STUDY ASPECTS FOR THE SOLAR-PHOTOVOLTAIC SYSTEM WITH INSTALLATION CAPACITY OF 60.3 kWp

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Study aspects for the solar-photovoltaic system with installation Capacity of 60.3 kw_p

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Abstract: Today's socio-economic development is closely related to the process of electrical energy production in Kosovo. High energy consumption around the world has made reserves of fossil fuels, from which electricity is produced in most cases, increasingly scarce. The exploitation of fossil resources for energy production has left many consequences in terms of environment. This has led to the focus shifting to renewable energy sources. The preferable one seems to be solar energy, which has had a great development also for the fact that it is very environmentally friendly. Due to their great potential, photovoltaic systems will be one of the most important forms of energy in the future. In this paper, comparative statistics are provided for air pollution in Pristina, compared to other world centers such as Zagreb, Beijing, Paris, Berlin. Disturbing data extracted in real time, make us think much more seriously about our health and that of those who will come after us. A study analysis of a project with an installation capacity of 60.3kWp has also been done.

Keywords: Solar energy, production capacities, economy, etc.

1 Introduction

Energy development, in addition to creating very beneficial and positive effects, also comes with side effects. On the one hand, it is universally recognized that the provision of adequate and sustainable energy services – heat, light and power for movement – is a prerequisite for sustainable economic development in the context of the world economy. In fact, improving access to energy services is closely related to improving people's well-being. However, in recent years the side effects of energy consumption have attracted widespread attention with increasing international recognition of the ongoing process of climate change (also known as "global warming"), which today is certainly the threat most serious about the environment in the world. Solar radiation energy is mainly used in two forms:
a) The direct conversion of solar radiation into electricity by means of a semiconductor device called a solar cell;
b) Collecting heat for heating water in devices known as solar collectors;
The primary focus has been on the emission of harmful gases ("greenhouse gases") as a result of the burning of fossil fuels in the atmosphere. Globally, such emissions have quadrupled since the mid-20th century. Our country faces an extraordinary lack of appropriate investments in the field of electricity, this is due to the bad development policies for the field of energy in our country, which policies would also attract strategic investments, which would help the economy of Kosovo to develop further.

2. Environmental pollution in Kosovo
The state of environmental quality in Kosovo

The local primary factors that influence the climate of Kosovo are: relief, waters, soil and vegetation. The basic factors that influence the quality of the environment are the rate of pollutant emissions, climate and topography. Their interaction is very complex. Currently, the biggest contributors to environmental pollution in Kosovo are stationary and mobile sources, sources in urban areas, main energy production areas and industrial areas. These are facilities for energy production, industrial facilities (metallurgy, mines, cement factories, etc.), the transport sector, agricultural activities and waste disposal sites. Fossil fuel raw materials such as coal and oil derivatives, with a high sulfur content, are mainly used in energy production facilities. The transport sector is characterized by a large number of obsolete cars and the use of low-quality fuels (in most cases). In addition, the industry sector in most cases uses old equipment. The agricultural sector contributes to environmental pollution mainly through the burning of biomass. Areas where waste is dumped and their uncontrolled burning represent a serious source of environmental pollution. In general, the low level of awareness of entrepreneurs, consumers and the general public also influence the current situation.

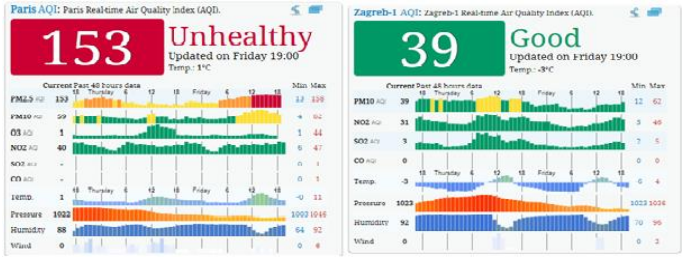

Fig.2.1 Pollution level in Paris and Zagreb

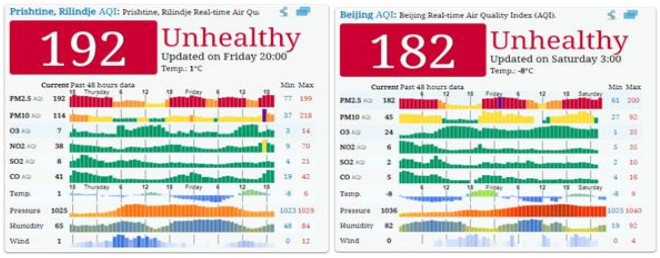

Fig. 2.2 Pollution level in Pristina and Beijing

3. Photovoltaic systems

3.1 Photovoltaic phenomenon

The energy of light photons is absorbed by electrons, which in cases where the absorbed energy is sufficient, release their electronic layer and move to the higher layers, and then they have an easier time pulsating the atom and becoming carriers of electricity (current). Not the entire spectrum of light in certain materials is able to extracted electrons. There is internal and external photo effect. When the light only raises the electron to some higher level, but does not release the material, it is called the internal effect. When the light has enough energy to not only remove the electrons from their own energy level, but also to give you enough energy for them to release the material, it is called an external photo effect - PHOTOCURRENT.

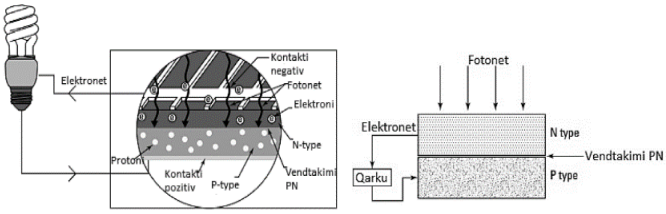

Fig. 3.1. Photovoltaic current generation

4. Study analysis of the month of March for the solar-photovoltaic system with an installed capacity of 60.3kWp

The place where the photovoltaic panels with a capacity of 60.3 kWp will be installed is in the "Vera" hotel facility in Fushë Kosovë. The photovoltaic system will be semi-integrated into the grid, since the grid will only be used for receiving electricity and not for feeding it into the grid. This is because its needs for electricity during the day will always be greater than the production capacity of the photovoltaic system and in this way the photovoltaic system will only serve to meet the needs of the hotel during the day.

Location: Vragoli
Latitude: 42°36'48.13''N
Longitude: 21°04'08.73'' E
Altitude: 550 m

Fig. 4.1 Satellite view of the location

4.1. The characteristics of photovoltaic panels

The panels used in this photovoltaic installation are mono crystalline from "Kyoto Solar". Features of the panel:

Type	**Mono Halfcut 335Wp**
Panel power	**335Wp**
Panel dimensions	**1684 mm * 1002 mm**
Panel efficiency	**19.85 %**
Area required KWp	**5.06**
Open circuit voltage (Uoc)	**40.93 V**
Short circuit current (Isc)	**10.36 A**

60 crystalline cells	**156 mm * 156 mm**
Maximum system voltage	**1000 V DC**
Ambient temperature	**+85 °C deri -40°C**
Cable length	**2 * 1000 mm**
Performance Guarantee	**90% after five years and 80% after 25 years**
Product Guarantee	**25vite**

Dimensions (including frame)	**1666 mm · 992 mm · 40 mm (+/- 2 mm)**
Weight with/without	**19.50 kg / 17.50 kg**
Glass specifications	**Solar glass ESG 3.2 mm (with strong anti-reflective coating)**
Certification evidence	**IEC 61215, Ed. 2 including the mechanical load test.**

After choosing the photovoltaic panels that will be installed, it is necessary to know the exact number of modules that are needed to produce the required power of 60.3 kWp. This can be found from the ratio of the installation power and the power of the photovoltaic module.

$$n_m = \frac{P_{m_0}}{P_{max}} = \frac{60.3 \cdot 10^3}{335} = 180\ panel$$

Fig.4.2 Design and real view of the project

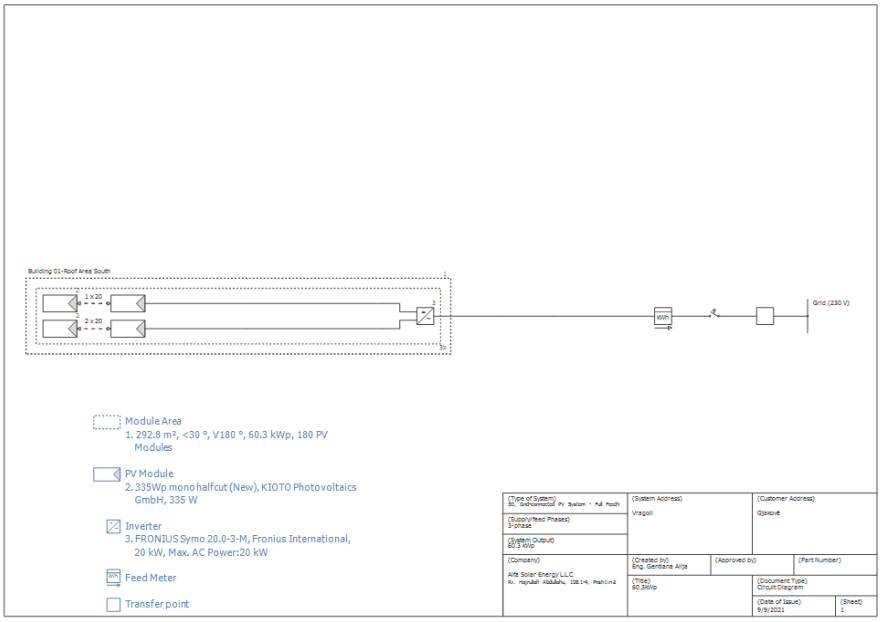

Fig. 4.3. One-time diagram of the PV system

4.2. System simulation with PVSol* Premium licensed software

To design this system we used the licensed software PVSOL*Premium where based on the data of the location of the hotel, the slope of the angle of the panel, the orientation of the panels, we obtain an approximate forecast of the productivity of the system in monthly and annual terms. As a basis for this paper, we took the analysis of productivity in the month of March, since it is the most critical month, the transition from the Winter season to the Spring season. Figure 4.4 shows the production forecast based on the design, and figure 4.5 shows the real production in the month of March obtained from Fronius Solar.Web. Fronius Solar.Web is an application for monitoring solar (photovoltaic) systems, this application gives us real-time data about our PV system. However, for more detailed data you need Premium Solar.Web, The productivity difference between the design and actual productivity for the month of March is 1.42%. This system also avoids the emission of carbon dioxide (CO2) 37,024 kg/year and this system is equivalent to planting 1,145.7 trees.

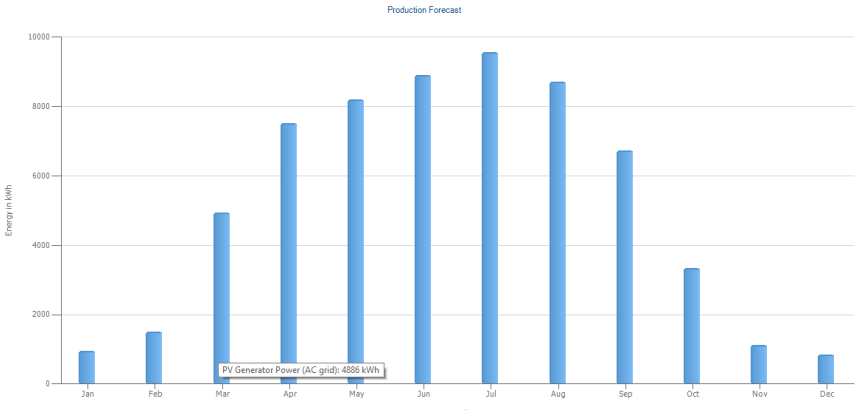

Fig. 4.4. Predicting energy production during design with PVSOL*Premium

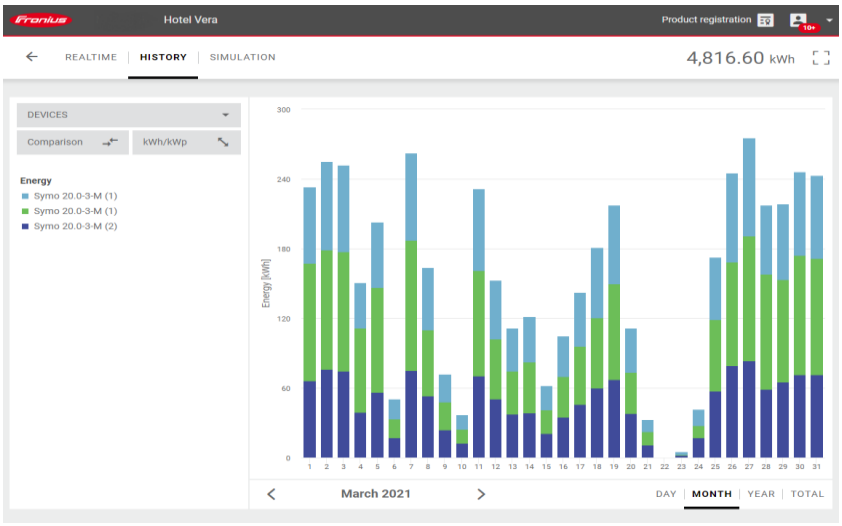

Fig. 4.5 Real-time monitoring by Fronius Solar.Web for the month of March

4.3. Energy balance

Some types of losses in a photovoltaic system are unavoidable, but it is important to consider every factor during design in order to avoid losses as much as possible. According to the software, this is expected to be the power balance.

PV System Energy Balance			
Global radiation - horizontal	**1,313.1**	**kWh/m²**	
Deviation from standard spectrum	-13.13	kWh/m²	-1.00 %
Orientation and inclination of the module surface	123.92	kWh/m²	9.53 %
Shading of diffuse radiation by horizon	0.00	kWh/m²	0.00 %
Reflection on the Module Interface	-62.95	kWh/m²	-4.42 %
Global Radiation at the Module	**1,360.9**	**kWh/m²**	
	1,360.9	kWh/m²	
	x 292.84	m²	
	= 398,537.8	kWh	
Global PV Radiation	**398,537.8**	**kWh**	
Soiling	0.00	kWh	0.00 %
STC Conversion (Rated Efficiency of Module 20.81 %)	-315,605.38	kWh	-79.19 %
Rated PV Energy	**82,932.5**	**kWh**	
Module-specific Partial Shading	-3,446.11	kWh	-4.16 %
Low-light performance	-10,339.83	kWh	-13.01 %
Deviation from the nominal module temperature	-3,160.26	kWh	-4.57 %
Diodes	239.26	kWh	0.36 %
Mismatch (Manufacturer Information)	-1,324.51	kWh	-2.00 %
Mismatch (Configuration/Shading)	-1,166.50	kWh	-1.80 %
PV Energy (DC) without inverter regulation	**63,734.5**	**kWh**	
Regulation on account of the MPP Voltage Range	-40.86	kWh	-0.06 %
Regulation on account of the max. DC Current	0.00	kWh	0.00 %
Regulation on account of the max. DC Power	0.00	kWh	0.00 %
Regulation on account of the max. AC Power/cos phi	0.00	kWh	0.00 %
MPP Matching	-14.69	kWh	-0.02 %
PV energy (DC)	**63,679.0**	**kWh**	
Energy at the Inverter Input	**63,679.0**	**kWh**	
Input voltage deviates from rated voltage	-61.51	kWh	-0.10 %
DC/AC Conversion	-1,882.23	kWh	-2.96 %
Stand-by Consumption	-28.21	kWh	-0.05 %
Total Cable Losses	0.00	kWh	0.00 %
PV energy (AC) minus standby use	**61,707.0**	**kWh**	
Grid Feed-in	**61,735.2**	**kWh**	

Fig. 4.5. Energy balance

Conclusion

The rapid increase in the number of the population and the increase in the standard of living resulting in the increase in the demand for energy, has caused that day by day the conventional sources of energy such as oil, coal, natural gas are going towards exhaustion, even more so due to the production of electricity from coal causes significant pollution in the environment, it also has significant negative health effects. Therefore, it is necessary to think about another type of energy that is easily accessible, does not pollute the environment and is inexhaustible. Through the use of solar energy in Kosovo, the emission of CO2 into the atmosphere will be reduced, because by producing electricity from photovoltaic panels, we will significantly reduce the amount of electricity consumed by the electricity network, which in our country is produced from conventional sources. Production capacity from solar PV in Kosovo is still not very

large. The PV panels that are applied in Kosovo are mostly polycrystalline, because they are more economical. As a case study, we took and analyzed the productivity of the photovoltaic system with an installed capacity of 60.3kWp for the month of March, 2021. Where through the monitoring enabled by Solar.Web we saw the differences between the design and the real project for the month of March. The difference was 1.42% less than expected. By means of this system, the emission of carbon dioxide (CO2) 37,024 kg/year is avoided. And it is equivalent to planting 1,145.7 trees.

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