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Elena Mirkovska

Solar energy: Impetus for the future development of the Macedonian economy

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List of abbreviations

CDM	Clean Development Mechanism
CEFTA	Central European Free Trade Agreement
CER	Certified Emission Reduction
EFTA	European Free Trade Agreement
ELEM	Macedonian Power Plants
EVN	Macedonian supply and distribution company
FDI	Foreign Direct Investments
FYROM	Former Yugoslav Republic of Macedonia
GDP	Gross Domestic Product
GHG	Greenhouse gases
GWh	Gigawatt hour
HPP	Hydropower plant
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
ktoe	Kilotonne of oil equivalent
kV	Kilovolts
MEPSO	Macedonian operator of the electricity transmission system
MtCO2 eq.	Million tons of CO2 equivalent
NATO	North Atlantic Treaty Organization
NPAA	National Programme for the Adoption of Acquis communautaire
PEP	Primary energy production
PV	Photovoltaic
RES	Renewable Energy Sources

SAA	Stabilization and Association Agreement
TFEC	Total final energy consumption
TPEC	Total primary energy consumption
UN	United Nations Organization
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
WTO	World Trade Organization

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”We are like tenant farmers chopping down the fence around our house for fuel when we should be using Nature›s inexhaustible sources of energy — sun, wind and tide. ... I‘d put my money on the sun and solar energy. What a source of power! I hope we don‘t have to wait until oil and coal run out before we tackle that.”

Thomas Edison (1847-1931)
Inventor

1. Introduction

The sun has unique powers. It is a star in the middle of the solar system, round which the Earth orbits. The sun is crucial for the Earth, especially in the process of photosynthesis which is vital for all aerobic life. This star was subjected to great transformation in its importance: Once being a god in the ancient civilizations, today the sun is even considered as a threat to the Earth's communications, navigation in the air traffic and the functioning of the satellites. The threat caused by the solar storms is expected to reach its peak in 2013 that could have devastating impact on the Earth's sensitive infrastructure[1]. On the other hand, the sun's power is perceived as new source of energy, as a good alternative for the limited natural resources of oil and coal, which the human extracts to a great extent.

Why the world is slowly turning its attention to the sun and other renewable energy sources? Two reasons contributed to this shift: climate change and natural disasters that humans cannot control or stop. The climate change can have adverse effect on water resources, eco systems, food security and human health. The Intergovernmental Panel on Climate Change (IPCC) target is to limit the raising global average temperatures and to reduce the greenhouse gases (GHG) emissions. This is where the renewable energy sources (RES) come into the game. They can contribute positively to providing low carbon technologies, and most importantly, secure energy supply.[2]

On the other hand, the last natural disaster in Japan had catastrophic impact on this country and re-opened the debate whether the nuclear power plants still represent secure and reliable source of energy

1 Guardian "Solar storms could create $2tn 'global Katrina', warns chief scientist" dated 21.02.2011, online newspaper edition.

2 Intergovernmental Panel on Climate Change, Special report on renewable energy sources and climate change mitigation, 2011.

supply. After this unfortunate event, the renewable energy gained on importance. One possible indicator for the future trend in Europe in this regard is the announcement of the Federal Chancellor Angela Merkel that Germany, the main driving force of the European economy, plans to close down all nuclear power plants in the country by 2022. The new German energy concept encompasses promotion of the RES and increasing their share in the energy production.[3]

The solar energy, the subject of this paper, has become attractive business in the last decade and its progress has been impressive. The total installed photovoltaic (PV) capacity in the world has increased from 1.5 GW in 2000 to 39.5 GW in 2010 with a yearly growth rate of 40 per cent. This tremendous development is a result from the decreasing prices, support from the policy makers via feed-in tariffs and subsidies, and increased competition. It can be expected that this energy sector will certainly develop with a higher pace in the next decades, since the solar innovations and big projects can contribute to widening the market's dimensions.[4] Most innovations are present in the field of transport. We now have the first solar-powered airplane[5] and a solar boat[6] both pointing at the under-exploited potential of the solar energy. On the other hand, the resource-scarce Europe launched the huge project "Desertec" in the Sahara desert – a great location for solar energy production. The first solar-generated electricity from North Africa should be imported in nearly five years[7].

3 German Federal Government, "The way toward the energy of the future", press release dated 30.05.2011.

4 European Photovoltaic Industrial Association EPIA, Global Market Outlook for Photovoltaics until 2015, May 2011.

5 EurActiv.com, Special report: Solar plane is European 'dream bird' dated 24.05.2011, online edition.

6 Guardian, "Solar-powered boat Türanor raises hopes of a sun-fuelled future" dated 01.04.2010 online newspaper edition.

7 EurActiv.com, "EU sees solar power imported from Sahara in five years" dated 23.05.2011, online edition.

Looking at the world's trends the question arises: What is happening in the Republic of Macedonia with the solar energy sector? Although this country possesses natural solar potential with 270 sunny days during the year, the solar energy sector remains undeveloped - its role is symbolic because the energy supply is based on the domestic lignite, hydro potential, and on imported liquid fuels and natural gas. Considering the low status of this sector, this paper aims to clarify the question what legal and market conditions are necessary for making the solar energy attractive business in the Republic of Macedonia and what obstacles need to be removed for achieving the necessary breakthrough? And the other way round, can a possible progress in the solar energy sector boost the performance of the Macedonian economy? The European Union as an external factor plays significant role in the promotion of the RES. The analysis will also be focused on the relations between the European Union and the Republic of Macedonia, since this country has candidate status for EU membership. The country is obliged to align the national legislation on the internal electricity and gas markets and RES in order to gradually liberalize the energy market. The energy market liberalization can give the solar energy a chance for prospect because the RES share on the market should be increased, causing simultaneously a change in the national policy-making processes, but can also create obstacles for its development. The paper will also depict the solar energy as environmentally friendly perspective for reducing the CO_2 emissions in the energy sector, which is the greatest pollutant in the country.

The structure of the thesis is organized in several sections. The first two sections give an overview on the Macedonian political and economic system and provide introduction in the national energy market. What follows afterwards is an in-depth analysis of the legal framework, including the country's obligations under the Kyoto Protocol, and the economic opportunities for future progress of the solar energy sector, studying at the same time its effect on the overall Macedonian

economy. The paper will be concluded with the main findings of the research.

2. Profile of the Republic of Macedonia[8]

The Republic of Macedonia is situated in the central part of the Balkan Peninsula in Southeastern Europe covering an area of 25.713 km square kilometers. The country has five neighbors: Serbia and Kosovo in the North, Bulgaria in the East, Albania in the West and Greece in the South (figure on the next page). It is a landlocked country, characterized by high and large mountain massifs, plains and valleys formed along the Vardar River. The climate varies from continental to Mediterranean[9]. The capital city of the Republic of Macedonia is Skopje and the official language is the Macedonian language. According to the data of the last census[10], held in 2002, 2.022.547[11] citizens live in Macedonia. The Republic of Macedonia declared its independence[12] on 8th September 1991 and the Constitution[13] was adopted on 17th November 1991.

8 Note of the author: the thesis encompasses the English version of all Macedonian documents necessary for the research. Where no such option existed I personally translated the documents in English which are designated with the term “own translation”.

9 Ministry of environment and physical planning, Second National Communication on Climate Change, December 2008, page 23-24.

10 The next census will be held from 01.10 to 15.10. 2011.

11 State Statistical Office, Census of population, households and dwellings in the Republic of Macedonia, 2002 – Book XIII, page 20.

12 This year the Republic of Macedonia celebrates 20 years independence.

13 Assembly of the Republic of Macedonia, Decision on Proclaiming the Constitution of the Republic of Macedonia No. 08-4642/1 dated 17.11.1991, Skopje, own translation.

The national flag[14] consists of yellow sun with eight rays on a red background. This country was admitted in the United Nations (UN) on 8th April 1993 under the provisional name “the Former Yugoslav

14 The national flag was changed as a result of the name dispute with Greece. The first national flag had a sun with 16 rays, known as “The Sun of Kutlesh” or “The Sun of Vergina” which represents the symbol of the Macedonian ancient army and royal dynasty. The most famous representative of the dynasty is the Alexander III Macedonian.

Republic of Macedonia" (FYROM)[15] due to the name dispute with Greece. Both countries negotiate to resolve this issue under the auspice of the UN, but no solution has been found until the present day. The name dispute has great influence, and causes obstacles as well, on the Macedonian aspirations for EU and NATO membership since Greece is member in both organizations. The EU and the Republic of Macedonia signed the Stabilization and Association Agreement (SAA)[16] in 2001 and the country received status of candidate country[17] in 2005, but the negotiations for membership have not begun yet. This country should have also become NATO member in 2008 during the Bucharest Summit, but Greece vetoed the admission and violated the Interim Accord[18] of 1995 between Greece and the Republic of Macedonia. As a result, the Republic of Macedonia initiated legal proceedings against Greece in the International Court of Justice (ICJ) in The Hague. The ICJ ruled on 5th December 2011 that Greece breached its obligations under the Interim Accord by objecting the admission of the Republic of Macedonia to NATO[19].

Concerning the economic characteristics of the country, the Republic of Macedonia is an open market economy based on the principles of competitiveness and high-qualified labour force. The objectives of the Macedonian economy are to achieve sustainable development,

15 UN General Assembly Resolution A/RES/47/225 dated 08.04.1993.
16 Stabilisation and Association Agreement between the European Communities and their Member States, of the one part, and the former Yugoslav Republic of Macedonia, of the other part, Council of the European Union 6726/01 Brussels 26 March 2001.
17 Council of the European Union, Presidency Conclusions of the Brussels European Council 15/16 December 2005, paragraph 24.
18 Interim Accord No. 32193 between Greece and the Former Yugoslav Republic of Macedonia signed at New York on 13 September 1995.
19 International Court of Justice, Case The Former Yugoslav Republic of Macedonia v. Greece: Application of the Interim Accord of 13 September 1995, paragraphs 81-83, 101, 103, 113 dated 05.12.2011 http://www.icj-cij.org/docket/files/142/16827.pdf

increase competitiveness, attract domestic and foreign investments, increase living standard and decrease the unemployment rate. In 2007 and 2008 the Republic of Macedonia realized growth rates of 6% and 5% respectively, but this progress in 2009 was slowed down because of the financial crises (Table 2.1). In 2011[20], it is expected the crises to be overcome with GDP growth of 3.5% and 2% inflation, and it is estimated that the Macedonian economy will be back on track with growth rates of 5% by 2013. The unemployment rate is a chronic problem of the Macedonian economy accounting for 32 %[21]. More detailed information and economic projections can be found in Annex 1.

Table 2.1 Economic indicator for the Macedonian economy

	2007	**2008**	**2009**	**2010**
Real GDP growth rate (%)	6.1	5.0	- 0.9	0.7
Inflation, average (%)	2.3	8.3	- 0.8	1.6
Unemployment rate (%)	34.9	33.8	32.2	32.0
FDI (in million EUR)	506	400	145	221
Current Account deficit (in % of GDP)	- 7.1	- 12.8	- 6.7	- 2.8

Source: Ministry of Finance of the Republic of Macedonia

20 According to the estimated data by the State Statistical Office, the growth rate of GDP in the first quarter of 2011 was 5.1%; State Statistical Office, News release no. 3.1.11.04: Gross Domestic Product, first quarter of 2011 dated 24.06.2011.

21 Ministry of Finance of the Republic of Macedonia, Basic macroeconomic indicators and projections.

Regarding the field of trade, the Republic of Macedonia joined the World Trade Organization (WTO) in April 2003[22]. This country has duty-free access to the EU market as a result of the Stabilization and Association Agreement. It has signed Free Trade Agreements with the Balkan countries within Central European Free Trade Agreement (CEFTA)[23], Turkey, Ukraine and European Free Trade Association (EFTA) countries.

3. Overview on the Macedonian energy market and solar energy sector

3.1 Importance of energy for economic development

The energy is the basic input in all economic activities and is an integral part and key condition for sustainable development. The sustainable development is defined as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs[24]". The energy maintains the current living standard and material progress by providing the basic human needs: electricity and heating. Additionally, the electricity is especially important because it drives the automated and computerized production systems. The energy that is transformed for the needs of the economy comes basically from two sources: renewable (forests, fish) and exhaustible sources (oil, coal, copper).

22 More details on http://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm
23 CEFTA was signed in 2006 under the auspices of the Stability Pact for South Eastern Europe.
24 World Commission on Environment and Development (WCED), Our Common Future, A/42/427 dated 04.08.1987, paragraph 49, page 51.

The landmark research concerning the positive link between energy and broader economic development was conducted in 1984 by Sam Schurr. He postulates the interaction between developments in energy supply and use, on one hand, and technological progress on the other. He claimed that "energy was not only cheap and abundantly available but increasingly in forms (i.e. electricity and fluid fuels) that were unusually flexible in their use compared to the solid fuels that had previously dominated energy supply. These characteristics of energy supply – low cost, abundance and enhanced flexibility in use – provided a rich soil for the discovery, development and use of new processes, new equipment, new systems of production and new industrial locations"[25]. Moreover, changes in the quality of energy services are crucial element of broader economic productivity, apart from the physical availability of energy per se.

The linkage between the energy and economic activity changes as the economy moves through different stages of development. Commercial fossil fuels and ultimately electricity become predominant in the most advanced stages of industrialization and development. Changes in relative opportunity costs, as well as incomes, can move households and other energy users up and down the "energy ladder" for different energy-related services[26]. Energy is not the only factor, however, that enhances development. Development involves a number of other elements, such as evolution of education (investment in human capital) and labor markets, physical capital (the stock of equipment and structures that are used to produce goods and services), financial

25 Sam H. Schurr, "Energy use, technological change and productive efficiency: an economic-historical interpretation", Annual Reviews Energy 1984.9 409-425, page 145.

26 Michael A. Toman and Barbora Jemelkova, "Energy and economic development: an assessment of the state of knowledge", Energy Journal Vol. 24 no. 4 in 2003, page 95-96.

institutions to support capital investments, and the application of technological knowledge. Advanced industrialized societies use more energy per unit of economic output and far more energy per capita than poorer societies. For example, the OECD, which represents about one-fifth of the world's population, accounts for over half of the global energy consumption. The same energy pattern can also be expected for the developing countries as their incomes advance. As the energy requirements of the developing countries expands, there will be increasing pressure to expand existing resource bases and increase the efficiency of end-users in order to maintain relatively cheap fossil fuels[27].

3.2 Macedonian energy market

3.2.1 Key features of the energy sector

The energy sector faces several problems in its functioning that in return cause negative economic implications for the future development: (i) energy deficiency; (ii) long term depressed energy prices, especially electricity prices, and lack of stimuli to save energy; (iii) obsolete technologies and lack of investments for maintenance, modernization and expansion of the existing capacities, as well as construction of new capacities; (iv) unfavorable industrial infrastructure which determines high energy intensity; (v) high electricity losses (both technical and commercial); (vi) low energy efficiency and (vii) incomplete harmonization with the European standards with respect to price policies, environment etc.[28]

27 Kenneth B. Medlock & Ronald Soligo, Economic development and end-use energy demand, Energy Journal Vol. 22 no. 2 in 2001.

28 Ministry of Economy, Strategy for energy development in the Republic of Macedonia until 2030, Skopje 2010, page 19.

The energy deficiency is crucial issue in the performance of the energy sector, because the country cannot satisfy the energy demand from the domestic energy resources, and as a result the necessary energy must be imported. The Republic of Macedonia became strongly dependent on the energy import[29], because it does not possess oil and natural gas deposits. The prices of these energy sources show great volatility on the world market, which have effect on the Macedonian trade deficit and could also have an impact on the inflation in the country. One way to alleviate these negative effects is to increase the national energy mix, that is, to diversify the energy sector, to increase the domestic production and to invest in new energy capacities. More energy sources would also mean more competition, not just on the market, but also in prices. The Republic of Macedonia should also connect to different gas and oil pipe lines that are planned in its neighborhood – for this purpose the diplomatic and lobbying activities should be intensified. The third option is to invest more in the hydro energy sector because the hydro potential in the country is not completely utilized.

The price is the second most sensitive issue because it is regulated at low level with the aim to protect the living standards of the citizens. This mechanism of low-regulated price has been practiced for 20 years and is inherited from the socialism. The long term trend caused low investments, which also means no modernization of the grid, and no timely revitalization of the power plants that influences their proper

29 To illustrate the country's energy dependency, the Macedonian government declared energy crises by imposing energy restrictions and export ban from 13-29.02.2012, as Serbia and Bulgaria introduced the same measures because of the harsh winter conditions and their inability to satisfy the domestic energy demand. The final result was: no street lighting (saved 6.000 MWh) and additional import of expensive electricity. Source: Government of the Republic of Macedonia, Public Announcement: The Government decided to restrict the electricity export, dated 12.02.2012 (own translation) http://vlada.mk/node/1835.

functioning. The Republic of Macedonia has to give up the habit to regulate the price because in 2015 the energy market liberalization takes place. It means that the market will dictate the price which will certainly have impact on the citizens with low income, who could not afford higher energy price. All the issues mentioned in this part will be analyzed more closely in section 5 that deals with the economic analysis.

3.2.2 Electrical and power system and institutional framework

Three energy companies operate with the electrical and power system. AD ELEM (Macedonian Power Plants)[30] is state-owned company and is responsible for electricity production from the thermo and hydro power plants. In 2010[31] the total production amounts 6.462,3 GWh - the thermal power plants account for 82% (4.277, 4 GWh) and the share of the hydro power plants is 18% (2.184, 8 GWh). AD MEPSO (Macedonian operator of the electricity transmission system)[32] is also a state-owned company and main transmission system operator. Its main responsibility is the electricity transmission through the high voltage network[33] to the large industrial customers and to the low voltage grid of EVN Macedonia. EVN Macedonia[34] is part of the Austrian EVN AG. In 2006 EVN AG bought 90% of the former state energy company AD ESM – 10% remains in state ownership. The main activity of the company is electricity distribution and supply for approximately 800.000 customers in the whole state. EVN Macedonia

30 http://www.elem.com.mk/en/ElemToday.asp

31 AD ELEM, Annual Report for the production, realized import and marketed surpluses of electricity for the year 2010, published in February 2011 in Skopje; page 9, own translation.

32 http://www.mepso.com.mk/en-us/Default.aspx

33 High voltage grid consists of 400kV, 220kV and 110kV lines and the low voltage grid of 35kV, 20kV, 10 kV and 0.4kV.

34 http://www.evn.com.mk/de/evnmazedonien/istorijat.asp

also possesses 11 hydro power plants with annual production of 150 GWh.

On the other hand, three state institutions are responsible for the monitoring and smooth operation of the energy sector: Energy Department as part of the Ministry of Economy, the Energy Agency of the Republic of Macedonia and the Energy Regulatory Commission. The Ministry of Economy[35] is the competent institution for the energy market, especially the Energy Department as internal unit within the organizational structure of the Ministry. The main tasks of the Energy Department are linked with the planning and development of national legislation and the implementation of the national energy policy. The Energy Agency of the Republic of Macedonia[36] is founded in 2005 and provides support in the implementation of the energy policy. It prepares energy strategies, develops plans and programs,with particular emphasis on energy efficiency (EE) and renewable energy sources (RES). The last actor in the institutional framework, the Energy Regulatory Commission[37], represents independent body whose main competences are to ensure safe, secure, continuous and quality energy supply to the final consumers, to protect the environment, nature and the consumers and to promote competitive energy market based upon the principles of objectivity, transparency and non-discrimination.

35 http://www.economy.gov.mk/Home?lang=2

36 Law on Establishing the Energy Agency of the Republic of Macedonia, Official Gazette of the Republic of Macedonia no. 62/05 dated 28.07.2005, page 78, own translation.

37 http://www.erc.org.mk/DefaultEn.asp#

3.2.3 Energy resources, consumption and future trends

With the aim to depict better the basic energy indicators and future trends in the energy sector I will use information from the “Strategy for energy development in the Republic of Macedonia until 2030” that is prepared by the Macedonian Academy of Sciences and Arts, and adopted by the Ministry of Economy as a national strategy. The newest status on the energy production and import shall be illustrated with the information published by AD ELEM.

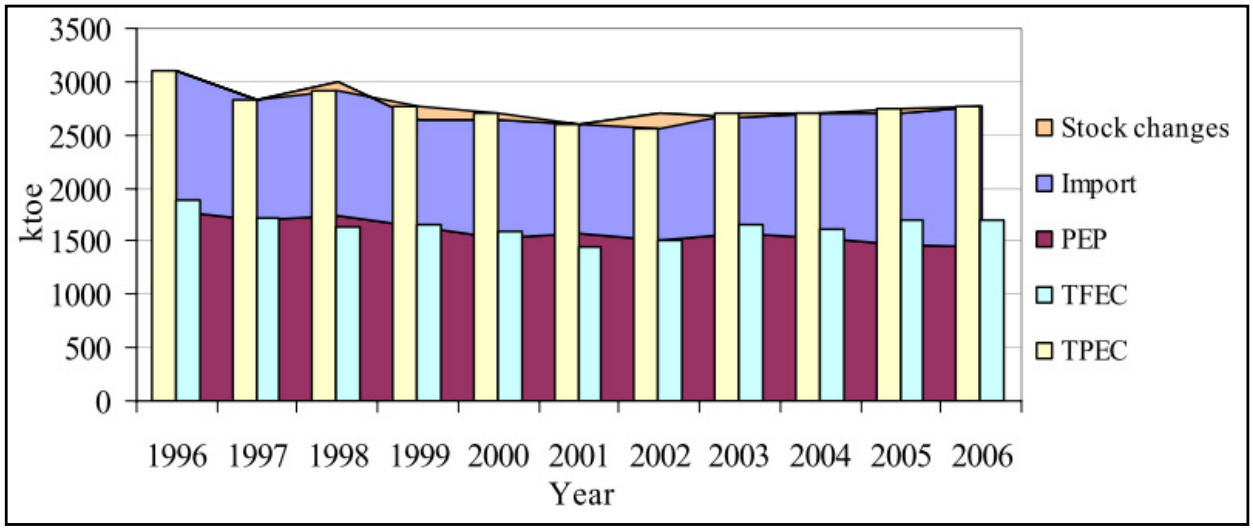
The geography of a country determines which energy sources will be utilized. The Republic of Macedonia has excellent strategic position, but the oil and natural gas pipelines do not cross the country. This fact indicates that the so-called “energy diplomacy” must be strengthened for attracting foreign investments. Accordingly, the main domestic sources for energy production are coal (lignite), the hydro power and biomass, as well as, geothermal power, solar and wind energy, but to smaller extent[38]. Graphic 3.2.3.1 gives an overview on the total primary energy consumption (TPEC), total final energy consumption[39] (TFEC), the energy production, as well as, the net imports from 1996 to 2006. The energy consumption has not changed over the years, but shows upward and downward fluctuations. The energy sector demonstrates low efficiency concerning the energy transformation and transmission of energy to the end users. The TPEC/TFEC ratio ranges from 55% to 62% which is below the level of the European OECD countries, where 72% of the total primary energy consumption are transformed into final energy. The imports from 1999 have grown from 37% to 48% that clearly shows the energy dependence of the country. It is a net

38 Ministry of Economy, Strategy for energy development in the Republic of Macedonia until 2030, Skopje 2010, page 47-48.

39 Final energy consumption represents the part of the primary input energy that serves as final energy in different sectors after it is subjected to transformations with the help of adequate energy technologies.

importer of oil, petroleum products, natural gas and electricity (since 2000) mainly from Serbia and Bulgaria and at the same time has net export to Greece[40].

Graphic 3.2.3.1 Total primary and final energy consumption (TPEC and TFEC), primary energy production (PEp), net imports and change in the domestic reserves during the period 1996-2006

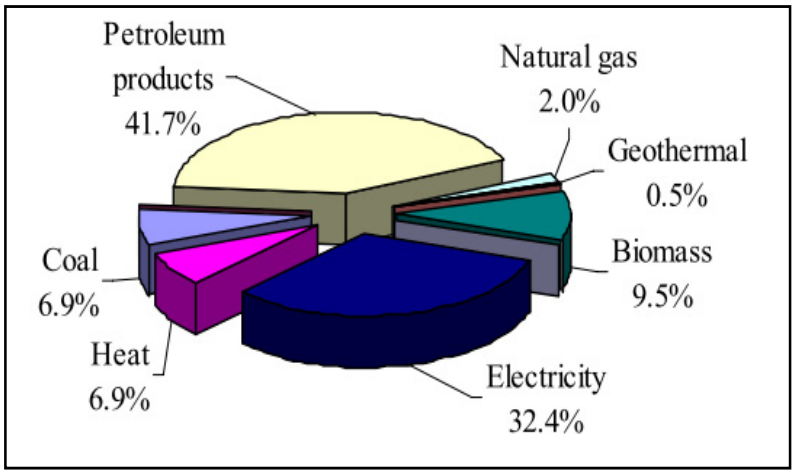


Source: Strategy for energy development in the Republic of Macedonia until 2030.

Looking at the share of the different fuels in the final energy consumption for the year 2006, it can be noted that the petroleum products and the electricity have the biggest share accounting for 41.7% and 32.4% respectively (see graphic 3.2.3.2). These are followed by biomass (9.5%), heat and coal with (6.9%), natural gas (2.0%) and geothermal energy (0.5%).

40 Pöyry and Nord Pool Consulting, "South East Europe: Wholesale Market Opening", final report April 2010, page 57.

Graphic 3.2.3.2 Share of different fuels in the final energy consumption in 2006

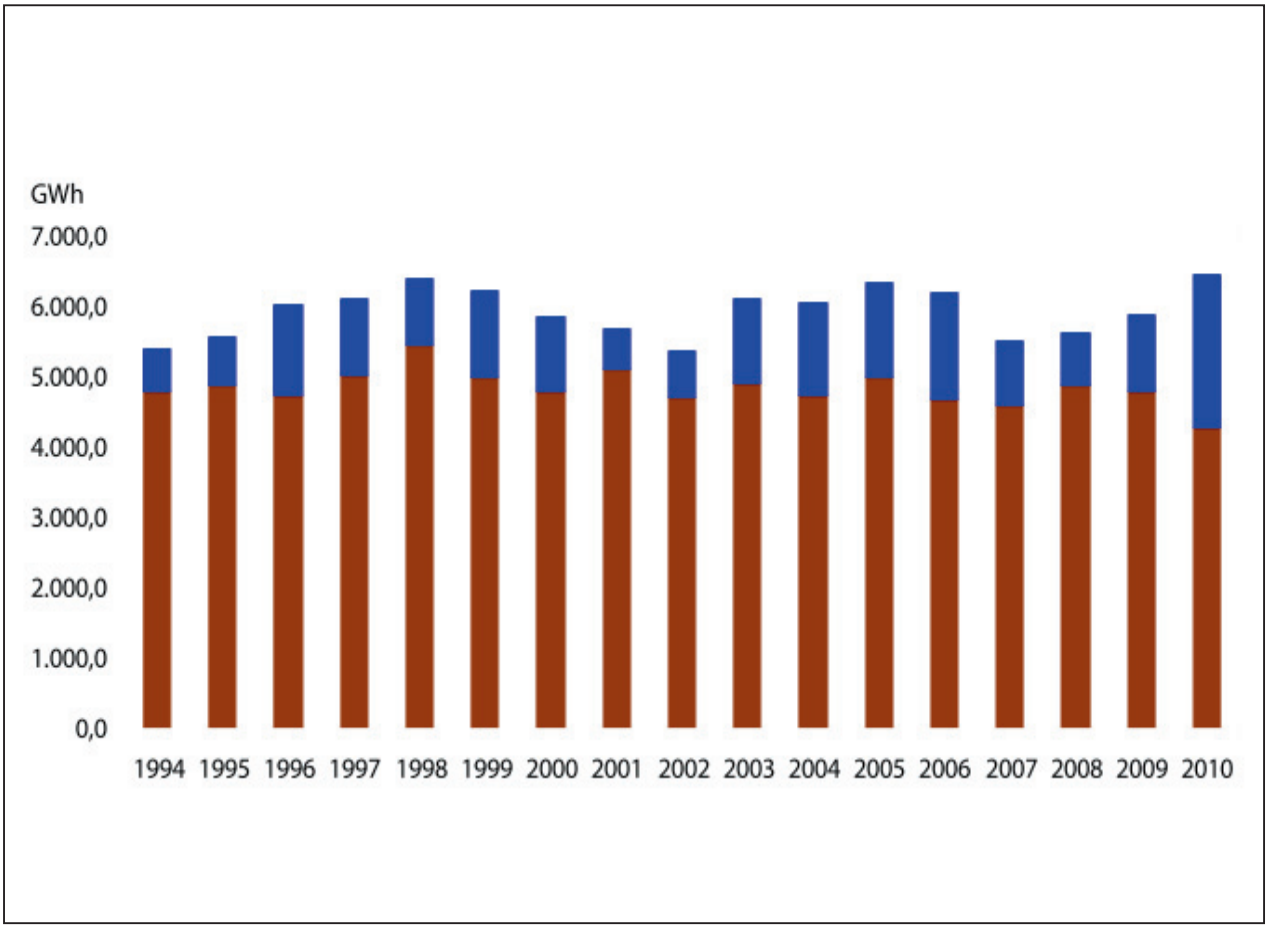


Source: Strategy for energy development in the Republic of Macedonia until 2030

The domestic electricity production originates from the thermal and hydro power plants. The intensity of exploitation between these sources is coordinated regarding the favorable or unfavorable weather conditions. Graphic 3.2.3.3 illustrates the annual domestic production from 1994 to 2010 and the shares of the thermal and hydro power in this regard. The production fluctuates over the years and shows upward trend in the last three years. The highest values are noted in 1998 (6.400 GWh) and 2010 (6.462 GWh). In 2010 the hydro power plants reached their highest performance compared to other years, which in return had two positive effects: firstly, 961.000 t of coal is saved and secondly, the import was reduced by 35.2% (savings in value of 13 million euro)[41].

41 AD ELEM, Annual Report for the production, realized import and marketed surpluses of electricity for the year 2010, published in February 2011 in Skopje, page 9, 29-30, own translation.

Graphic 3.2.3.3 Annual domestic electricity production 1994-2010

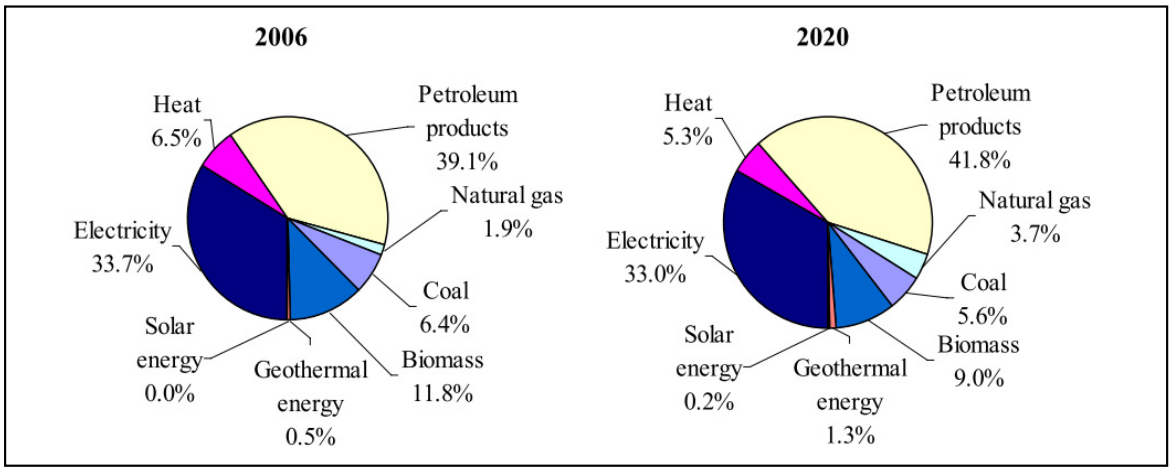


Source: AD Elem (red = Thermal; blue = Hydro)

How the energy demand and the national energy mix will develop in future? The Strategy for energy development forecasts that until 2020 the annual final energy demand will increase by 2.6%. The solar energy will have the highest growth rate of around 14.5%, followed by the natural gas with 7.8%, geothermal energy with 9.7% and petroleum products and bio fuels combined with 3.1%. The growth rate of the electricity is 2.5%. The lowest growth rates are forecasted

for coal 1.6%, heat 1.2% and biomass for combustion 0.7%.[42] For better understanding the evolution in the share of fuels in the final energy consumption by 2020, it is worth looking at the graphic 3.2.3.4 which compares the foreseen changes in this regard. The petroleum products will further increase their share accounting for around 42%, while the electricity will have a bit lower share. The biomass and the coal and heat will reduce their share by 2% and 1% respectively. On the other hand, the share of natural gas, geothermal and solar energy will increase in future.

Graphic 3.2.3.4 Distribution of the final energy demand according to the share of fuel



Source: Strategy for the energy development of the Republic of Macedonia until 2030

42 Ministry of Economy, Strategy for energy development in the Republic of Macedonia until 2030, Skopje 2010, page 102.

3.3 Solar energy sector

After presenting the main indicators and conditions related to the energy and power system, I will now discuss the main features of the solar energy, under which circumstances this energy sector develops in the Republic of Macedonia and the forecasts for its future prospect. The solar energy is a renewable energy source. What does the term "renewable" mean? The IPCC provides the following definition:

*"Renewable energy is obtained from the **continuing or repetitive flows of energy occurring in the natural environment** and includes resources such as biomass, solar energy, geothermal heat, hydropower, tide and waves, ocean thermal energy and wind energy[43]."*

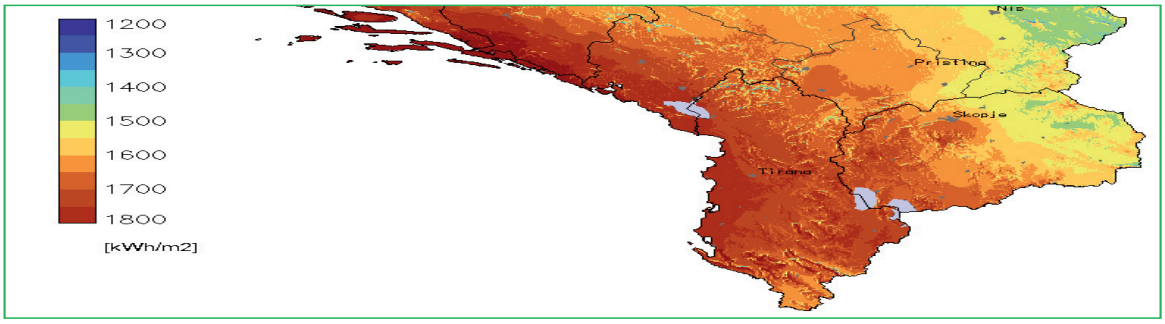
According to the intensity and durability of solar radiation, geographical position and climate (hot and dry summer) there is a great potential in the Republic of Macedonia for utilizing this kind of energy. The annual sum of insolation ranges from 2.200 to 2.400 hours[44] and the total solar radiation varies from 1250 kWh/m^2 in the northern part to 1530 kWh/m^2 in the southwestern part of the country (figure 3.2.1). The annual daily average radiation varies between 3.4 kWh/m^2 and 4.2 kWh/m^2.[45]

43 Intergovernmental Panel on Climate Change (IPCC), Special report on renewable energy sources and climate change mitigation 2011, page 11.

44 Ministry of Environment and Physical Planning of the Republic of Macedonia, Second National Communication on Climate Change, December 2008, Skopje, page 47.

45 Ministry of Economy, Strategy for using the renewable energy sources in the Republic of Macedonia until 2020, Skopje 2010, page 46, own translation.

Figure 3.3.1 Yearly sum of global irradiation received by optimally-inclined PV modules



Source: Photovoltaic Geographical Information System (PVGIS)

The solar energy may be used in two ways: by direct change into electricity (photovoltaic cells) and for getting hot water (solar collectors). The use of hot water solar collectors is only in a symbolic form in the households. In 2006 the share of the solar energy in the total final energy consumption was 7.4 GWh (0.6 ktoe), that is, 0.04% due to the existence of 4.280 solar collectors. The hot water for sanitary purposes in almost all households and commercial objects is acquired by electricity, which is understandable because the electricity price is low. According to the financial evaluation, one average solar collector costs 700€. The electricity price for the households amounts 0.05 €/kWh, which means that annually 50€ could be saved and it takes 10 years to return the initial investment.[46] The introduction of a market price in 2015 is regarded as a chance for the solar collectors to gain on importance and attractiveness and simultaneously, as an opportunity to reduce the electricity overload in the power system. On the other hand, since 2007 the Government started to promote the use of solar thermal collector systems by subsidizing the first 500 buyers. The simulative measure is 30% of the investment, but no

46 Ministry of Economy, Strategy for using the renewable energy sources in the Republic of Macedonia until 2020, Skopje 2010 page 47, own translation.

more than 300 € per applicant[47]. The Strategy for using the renewable energy resources forecasts the use of solar collectors will expand in the next 10 to 20 years: until 2020, 55.000-80.000 installations are planned in the households (70.000-140.000 installations until 2030) and the total solar energy consumption would amount from 60-90 GWh until 2020, i.e. 83-155 GWh until 2030. There is also an interest in the Republic of Macedonia for building photovoltaic (PV) systems for energy production, the second option for utilizing the solar energy, but this business is not very developed. According to the statistics of the Energy Agency of the Republic of Macedonia, eight PV plants are registered as electricity producers from RES. Their total installed power is 1.468 kW with planned annual production of 2.016 MWh (Annex 2).

The Energy Regulatory Commission (ERC) adopted in 2008 high feed-in tariffs for the electricity produced from PV systems amounting 46 €cents/kWh (for PV systems below 50 kW) and 41 €cents/kWh (for PV systems exceeding 50 kW)[48]. The goal is to promote and develop the solar energy market and to make investments in this sector more attractive and profitable. The feed-in tariffs are now reduced and amount 30 €cents/kWh (≤ 50 kW) and 26 €cents/kWh (51 > 1000 kW)[49]. These incentives are promoted and find their support in the national legislation[50] (see section 4).

47 Government of the Republic of Macedonia, Pre-accession economic programme 2009-2011, January 2009, Skopje page 77.

48 Official Gazette of the Republic of Macedonia no. 112/08, dated 04.09.2008, page 49 -51, own translation.

49 Official Gazette of the Republic of Macedonia no. 44/2010, dated 31.03.2010, page 54, own translation.

50 Energy Law articles 149-154, Official Gazette of the Republic of Macedonia no.16/2011.

What effects causes the feed-in structure? The national energy network operator (MEPSO) is obliged to purchase the electricity produced from PV-systems[51] under the approved feed-in tariffs by the ERC, whose amount is at a higher rate than the retail price with the aim to allow the PV systems to overcome the price disadvantages. The feed-in tariffs are fixed and the eligible producers always get guaranteed price granted for a limited period of time (15 years), which in return increase the certainty for the investors and reduces market risks. In this context, the eligible producers will be willing to produce electricity from PV-systems until the marginal cost of production equalizes the feed-in tariff. The producers who have lower production costs than the proposed tariff will gain more profit. On the other hand, however, one of the problems with the investments in the PV systems is that the Republic of Macedonia does not produce and possess the required technology for that purpose. The supply of solar energy technologies is also limited, and as a result an interested customer cannot chose from wide range of products[52]. Additionally, the main setback of the solar energy is that it cannot continuously generate electricity, because the sun is not available 24 hours, that is, it suffers from the intermittency problem[53].

51 Ibid., article 153(1).

52 D. Mukherjee & S. Chakrabarti, Fundamentals of renewable energy systems, New Delhi 2004.

53 PV systems do not have technology to store power. On the other hand, the solar thermal power plants possess this potential. In the solar thermal power plants the sunlight is concentrated by mirrors and used to generate steam and drive a turbine that produces electricity. The concentrated solar power can be used to heat sodium chloride above its melting point. The liquid sodium chloride will keep most of its heat for up to seven hours. This means that a solar thermal power plant that uses this technology can provide electricity for at least seven hours after sunset. Source: Geoffrey Heal, The Economics of Renewable Energy, Working Paper 15801, p. 17.

It is foreseen that 10-30 MW PV systems with annual production from 14-42 GWh will be constructed until 2020 and the forecasts until 2030 indicate constructing 20-40 MW PV systems producing 28-56 GWh[54]. The share of the solar energy on the market will be increased by 14.5% until 2020, and if this sector is strengthened with energy efficiency measures, its growth rate would amount 17.8% (the highest growth rate compared to the other fuels)[55]. This goal can be reached if the market price in future is substantially higher than the current price and if some cheaper technologies will be available for utilizing the solar energy.

54 Ministry of Economy, Strategy for using the renewable energy sources in the Republic of Macedonia until 2020, Skopje 2010, page 87, own translation.

55 Ministry of Economy, Strategy for energy development in the Republic of Macedonia until 2030, Skopje 2010, page 102-105.

4. Legal framework

The EU plays an important role and influences the Macedonian legislation in the field of energy and RES policy. The Republic of Macedonia as candidate for EU membership must adopt the acquis communautaire, follow the changes in the EU legislation in this regard and prepare every year National Programme for the Adoption of the Acquis Communautaire (NPAA). The NPAA represents a key document for the integration process that depicts the dynamics of the alignment of the Macedonian legislation with the EU law and the adaptation of the national institutions to the European administrative structures. The Copenhagen and Madrid accession criteria[56] are always followed during the preparation of this programme.

Before analyzing the relations between the EU and the Republic of Macedonia and the legal basis for the solar energy sector, it is worth noting in which energy international organizations this country takes part and the obligations that derive from the memberships. The Republic of Macedonia signed the Energy Charter in 1996 and adopted the Treaty two years later[57]. The Charter sets the principles and multilateral framework underpinning the international energy cooperation, based on a shared interest in secure energy supply and sustainable economic development. This country also signed the

56 The Copenhagen membership criteria were adopted in 1993 as preparation for the EU enlargement to Central and Eastern European Countries. The candidate countries must achieve the political and economic objectives of the Union and implement the acquis communautaire. The Madrid accession criteria from 1995 require that the candidate country must have created the conditions for its integration through the adjustment of its administrative structures. It is emphasized that the European legislation should be implemented effectively through appropriate administrative and judicial structures in the candidate country.

57 http://www.encharter.org/index.php?id=303&L=title%3DGo#c931

Treaty establishing the Energy Community in 2005 aimed at the South Eastern European Countries. The goal is to guarantee stable and continuous energy supply, to enhance economic development and social stability. The Republic of Macedonia is also one of the founding members of the International Renewable Energy Agency (IRENA) established on 26.01.2009[58]. IRENA will promote the adoption and use of all the renewable energy and facilitate access to all technical and economic data, best practices and RES potential data. The country also adopted the Kyoto Protocol, which will be further presented in the second part of this section, with special attention to the potential of the solar energy for reducing the CO_2 emissions in the energy sector.

4.1 Relations between the EU and the Republic of Macedonia

The basis for the cooperation between the EU and the Republic of Macedonia in the field of energy can be found in Article 99 in the SAA. The cooperation is aimed at formulating and planning energy policy, modernizing the infrastructure, better access to the energy market, transfer of technology and know-how, promoting energy saving, energy efficiency, renewable energy and studying the environmental impact of energy production and consumption[59]. The Council of the European Union, on the other hand, sets the objectives in its Decision 2006/57/EC on the principles, priorities and conditions contained in the European Partnership with the Republic of Macedonia[60], with emphasis on:

58 IRENA: List of Members, signatories and applicants for membership as of 21.06.2011,http://www.irena.org/DocumentDownloads/Signatory/Signatory_States_2011.pdf

59 Stabilisation and Association Agreement Article 99(2).

60 Council Decision 2006/57/EC on the principles, priorities and conditions contained in the European Partnership with the Republic of Macedonia and repealing Decision 2004/518/EC dated 30.01.2006, page 6.

- aligning the legislation on the internal electricity and gas markets, energy efficiency and renewable energy sources with the acquis in order to gradually open the energy market to competition,
- strengthening the independence of the Energy Regulatory Commission,
- implementing the Energy Community Treaty,
- enhancing administrative capacity in all energy sectors.

The Republic of Macedonia signed in 2005 the Treaty establishing the Energy Community. The Energy Community is established between the European Union, on one hand, and the West Balkan countries, on the other hand[61]. The goal is to create stable regulatory and market framework capable of attracting investment in gas networks, power generation, and transmission and distribution networks, so that the access to a stable and continuous energy supply is enabled that is essential for economic development and social stability. Special attention is also paid to the improvement of the environment, fostering energy efficiency and the use of renewable energy, and to the conditions for energy trade in the single regulatory space[62]. The Republic of Macedonia must align its national legislation with the acquis communautaire on energy, environment, competition and renewable energy (Annex 3). The electricity and natural gas market liberalization that will occur in 2015 has its basis in (i) the Directive 2003/54/EC concerning common rules for the internal market in electricity[63], (ii) the Directive 2003/55/EC concerning common rules for

61 The other contracting parties are: Albania, Bosnia & Herzegovina, Croatia, Montenegro, Serbia and the United Nations Interim Administration Mission in Kosovo. The geographical scope was broadened: Moldova and Ukraine joined the Energy Community in 2010 and 2011 and Georgia, Norway and Turkey take part as observers.
62 Treaty establishing the Energy Community signed in Athens on 25.10.2005, article 2.
63 Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity, L176/37.

the internal market in natural gas[64], and (iii) the Regulation 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity[65].

Article 20 in the Treaty establishing the Energy Community relates to the European legislation that needs to be implemented in the field of renewable energy: (i) Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market[66] and (ii) Directive 2003/30/EC on the promotion of the use of bio fuels or other renewable fuels for transport[67]. The latest Directive 2009/28/EC[68] substitutes and amends the previous two directives. This Directive sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption until 2020 and for this purpose the member states must adopt national renewable energy action plan[69]. Following this pattern, the Republic of Macedonia adopted the “Strategy for using the renewable energy sources in the Republic of Macedonia until

64 Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas, L176/57.
65 Regulation 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity, L176/1.
66 Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market, L283/33.
67 Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of bio fuels or other renewable fuels for transport, L123/42.
68 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, L140/46.
69 Directive 2009/28/EC articles 1, 3(1)(2) and 4(1) and Annex I in the Directive.

2020", with the aim to determine the potential of RES in the country and increase their share in the final energy consumption through the national legislation and financial support. According to the basic calculations in the Directive, the Republic of Macedonia sets a target for increasing the share of RES to 21% until 2020. In 2005 the share of RES in the final energy consumption amounted 13.8%, which means that the Republic of Macedonia ranks highly among the countries with large RES utilization.

The acquis communautaire is transposed in the Macedonian national legislation via laws, rulebooks and different strategies and national plans. The main elements are consisted in the Energy Law, and all additional specific rules are narrowly regulated in different rulebooks (Annex 4). The Energy Law[70] rules that the Energy Agency issues guarantees of origin of electricity from RES and manages register of producers for that purpose. The electricity producers can acquire the status "eligible producers of electricity from RES" after fulfilling the conditions and obligations which enable them access to the feed-in tariffs. The feed-in tariffs fall under the competence of the ERC[71]. All these rules are also applied for the solar energy sector. An important regulation in this regard is the "Rulebook on the method and procedure for establishing and approving the use of feed-in tariffs for electricity produced from photovoltaic systems" (Official Gazette of the Republic of Macedonia no. 112/2008 and 44/2010) which was explained in section 3.2. Apart from granting subsidies for promoting the solar energy, the Government also reduced the value added tax (VAT) for solar collectors to 5 per cent[72]. Regarding the future activities in the energy sector, in the NPAA 2011 is planned the adoption of

70 Official Gazette of the Republic of Macedonia no. 63/2006, 36/2007, 106/2008 and 16/2011.

71 Energy Law no. 16/2011 articles 147, 149-154, own translation.

72 Official Gazette of the Republic of Macedonia no. 114/2007, Law on amending the Law on value added tax dated 21.09.2007.

several secondary legislative acts for improving the national legal framework in the field of RES. The Government will adopt Action Plan for the renewable energy sources due to the implementation of the "Strategy for using the renewable energy sources in the Republic of Macedonia until 2020" and "Decision on the annual share of bio fuels in the total quantity of transport fuels", and will amend the "Rulebook on the renewable energy sources"[73].

On the other hand, the European Commission presents annual reports on the progress the Republic of Macedonia is achieving[74], by analyzing the introduced reforms for fulfilling the Copenhagen criteria and implementing the acquis communautaire in the national legislation. The first report was issued in 2006 and the newest one is expected in November 2011. The progress is measured for all 33 chapters that constitute the key element in negotiation process for membership. In this regard, only the Energy Chapter will be analyzed. When comparing the reports of the European Commission in the last five years concerning the status of the energy sector, it can be concluded that the Republic of Macedonia has made some progress, but more remains to be done. The electricity prices still do not reflect the costs although they were increased for 10% in 2010 and bill collection rates are insufficient to secure the viability of the system. Good progress has been achieved concerning the internal energy market by postulating the legal basis for gradual opening of the energy market, fulfilling the obligations arising from the participation in the Energy Community. Since 2008 the field of renewable energy is moderately advancing by providing legal security in this regard

73 Government of the Republic of Macedonia, National Programme for the Adoption of the Acquis Communautaire: Revision 2011, Skopje 28.12.2010, page 169-170, own translation.

74 Council Decision 2006/57/EC on the principles, priorities and conditions contained in the European Partnership with the Republic of Macedonia and repealing Decision 2004/518/EC dated 30.01.2006 article 2.

and offering advantageous feed-in tariffs to the potential investors, but further efforts are needed to improve the share of renewable energy in final energy consumption. Special attention must be paid to strengthening the independence of the ERC for better regulation of the market and protection of the customers. The administrative capacity of the Energy Department within the Ministry of Economy must be further developed because currently this Department is understaffed which causes obstacles for addressing appropriately the energy policy challenges[75].

It is apparent that the EU will further increase its influence in the Republic of Macedonia through insisting on applying different instruments and pushing for reforms and restructuring the energy sector. It will also set the future dynamics on the market development. One indicator is the market liberalization that was initiated by the EU through the Energy Community. In this context, the solar energy could gain on attractiveness, especially for reaching the share of RES in the country. Until now, on the other hand, all relevant EU directives and regulations have been transposed in the national legislation, and its implementation will be big test for postulating non-discriminatory market. All developments and activities in this regard will depend solely on the Macedonian authorities.

75 European Commission, The Former Yugoslav Republic of Macedonia 2006 Progress Report SEC(2006) 1387 dated 08.11.2006, 2007 Progress Report SEC(2007) 1432 dated 06.11.2007, 2008 Progress Report SEC(2008) 2695 dated 05.11.2008, 2009 Progress Report SEC(2009) 1335 dated 14.10.2009 and 2010 Progress Report SEC(2010) 1332 dated 09.11.2010, 2011 Progress Report SEC (2011) 1203 dated 12.10.2011.

5. Economic analysis

The solar energy is an open access resource, that is, no one owns it. It represents a public good, which means that a market price is not available. Public goods have the characteristics of joint consumption and non-exclusion, which means that when the good is consumed by one person, it does not diminish the amount consumed by another person[76]. The main advantage of the solar energy over conventional energy generation is that it contributes to the preservation of other public goods, namely clean air and climate stability. Observing the solar energy in this regard, it can be noted that this RES shows non-rival characteristic as a public good which means that the private actors are not prepared to invest in something which everyone can acquire free of charge. In such conditions, the diffusion of solar energy cannot be assured spontaneously by the market[77].

After giving a general overview on the basic characteristics related to solar energy, I would now turn my attention to the position of this sector in economic sense in the Republic of Macedonia, analyzing simultaneously the possible benefits and constraints concerning the breakthrough of this RES in the country. Several issues are important for the solar energy sector: price and market liberalization, investments and future projects, the integration of solar energy in the Macedonian electricity and power system, i.e. the existence of adequate infrastructure, reduction of CO_2 emissions, and technology transfer. Since the solar energy technologies can generate electricity, I will start with this source.

76 R. Kelly Turner, David Pearce & Ian Bateman, ”Environmental economics: An elementary introduction”, 1994.

77 Philippe Menanteau, Dominique Finon & Marie-Laure Lamy, ”Prices versus quantities: choosing policies for promoting the development of renewable energy”, Energy Policy 31/2003, pages 799–812.

Electricity is commonly used energy source because it is cheap. It is cheap because the price is still a social category that is regulated by the Government at very low level. The price as such does not reflect the costs of the electricity generation companies, transmission and distribution costs and the environmental damage that it is caused. This means that the governmental policy of regulating the price is not sustainable any more. The negative effect is low investment rate in the energy sector (the energy infrastructure is not modernized) and in turn difficult breakthrough of the solar energy as alternative energy source. The electricity price in the Republic of Macedonia is lagging behind the price in the EU countries. In 2007, the price for the residential sector was three times lower compared to EU-27. When taking the neighboring countries into account, even Bulgaria, Serbia, Kosovo and Greece have 50% higher price than the Republic of Macedonia[78]. In 2008 and 2010 the electricity price rose for 13% and 10% respectively, but it is still not cost-reflective.

The energy market liberalization in 2015 can be considered as opportunity for increasing the dynamics in this sector. It can be indicated that the energy companies, which operate on the basis of regulated, territorial monopolies over decades, now have to compete for customers[79]. This means that a market price will be introduced, there will be increased competition and more private entities will be able to invest in the energy market. The Republic of Macedonia chose gradual model towards full market liberalization: the process has begun with the privatization of the electricity distribution sector, participation in the Energy Community, creating modern national legislation, accepting and implementing part of the EU directives

78 Ministry of Economy, Strategy for energy development in the Republic of Macedonia until 2030, Skopje 2010, page 147-149.

79 Jochen Markard & Bernhard Truffer, “Innovation processes in large technical systems: Market liberalization as a driver for radical change?”, Research Policy 35 (2006) 609–625, page 610.

which enable better access to the Macedonian market. After 2015 all customers will have the right to choose their own energy supplier under market conditions. The domestic and foreign energy suppliers must previously acquire license from the Macedonian competent institutions for performing this activity[80]. The main steps and measures in the market liberalization towards achieving a well functioning market-oriented industry are outlined in Annex 5.

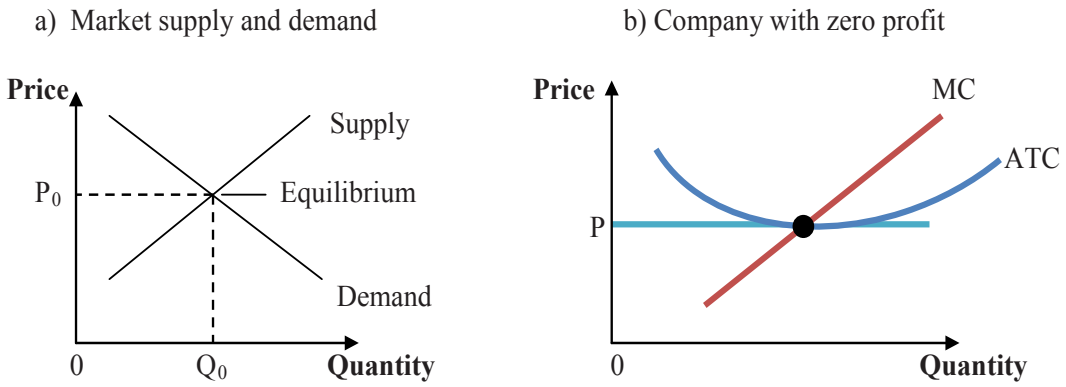
The market price, that will be introduced, will depend on the supply and demand interaction. According to the supply and demand economic theory, in a competitive market the buyers and sellers are price takers, that is, they must accept the price the market determines. The behavior of the buyers and sellers drive the market towards equilibrium. The intersection of the supply and demand curves shows that quantity buyers are able and willing to buy equals the quantity that sellers want to sell (Graph 5.1 (a)). The price in turn gives the signal what kind of economic decision should be made, how the resources should be allocated and is a measure both for the marginal benefit to each individual and marginal cost to producers[81]. On the supply side, when the company is price taker, price equals marginal revenue. In a competitive market, a company maximizes profit by increasing output until the cost of adding another unit of output (marginal cost) is exactly equal to the revenue obtained by selling one more unit (marginal revenue). The company produces the quantity at which marginal revenue equals marginal cost - the supply curve of one firm is its marginal cost curve (graph 5.1 (b)). For a company to stay in the long-run on the market it must make zero economic profit. This is possible only if the price of the good equals the average total cost

80 Ministry of Economy, Strategy for energy development in the Republic of Macedonia until 2030, Skopje 2010, page 21.

81 William Spangar Pierce, Economics of the Energy Industries, second edition 1996, printed in the United States of America, page 31-35.

(ATC) of producing the good. If the price is above the average total cost, the profit will be positive, which encourages new firms to enter the market.

Graph 5.1 Market equilibrium and company with zero profit

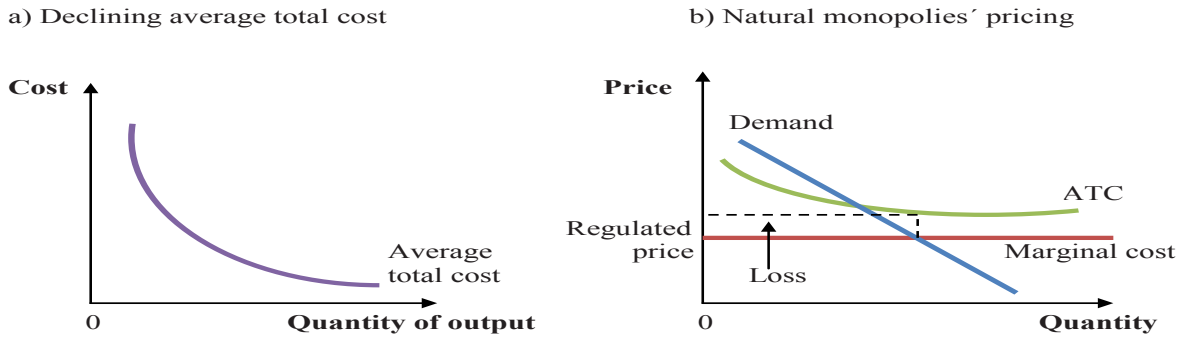


Source: Mankiw, N. Gregory and Taylor, Mark P., Economics

Currently, the Macedonian energy market is not competitive and the price is regulated. The price control does not cover the rapidly rising marginal cost and the price can adapt slowly to this changes. As a result, the energy companies make lower profits and invest less in the modernization of the grid. It is important to emphasize that currently in the Macedonian energy sector natural monopolies exist and the electricity price regulation can be considered as one way to control these monopolies, since they could have the incentive to increase the price of their services in order to achieve extra profits. The natural monopolies can be found in the field of electricity transmission and distribution sector. They can supply their services at a smaller cost than could two or more firms and they arise when economies of scale exist. In this case, the average total costs are lowest for any provided amount of output. If more firms operate, the average total costs would increase (graph 5.2 (a)). The natural monopolies by definition have

declining average total cost. When average total cost is declining, marginal cost is less than average total cost. If the regulated price is set to equal the marginal cost, then the price will be lower than the company´s average total cost (ATC). As a result the company will lose money – dashed outline in graph 5.2 (b). Furthermore, the monopolist does not have incentive to reduce costs. Each firm in a competitive market tries to reduce its costs because lower costs mean higher profits. But if a regulated monopolist knows that regulators will reduce prices whenever costs fall, the monopolist will not benefit from lower costs.

Graph 5.2 Declining average total cost and natural monopolies' pricing



Source: Mankiw, N. Gregory and Taylor, Mark P., Economics

When the market will be liberalized the electricity market price will increase. A higher price is necessary also for the solar energy sector. The PV systems can generate electricity, are capital intensive and have large fixed costs. The solar energy requires substantial up-front capital expenditures before any energy is generated, but has no fuel costs[82]. Further is needed only access to sunlight and good location. The Republic of Macedonia fulfills these requirements, but

82 Geoffrey Heal, The economics of renewable energy, working paper 15081 National Bureau of Economic Research in Cambridge United States of America, June 2009.

the high costs are not very attractive and represent great barrier for wide spreading the PV systems in the energy market. At the current level of market prices and feed-in tariffs, it takes at least seven years for the producers of electricity from RES to return their investment. The costs for the PV equipment and components on the world market should further be reduced for their broader promotion on the Macedonian market. The cost of PV electricity depends not only on the initial investment, but also on the amount of sunlight available, operational costs and lifetime of system components and the system performance[83].

On the demand side, however, the following two questions can be asked considering the solar energy and the pricing policy: Are the customers willing to pay higher price for green electricity? Can they afford the awaited increased electricity price? The law on demand claims that, other things equal, the quantity demanded of a good falls when the price of the good rises – the quantity demanded is negatively related to the price. In context of the electricity as a product, this is not always the case. The demand for electricity will not decrease in the short run. The goods like electricity tend to have more elastic demand over longer time horizons. If the electricity price raises much above the prices of other energy sources, and the price difference persists over several years, then it can be expected that people would consider other energy sources, which could result in fall in electricity demand. The customers are, of course, never happy when the prices increase. Their ability to pay the electricity bill depends on their personal income. So far, as stated in section 4.1, the bill collection rates are low which does not create viability of the energy market. With rising electricity prices the situation could deteriorate. According

83 Henry Kelly, Introduction to photovoltaic technology in: T.B. Johansson, H.Kelly, Amulya K.N. Reddy, R.H.Williams (eds), Renewable energy: sources for fuels and electricity, 1993, page 297-300.

to the latest information from the State Statistical Office[84], the average net wage per employee in December 2010 was 21.454 denars (348 euro), whereby the total cost for food and drinks amounts 12.342 denars (200 euro)[85] that was 42.5% lower in regard to the average net wage. Moreover, the unemployment rate in 2010 was 32% (see section 2 and Annex 1).

From the presented data it can be easily concluded that the Macedonian citizens do not possess very high economic power to face the changes on the energy market. The increased price will cause further constraints on the households' budget. Those who are employed can cover the costs of their electricity consumption, but the greatest challenge will be the category of economic vulnerable citizens. The Government adopted in 2009 Energy Poverty Action Plan that foresees subsidies in amount of 10 € for 58.000 families that receive social benefits. The goal is to help these citizens cover the increasing energy costs[86]. It would be wise if the price increases gradually as a way to alleviate the price shock and if it collates with the standard of living.

If the prices of oil and coal increase further, for example, people may switch to other resources, in this case to solar energy. The financial calculations for buying solar collector have already been mentioned in section 3.2 drawing the conclusion that it takes 10 years with the current prices to return the investment. The higher prices can improve the bad image of the solar energy technologies as "not having

84 State Statistical Office, News release no. 4.1.11.18: Consumer basket, prices and wages October-December 2010, Skopje dated 10.03.2011.
85 Denar is the Macedonian currency; middle exchange rate in denars of the National Bank of the Republic of Macedonia valid for 12.07.2011, own calculations.
86 Government of the Republic of Macedonia, "The state will cover 10 € of the electricity bill for the socially vulnerable citizens", press release dated 22.04.2010, own translation.

economic justification". The solar collectors and PV systems can find their maximal utilization in summer during the high demand peaks caused by the air conditioners. The latest information confirms this fact. According to EVN Macedonia, in the beginning of July 2011 the daily electricity consumption increased due to the high temperatures. The whole state consumed 21 million kWh, and the EVN´s customers 15 million kWh. These figures are 5% higher compared to last year[87]. In this regard, the solar energy could help the overburdened energy system using efficient equipment that can cause some savings. These circumstances will gradually boost the interest for the solar energy, as the energy costs would further increase.

As a general overview, if the Republic of Macedonia wants to sustain and improve its growth rates, it must address carefully the issues concerning both the supply and demand side. The energy demand and consumption in the Republic of Macedonia will not decrease in the following 10 to 20 years. Taking into account the forecasts that the Macedonian economy will expand and achieve higher growth rates in the following years (table 2.1 and projections in Annex 1), it can be argued that the large industrial capacities, construction sector and the other economic sectors will demand more energy for sustaining their growth pace. Following this trend, if the companies manage to develop themselves with fewer costs, then new work places can be created, which in turn would increase the citizens´ economic power.

The solar energy sector is also considered as job creator. Although the required technology is transferred from abroad, the local firms and population can provide support during installation, maintenance and operation of the systems. These capacities would require high- and low-skilled workforce. According to some estimation, the Republic of Macedonia can save minimum 32 million € from applying the solar

87 Vecer, "The air conditioners increase the kWh", online newspaper edition dated 16.07.2011, own translation.

energy – the same amount is needed as financial contribution that employers pay for opening 6.874 new jobs[88]. Local municipalities and private entities can easily get involved as investors in solar energy technologies during renovations of city districts or city planning processes. The solar technologies can also be mobilized through local development strategies. On the other hand, however, it is interesting to note that the changes in electricity prices can also be regarded as possibility for altering the customers´ behavior. In the last 20 years, they were used to low-regulated price, were very satisfied and did not appreciate the value of electricity as a good. As the price rises, the customers could be stimulated to save more energy and be more careful how they are using it.

The inclusion of the solar energy in the energy market brings several advantages: improved energy mix, more investments and transfer of new technology. These characteristics are very important because a depressed price leads to less investment, and the Republic of Macedonia uses low-efficient and outdated technology that is also related to the high energy losses. Such circumstances on the energy market caused building fewer domestic electricity production capacities, which in turn increased the electricity import on which lots of money are spent. Good example for illustrating the bad investment environment is found in the hydro power sector. All hydro power plants (HPP) the Republic of Macedonia possesses are connected to the energy system in the 1960s and 1970s. The newest HPP was built in 2004 – thirty to forty years later. If this trend continuous, it will be no wonder if the energy system collapses one day.

PV systems can be located on sites where electricity is consumed. This possibility reduces the transmission and distribution costs, as well as the costs for connection to the energy system. The main

88 Utrinski vesnik, “Solar power plant in Demir Hisar”, online newspaper edition dated 10.09.2010, own translation.

disadvantage from technical aspect is that the amount of disposable electricity from the PV systems cannot be forecasted precisely. These circumstances can cause problem with the functioning of the energy and power system and in the balancing of the daily electricity needs. Until this is resolved the solar energy cannot replace the conventional energy resources[89]. The investments in PV system in the Republic of Macedonia are also linked with several administrative issues. Construction permits and licenses for becoming eligible producer of electricity from RES must be acquired, which can be time consuming and strategic planning is always necessary in this regard.

The solar energy confronts another "barrier" in the course of conquering the Macedonian energy market. It faces competition from the hydro power and natural gas sectors. The hydro potential of the Republic of Macedonia for electricity production amounts 5.500 GWh. So far, only 27% (1500 GWh) has been utilized. The state plans large capital investments until 2030 for increasing the percentage of utilization to 73%. This objective will be achieved through the construction of six large HPP in value of 1.530 million € and annual production of 1.200 GWh, 400 small HHP in value of 300 million € and the project "Vardar Valley" (10 small HPP) in value of 486 million €. In this regard, the HPP Chebren and HPP Galishte are strategically very important projects, especially because they are regarded as the heart of the Macedonian energy and power system[90]. These projects are not just attractive because of their financial value, but also they will provide green electricity.

The natural gas, on the other hand, is used only in the industry, but construction of new pipelines and development of the gas transmission system is planned in the next ten years. In this way, its utilization

89 Ministry of Economy: Strategy for using the renewable energy sources in the Republic of Macedonia until 2020, Skopje 2010, page 67-68, own translation.
90 Ibid., pages 28-29, 94-95, own translation.

will be increased in the households and agricultural sector and it will be attractive because of the lower price compared to the oil price. Most importantly, the Russian energy company Gazprom agreed to connect the Republic of Macedonia to the gas pipeline South Stream – a project worth 300 million €, which gives the country a possibility to be incorporated in the map of energy transport corridors[91]. If all these projects are realized as planned, the solar energy would not get much chance in the middle run.

The solar energy can positively contribute to the reduction of CO_2 emission in the country. The Republic of Macedonia ratified the United Nations Framework Convention on Climate Change (UNFCCC)[92] in 1997 and the Kyoto Protocol[93] in 2004, and belongs to the non-Annex I countries. The total CO_2-eq emissions from 1990 to 2002 range from 11.9 to 14.4 Mt CO_2-eq. In 2000 the emissions equaled 14.318 ktCO_2-eq (7.16 tCO_2-eq per inhabitant). The Macedonian economy is characterized by relatively high level of energy consumption and green house gases (GHG) emissions per unit of GDP - Macedonia's emissions per capita are higher than the corresponding emissions in some large and economically growing countries, such as: Turkey, Mexico, Brazil, China, and India. The energy sector is the biggest pollutant in the country contributing about 70% of the total country's GHG emissions or 10 Mt CO_2eq per year because it relies on the domestic lignite. The second biggest contributor is the agricultural

91 Cabinet of the President of the Republic of Macedonia, "The Republic of Macedonia joins the South Stream", press release dated 17.06.2011, own translation.

92 As a response to the climate change the international community agreed to the UNFCCC that entered into force in 1994. The Kyoto Protocol, on the other hand, is an international agreement closely linked to the UNFCCC that sets binding targets for 37 industrialized countries and the EU (countries from Annex I in the Protocol) for reducing the GHG emissions, source: http://unfccc.int/kyoto_protocol/items/2830.php

93 Official Gazette of the Republic of Macedonia no.61/97 and no. 49/04.

sector with 8-15% and all other sectors contribute to 10% (table 5.1)[94].

Table 5.1 Sectoral CO_2-equivalent emissions 1990-2002

	Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
[kt]	Energy	9,939.83	9,190.47	8,484.18	9,068.37	8,839.56	8,925.02	8,578.29	9,198.29	9,939.13	9,716.39	9,226.90	9,355.70	9,755.52
	Industry	889.29	908.89	957.78	831.36	716.56	793.28	819.71	910.30	893.31	750.76	894.03	937.35	792.38
	Agriculture	1,908.27	1,866.08	1,881.62	1,858.08	1,888.54	1,825.04	1,682.11	1,571.02	1,462.96	1,377.56	1,379.52	1,313.29	1,073.39
	LUCF	283.66	24.07	424.06	758.82	273.29	5.67	51.49	177.63	89.16	99.57	1,973.70	336.53	36.49
	Waste	785.39	793.79	807.60	809.49	755.15	779.30	785.39	822.35	830.12	827.81	843.56	835.37	839.78
	Total	**13,806.44**	**12,783.29**	**12,555.23**	**13,326.12**	**12,473.10**	**12,328.31**	**11,916.99**	**12,679.59**	**13,214.69**	**12,772.10**	**14,317.71**	**12,778.24**	**12,497.56**
[%]	Energy	71.99	71.89	67.57	68.05	70.87	72.39	71.98	72.54	75.21	76.08	64.44	73.22	78.06
	Industry	6.44	7.11	7.63	6.24	5.74	6.43	6.88	7.18	6.76	5.88	6.24	7.34	6.34
	Agriculture	13.82	14.60	14.99	13.94	15.14	14.80	14.12	12.39	11.07	10.79	9.64	10.28	8.59
	LUCF	2.05	0.19	3.38	5.69	2.19	0.05	0.43	1.40	0.67	0.78	13.79	2.63	0.29
	Waste	5.69	6.21	6.43	6.07	6.05	6.32	6.59	6.49	6.28	6.48	5.89	6.54	6.72
	Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Second National Communication on Climate Change

The Republic of Macedonia is interested in the Clean Development Mechanism (CDM). High ratio of GHG emissions to economic output (carbon intensity) signals about high cost-effectiveness of potential CDM projects as it implies that large volume of GHG emission reductions can be achieved per 1 US$ of investments[95]. From CDM perspective, the use of RES can be quite attractive. In the National Strategy for Clean Development Mechanism it is estimated that combined margin (CM) emission factor for Macedonian electricity grid accounts for 0.915t CO_2/MWh. More precisely: a hypothetical renewable energy project with expected annual electricity generation at the level of 60.000 MWh per year can generate approximately

94 Ministry of Environment and Physical Planning of the Republic of Macedonia, Second National Communication on Climate Change, December 2008, Skopje, page 40-41.

95 National Strategy for Clean Development Mechanism for the first commitment period of the Kyoto Protocol 2008-2012, page 8.

54.900 CERs (Certified Emission Reduction) annually. By selling this amount of CERs additional financial resources in the range of 2.74 million US dollars can be mobilized[96]. These circumstances are crucial for the country because one of the key CDM objectives is to achieve sustainable development and different projects could facilitate the energy market transformation and the transfer of high efficient technologies that emit less GHG. The benefits should not only be characterized as environmental and economic, but the improvement should also be felt in the social sphere. The pollution issue has always caused uproar on different levels. In order to understand its background and impact on the society, it is worth looking at the economic theory.

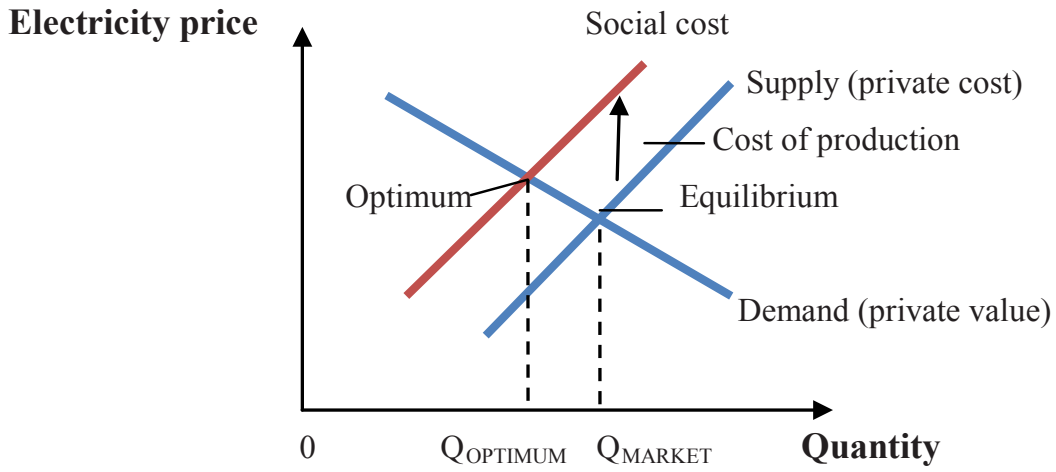
A large extent of pollution coming from the energy sector indicates that the market failed to allocate the resources efficiently. An externality is one example of a market failure and is defined as the uncompensated impact of one person's actions on the well-being of a bystander and the effect of either positive or negative. In the case of the energy market the impact on the bystander is adverse evoking negative externality and external costs. Such side effects cause welfare in a market to depend on more than just the value to the buyers and the cost to the sellers – it also includes the well-being of bystanders who are affected[97]. The negative externality can be illustrated as follows: for every produced kWh of electricity, the power plants emit GHG and pollute the air. The polluted air creates, on the other hand, health risks for the people. Because the externality exists, the cost to society is much higher that the costs to the electricity producers. The social cost is consisted of the private costs to the electricity producers plus the costs to those bystanders adversely affected by the pollution. Graph 5.3 depicts the social cost to producing electricity. The difference between the social-cost curve and the supply curve represents

96 Ibid., page 9.

97 N.Gregory Mankiw and Mark P.Taylor, Economics, London 2006, page 189-193.

the cost of pollution. The graph shows clearly that the social cost of producing electricity exceeds the private cost. As a result, the optimum quantity $Q_{OPTIMUM}$, that is acceptable to the society, is smaller than the equilibrium quantity Q_{MARKET}.

Graph 5.3 Social costs to producing electricity



Source: Mankiw, N. Gregory and Taylor, Mark P., Economics

One way to correct this market failure is to internalize the externality, that is, to alter incentives so that people take account of the external effects of their actions. In this sense, the Republic of Macedonia adopted several strategies for the energy sector which also deal with the environmental impact. The Second National Communication on Climate Change makes forecast for the CO_2 emissions until 2025 and sets different objectives how to reduce them. According to the scenario based only on coal (the so called “black option”), the emissions will increase to 21.500 kt CO_2-eq. in 2020. The second climate mitigation scenario (environmental improved scenario) foresees reduction of the emissions to around 15.000 kt CO_2-eq. in 2020, which is 30% less compared to the baseline scenario. This improvement will result from

the introduction of gas power plants for combined heat and power production, reduction of the growth of consumption of electricity, and increased use of solar energy and other forms of RES[98].

The solar energy has advantageous position as environmentally friendly tool because its technology does not generate any by-products when producing electricity. But, as IPCC notes in its report "the family of solar energy technologies may create other types of air, water, land and ecosystem impacts, depending on how they are managed. The PV industry uses some toxic, explosive gases as well as corrosive liquids in its production lines[99]". These impacts, however, are minor because of the rigorous control methods during the production process. Nevertheless, the Republic of Macedonia takes into account several climate mitigation technologies, including the photovoltaic systems, solar heater for hot water in individual houses and solar heater in public buildings and industry.

The solar energy can contribute to reducing 72 kt CO_2-eq by 2020[100] parallel to the increase of its share in the energy market (in 2010 accounting for 19.74% of CO_2 reduction). Although the PV systems can reach high level of efficiency and are beneficial for the environment, they are the most expensive option as well, because of the high initial investments - their specific cost is 398.22 USD/t CO_2-eq which makes other options and RES more attractive in this regard. For this country it is cheaper and easily feasible to reduce the CO_2 emissions through geothermal heating, replacing old diesel engines in the buses, to build

98 Ministry of Environment and Physical Planning of the Republic of Macedonia, Second National Communication on Climate Change, December 2008, Skopje; page 71-83.

99 Intergovernmental Panel on Climate Change (IPCC), Special report on renewable energy sources and climate change mitigation 2011, page 50.

100 Ministry of Economy, Strategy for using the renewable energy sources in the Republic of Macedonia until 2020, Skopje 2010 page 103-105, own translation.

large hydro power plants and increase the share of gas in the market (Annex 6). Due to these circumstances it is difficult to expect that the solar energy will achieve the necessary breakthrough in the short run as an instrument for CO_2 emissions reduction.

Last, but not the least, the solar energy can facilitate the transfer of technologies. In this context, the solar energy equipment is characterized by high productivity and efficiency, lower emissions of pollutants and can facilitate the need for replacing the outdated energy equipment with more modern one. But, the problem is that the Republic of Macedonia lacks the proper infrastructure that would be suitable for successful transfer of technology. The energy services that apply more efficient technologies cannot give results until the electricity prices stay a social category. In the field of human resources, there is need for training and further education for improving the existing knowledge and skills. Another constraint would be the lack of financial resources. For this purpose the private sector and foreign investors should participate more actively in the whole process because they could finance the efficient introduction and transfer of new technology[101].

101 Ministry of Environment and Physical Planning of the Republic of Macedonia, Second National Communication on Climate Change, December 2008 Skopje, page 102-103.

6. Conclusion

The purpose of the research set out in the master thesis is to clarify the question what legal and market conditions are necessary for promoting the solar energy as an alternative resource, what obstacles exist in this regard and can a possible progress in the solar energy sector have an impact on the performance of the Macedonian economy. After analyzing the status of solar energy sector and the possibilities for its development in the Republic of Macedonia, I drew several conclusions.

Firstly, the legal framework related to the solar energy and other renewable energy sources is guided by the relations between the European Union and the Republic of Macedonia. All the changes in the national legislation derive from the obligations concerning the Energy Community, SAA and possible future membership in the EU. By adopting and implementing the acquis communautaire on renewable energy the Republic of Macedonia created solid basis for promoting the solar energy via feed-in tariffs. What the country should also do in this regard is to simplify the procedures and reduce the administrative burden the investors could face when acquiring the necessary licenses for operating on the Macedonian energy market.

Secondly, the solar energy is excellent candidate for reducing the GHG emissions from the energy sector. But, the high costs and investments that are required for introducing the solar energy techniques divert the attention to other climate mitigation techniques. Until the costs are reduced overall on the world market, the solar energy cannot be used as widespread tool for improving the environmental status. The hydro power plants, natural gas and other technical measures will remain main components in the strategy for reducing CO_2 emissions.

Thirdly, the transformation of the Macedonian energy market is under its way to became reality until 2015. It is necessary requirement for achieving progress in the solar energy sector because it is not enough to create legal ground for investments, but most importantly market conditions must exist for using the full potential of the solar energy. This energy source can definitely increase the national energy mix, but it will not be enough to reduce the Macedonian energy dependency. Nevertheless, the competition that will arise from the market liberalization is always welcomed. Higher electricity prices will increase the investments not just in new production capacities, but also in the grid modernization.

Feed-in tariffs are granted to the eligible producers that will produce electricity from PV systems. However, as the market sets its own development dynamic, it would be advisable to reduce gradually the feed-in tariffs after the liberalization, corresponding to the rising market prices. The solar energy subsidies may not become governmental habit, similar to the low-regulated price in the last two decades. Upon that moment, every producer on the market should promote its energy services and products guided by the market conditions and principles. Additionally, as the feed-in tariffs would decrease, there is opportunity to increase the social assistance to the poorest households as an attempt to overcome the energy poverty.

In the short run the solar energy cannot conquer the Macedonian market or boost the economy. It will stay marginal player because the interest is now more concentrated on the hydro power and natural gas sectors for using their potential to larger extent. In the long run, it can remain good economic perspective, especially if the energy infrastructure is modernized and the costs for the technologies are reduced. This aspect is crucial because the Republic of Macedonia possesses excellent geographical and natural conditions for developing the solar energy business, but it lacks financial resources.

Annexes

Annex 1

Basic macroeconomic indicators and projections

Basic macroeconomic indicators	2010	2011	2012	2013	2014
Real sector					
GDP at market prices					
real growth rate	0.7	3.5	4.5	5.5	6.0
in million EUR	6.890	7.345	7.906	8.591	9.353
GDP per capita					
in EUR	3.350	3.565	3.831	4.156	4.517
Industry real growth rate	-2.0	5.2	6.4	7.5	8.3
Inflation, average	1.6	3.0	3.0	3.0	2.7
GDP deflator	2.5	3.0	3.0	3.0	2.7
External sector					
in million EUR					
Export of goods (f.o.b.)	2.493	3.036	3.400	3.900	4.407
Import of goods (f.o.b.)	3.961	4.760	5.300	6.000	6.742
Import of goods (c.i.f.)	4.119	4.955	5.517	6.246	7.018
Trade balance (f.o.b.)	-1.468	-1.724	-1.900	-2.100	-2.335
Current account deficit	-191	-400	-460	-534	-630
FDI	221	370	475	515	540
in % of GDP					
Trade balance (f.o.b.)	-21.3	-23.5	-24.0	-24.4	-25.0
Current account deficit	-2.8	-5.3	-5.8	-6.2	-6.7
FDI	3.2	5.0	6.0	6.0	5.8
Social sector					
Population	2.056.827	2.060.530	2.063.827	2.067.129	2.070.436
Net wage					
Nominal growth	3.0	4.0	6.2	8.2	9.0
Real growth	1.4	1.0	3.2	5.2	6.3
Gross wage					
Nominal growth	1.0	4.0	5.5	6.8	7.6
Real growth	-0.6	1.0	2.5	3.8	4.9
Unemployment rate	32.0	30.8	29.6	28.0	26.2
Employment growth	1.3	3.0	3.0	4.0	4.0
Productivity growth	-0.6	0.5	1.5	1.4	1.9

Source: Ministry of Finance of the Republic of Macedonia

Annex 2

Register of producers of electricity from PV systems

The Energy Agency of the Republic of Macedonia is responsible for updating the register of producers of electricity from PV systems and other renewable energy sources. The activities in this sphere started in 2009 with the opening of the first PV plant. Until the present day, eight producers are operating on the market. The total installed power is 1.468 kW and the planned annual production amounts 2016 MWh. The table gives and overview on the currently active producers, the nominal power of the individual PV plants and the date of inclusion into the system.

	Name of the plant	Type of plant	Nominal power [kW]	Entity name	Date of inclusion*
1.	Sieto 1	Photovoltaic	10.2	Sieto LLC, Skopje	12.05.2009
2.	Petro M	Photovoltaic	49.720	Petro M LLC, Skopje	14.06.2010
3.	Geo-Link Group	Photovoltaic	49.720	Geo-Link Group Ltd. Skopje	15.06.2010
4.	Mavis	Photovoltaic	250	Mavis LLC, Shtip	10.12.2010
5.	ALFA PARK	Photovoltaic	49.7	Alfa Engineering Ltd Radovish	25.02.2011
6.	Integral	Photovoltaic	49.9	Integral Ltd Tetovo	21.04.2011
7.	Foton	Photovoltaic	11.5	Foton Bosilevo	29.04.2011
8.	MEGA Solar	Photovoltaic	996.7	Germijan Bitola	27.05.2011

*Last change made on 05.07.2012

Annex 3

List of EU legislative acts in the area of electricity, gas, environment, renewable energy and energy efficiency

THE ACQUIS ON ELECTRICITY

- Commission Decision 2006/770/EC on Guidelines on the management and allocation of available transfer capacity of interconnections between national OJ L 312 11.11.2006 p. 59.
- Directive 2005/89/EC of the European Parliament and of the Council of 18 January 2006 concerning measures to safeguard security of electricity supply and infrastructure investment
OJ L 033 04.02.2006 p. 22-27.
- European Community Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity OJ L27 30.01.1997 p. 20.
- European Community Regulation 1228/2003/EC of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity OJ L176 15.07.2003 p. 1-10.

THE ACQUIS ON GAS

- Regulation (EC) No 1775/2005 of the European Parliament and of the Council of 28 September 2005 on conditions for access to the natural gas transmission networks OJ L289 03.11.2005 p. 1-13.
- Directive 2004/67/EC of 26 April 2004 concerning measures to safeguard security of natural gas supply OJ L127 29.04.2004 p.92-96.
- Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC OJ L204 21.07.1998 p.1

THE ACQUIS ON ENVIRONMENT

- Directive 2003/35/EC providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment OJ L156 25.06.2003 p. 17-24.
- Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants OJ L309 27.11.2001 p. 22.
- Directive 1999/32/EC relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC OJ L121 11.05.1999 p. 13-18.
- Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment OJ L073 14.03.1997 p. 5.
- Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment OJ L175 05.07.1985 p. 40-47.
- Directive 79/409/EEC on the conservation of wild birds OJ L103 25.04.1979 p. 1-18.

THE ACQUIS ON RENEWABLE ENERGY

- Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending OJ L140 05.06.2009 p. 16-63.
- Directive 2003/30/EC on the promotion of the use of bio fuels or other renewable fuels for transport OJ L123 17.05.2003 p. 42-46.
- Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market OJ L283 27.10.2001 p. 33.

THE ACQUIS ON ENERGY EFFICIENCY

- Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products OJ L153 18.06.2010 p. 1.
- Directive 2010/31/EU on the energy performance of buildings OJ L153 18.06.2010 p. 13.
- Directive 2006/32/EC on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC OJ L114 27.04.2006 p. 64-85.
- Directive 2002/40/EC on energy labeling of household electric ovens OJ L128 15.05.2002 p. 45-56.
- Directive 2002/31/EC on energy labeling of household air-conditioners OJ L86 03.04.2002 p. 26-41.
- Directive 98/11/EC on energy labeling of household lamps OJ L71 10.03.1998 p. 1-8.
- Directive 97/17/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household dishwashers OJ L118 07.05.1997 p. 1-25.
- Directive 96/60/EC on energy labeling of household combined washer-driers OJ L266 18.10.1996 p. 1-27.
- Directive 95/12/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household washing machines OJ L136 21.06.1995 p. 1.
- Directive 95/13/EC on energy labeling of household electric tumble driers OJ L136 21.06.1995 p. 28-51.
- Directive 94/2/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations OJ L45 17.02.1994 p. 1-22.

Annex 4

List of adopted rulebooks on renewable energy sources

- Rulebook on the method and procedure for establishing and approving the use of feed-in tariffs for purchase of electricity produced from small hydropower plants (Official Gazette of the Republic of Macedonia no. 16/2007).
- Rulebook on the method and procedure for determination and approving the use of feed-in tariff for purchase of electricity generated by wind power plants (Official Gazette of the Republic of Macedonia no. 61/2007).
- Rulebook on the method and procedure for determination and approving the use of feed-in tariff for purchase of electricity produced and delivered by power facilities which as operating fuel use biogas got from biomass (Official Gazette of the Republic of Macedonia no. 142/2007) and Rulebook on amending the Rulebook on on the method and procedure for determination and approving the use of feed-in tariff for purchase of electricity produced and delivered by power facilities which as operating fuel use biogas got from biomass (Official Gazette of the Republic of Macedonia no. 44/2010).
- Rulebook on the method and procedure for determination and approving the use of feed-in tariff for purchase of electricity generated by photovoltaic systems (Official Gazette of the Republic of Macedonia no. 112/2008) and Rulebook on amending the Rulebook on the method and procedure for determination and approving the use of feed-in tariff for purchase of electricity generated by photovoltaic systems (Official Gazette of the Republic of Macedonia no. 44/2010).
- Rulebook on the method and procedure for determination and approving the use of feed-in tariff for purchase of electricity produced and delivered by power facilities which as operating fuel use biomass (Official Gazette of the Republic of Macedonia no. 44/2010).

● Rulebook on the renewable energy sources for electricity production (Official Gazette of the Republic of Macedonia no. 127/2008).
● Rulebook on the guarantee of origin of the electricity produced from renewable energy sources (Official Gazette of the Republic of Macedonia no. 127/2008).
● Rulebook for acquiring of status of eligible producer of electricity from renewable energy sources (Official Gazette of the Republic of Macedonia no. 29/2009).

Annex 5

Measures for achieving well-functioning market

Experience from electricity liberalization around the world has produced a measure of consensus over some generic measures for achieving a well functioning market-oriented industry. Liberalization generally requires implementation of one or more of the following inter-related steps: sector restructuring, introduction of competition in wholesale generation and retail supply, incentive regulation of transmission and distribution networks, establishing an independent regulator, and privatization.

The table outlines the measures for reforming a vertically integrated and publicly owned electricity supply industry (ESI) into a competitive and privately owned industry. In practice, the actual measures need to take into account both the specific characteristics of the national (or supra-national region) electricity industry and the general features of the liberalization model.

Main steps in Electricity Reform

Restructuring	Vertical unbundling of generation, transmission, distribution, and supply activities
	Horizontal splitting of generation and supply
Competition and markets	Wholesale market and retail competition
	Allowing new entry into generation and supply
Regulation	Establishing an independent regulator
	Provision of third-party network access
	Incentive regulation of transmission and distribution networks
Ownership	Allowing new private actors
	Privatizing the existing publicly owned businesses

Annex 6

Costs and environmental effectiveness of the mitigation measures in the Republic of Macedonia

Mitigation option	Specific costs (USD/t CO_2-eq)	Unit type	Emission reduction (t CO_2-eq per unit)	Units in 2010	Emission reduction in 2010		
						Cumulative	
					Per option Mt/year	Mt/year	Percentage of baseline emissions in 2010
Geothermal heating	-187.15	1 unit	2,269.34	1	0.0023	0.0023	0.01%
Replacem. bus diesel engines	-171.49	1 bus	22.75	2,000	0.0455	0.0478	0.27%
Efficient lighting	-24.98	1000 bulbs	87.60	200	0.0175	0.0653	0.36%
Efficient refrigerators	-8.63	1 refrigerator	0.58	150,000	0.0876	0.1529	0.85%
Hydropower (Boskov Most)	-4.09	1 plant	202,195.87	1	0.2022	0.3551	1.97%
Efficient motors	-3.22	1 kW	0.78	25,000	0.0194	0.3745	2.08%
Landfill gas power	-2.85	1 plant	112,232.58	1	0.1122	0.4868	2.70%
Wind turbines	4.16	1 MW	2,872.98	50	0.1436	0.6304	3.50%
Mini-hydropower	7.21	4 MW plant	12,423.71	1	0.0124	0.6428	3.57%
Large solar heater	11.70	1unit	62.16	200	0.0124	0.6553	3.64%
Resid. solar water heating	19.35	1 unit	1.32	100,000	0.1320	0.7873	4.37%
Liquid fuel in power generat.	22.71	1 plant	1,238,139.75	1	1.2381	2.0254	11.25%
Biogas from agro-industry	43.21	1 digester	11,699.89	3	0.0351	2.0605	11.45%
Efficient indust. boilers	63.93	2 tonnes steam	29,652.40	50	1.4826	3.5431	19.68%
Air con. (residential)	70.51	1 air conditioner	0.16	60,000	0.0094	3.5525	19.74%
PVs connected to electric grid	398.22	1 kW	1.10	500	0.0006	3.5531	19.74%

Source: Ministry of Environment and Physical Planning, Second National Communication on Climate Change

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