure displays the geothermal heat flux for the FYR Macedonia. A medium heat flux is present throughout the country.

**Heat Flux of the FYR Macedonia**  
Source: Energie-Atlas GmbH



FYR Macedonia's geothermal development objectives for 2010 are:

- The reconstruction, modernization, and optimization of existing projects;
- The addition of new industrial and residential projects in the Kochani geothermal system;
- Connecting additional hotels to the Bansko heating system; and
- Completing the water center at Negorci and the medical center in the Katlanovo Spa (Popovski, 2005).

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## 7. Hydroelectric

There are seven large hydro plants in Macedonia with a combined capacity of 530 MW, and a number of small hydro plants with total capacity around 90 MW (UDI, 2009).

FYR Macedonia is divided into 3 separate drainage units/areas which are identified by their major rivers:

- The Vardar River water basin/drainage area of 20.535 km<sup>2</sup>

- The Crni Drim River drainage area of 3.350 km<sup>2</sup>; and
- The Strumica River drainage area of 1.535 km<sup>2</sup>

The possibility for the theoretical production of hydro-potential into electric energy is estimated to be much higher than its yearly exploitation. The total hydroelectric potential in Macedonia, which is technically suitable for exploration, is 6,436 GWh/year. Over 400 potential sites exist specifically for small hydro plants (45 kW to 5000 kW); small hydro has a potential capacity of 225 MW (Colovic, 2008). Only 24 percent of waterpower resources are utilized in the existing hydropower plants.

To meet growing demand and partly substitute imports over the long term, 2020, the country is planning new capacity including over 630 MW of new hydro power plants. Plans have also been developed to rehabilitate existing hydropower plants.

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## 8. Relevant Links

Please see webpage for relevant links.

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## 9. References

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## 10. Country Contacts

Contacts made in the preparation of this assessment are gratefully thanked for their contribution to this report. Please see webpage for contacts listing.