Implementation of photovoltaic technologies, according to Albanian climatic conditions

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Abstract

Albania a country in a developing way, with the respective problems of transition to be affronted, is forced to get an adequate solution to the increasing national energetic request, especially for electricity. Still now, in 2010 is continuing the power cut (especially in urban outskirts). The negativities created as impact of this phenomenon are present and reflected in the quality of education process, the ongoing of small business, families life, etc., so to the whole country economy. The perspective seems that also in a near future these kinds of problems will be present. In other part, the natural sources of the country present an optimistic perspective, especially for PV, as a helpful solution for this problem. In the context of new high-tech and the possibility to implement the alternative energy, the PV technology will be one of the most important elements, which can improve the situation and minimize the loads to the electric national network.

Keywords: *climate, reneweable energy, Abanian territory.*

1.Introduction

Development of infrastructure for an optimal implementation of photovoltaic system (PV), needs - Recognition and evaluation of solar energy sources, considerating the factors affected to it:

- Climatic and physio-geographic diversity;
- Spatial concentration of consumers necessity to energy.

The paper consists in the evaluation of energetic potential, integrated on urban systems. The main objective is the evaluation of energetic potential of photovoltaic systems in Shkodra's area, in optimum angle, fixed system and 2-axis tracking system, owing to GIS techniques, satelite information, atmospheric circulation models, data locations from meteorogical stations etc., giving very important information for all interested people, investitores and different users.

2.Study Area

Study area include Shkodra location, analysis to data of Shkodra meteorological station, evaluating the index of irradiation on horizontal, optimal and inclinal surface.
Albanian territory in general, especially Pre-Adriatic zones, as you can see from the solar irradiation map, result to have 2000-3000 solar hours/year.

The data accumulated and proccesed for a yearlong monthly average in Shkodra city, conclude that an optimum inclination angle PV system (H_{op}), generates more solar days (exactly 4810), than 90 degree PV systems (only 3140 solar days generated), or horizon irradiation plane PV systems (4180 solar days).
In fixed systems with inclination angle 34º, yearly average sum of generated energy is 1310 kWh and yearly average sum of emitted energy is 1760 kWh/m^2.
In 2-axis tracking system this numerals are respectively 1760 kWh and 2350 kWh/m^2, which means that this kind of system in Shkodra zone parameters, is more effective to generate the quantity of energy needed.

Background. Albania is undergoing a serious energy crisis due to insufficient investment in power generation and distribution, combined with a major increase in energy demand. Prices have been rising, putting pressure on those who have low incomes. At the same time, usage limits are also becoming stricter. Very little, if any, solar energy is being harnessed in Albania to meet this demand.

Project Description. There's a project testing the viability of using solar energy to pump water in two villages in Albania. In one village, solar photovoltaic panels were installed to pump water, and in the other, they were used for irrigation. The communities were trained in maintenance, and an awareness campaign was initiated to spread information about photovoltaics. The results of the project suggest that while solar panels have benefits, other methods, such as improved efficiency and possibly solar water heating, may address Albania's energy crisis more cost-effectively.

Implementation. The Energy Efficiency Center (EEC) first selected the two villages in which the photovoltaic panels would be tested. After researching the market, they selected a supplier of the photovoltaic equipment. The villages had some existing water supply infrastructure that had been put in place by a development agency, CAFOD. The project made as much use of this infrastructure as possible. In addition, instead of installing battery systems for storing electricity, it turned out to be more cost-effective in both villages to construct water reservoirs in order to deal with peak hours of water consumption. After receiving training from the supplier, members of EEC installed the water supply systems, and then trained villagers to maintain and operate them. In the village in which photovoltaics are used for irrigation, the panels were mounted on a farmer's roof, and he was responsible for maintaining them. The other village decided to pay someone to take care of maintenance. Installation was followed by an awareness campaign and a survey of the villages to assess the impacts of the systems impact on their lives.

Technology. The supplier of the panels was Helios Technology. EEC designed and installed the systems, including the control unit, main switch, pumps, and supporting cable.

Environmental Benefits. These two villages (Prefecture of Lushnja) now use solar energy to pump their water, which means they do not need to rely on fossil-fuel powered electricity for this purpose, thereby avoiding emissions of greenhouse gases.

Livelihood Benefits. The improved water supply for irrigation has increased farmers' ability to grow crops, thereby improving their income generating capacity. The village with improved access to potable water may have benefited from improved sanitation.

Beneficiaries. The primary beneficiaries are the residents of the two villages receiving water via solar water pumps. In addition, members of EEC have also benefited from the training and experience they through this project, which will help them implement other solar energy projects and also better assess all options for addressing the energy situation in Albania.

Capacity Development. EEC members received 4 days of intensive training by the supplier in the basics of solar energy, photovoltaic system, and specific applications such as water pumping. They also made site visits to see how installed PV systems operate. Finally, they received on-site training in how to assemble the systems. This training is of immense benefit to the NGO, since its ability to assess options for meeting Albania's energy crisis is greatly improved.

Compilation and application of the same detailed projects, in our country, brings to solution of serious economic problems, as for consumer, as for the government himself.

3. Tables, Figures and Graphics

3.1. Tables and Figures

Table 1(1) Solar hours according to locations
in Albanian meteorological stations

City	Solar hours (hours/year) 1951-1960	1961-1970	1971-1980	1981-1990	Aver.1951-1990
Vlore	2374	2718	2765	2524	2685
Durres	2666	2684	2717	2310	2595
Kuçove	2523	2674	2648	2441	2574
Shkoder	2533	2489	2370	2232	2406

Table 2(2)

City	SHK	LE	TIR	DRR	LU	KU	FR	VL
Solar hours av./day	6.6	7.1	7.1	7.4	7.3	7.2	8.1	7.6

Maximum energy emitted from optimum inclination
Shkodra Location

Table 3(2) Solar Irradiation, yearlong monthly average

Month	H_h	H_{opt}	H(90)	I_{opt}	T_L	D/G	T_D	T_{24h}	N_{DD}
January	1700	2810	2820	63	2.6	0.52	7.0	5.8	367
February	2400	3450	3070	55	3.1	0.50	8.1	6.7	294
March	3600	4470	3330	43	3.1	0.48	11.0	9.6	211
April	4940	5360	3170	28	3.6	0.43	14.7	13.3	77
May	6120	6010	2830	15	4.1	0.40	20.3	18.5	5
June	6730	6270	2580	8	3.9	0.37	24.7	22.7	0
July	6970	6680	2830	12	4.6	0.33	27.2	25.2	0
August	6260	6590	3460	24	3.6	0.33	26.8	24.9	0
Septem.	4810	5880	4060	40	3.7	0.34	21.9	20.2	8
Octob.	3190	4530	3870	53	3.3	0.41	17.9	16.2	115
Novem.	2000	3290	3250	62	3.2	0.46	12.4	10.9	268
Decem.	1390	2310	2360	64	2.7	0.57	8.2	7.1	353
Year	**4180**	**4810**	**3140**	**35**	**3.5**	**0.40**	**16.7**	**15.1**	**1698**

Ed **:** Daily average of electric energy generated from system. (kWh)
Em : Monthly average of electric energy generated from system. (kWh)
Hd : Daily average sum of irradiation per meter square emitted from system's modules. (kWh^2)
Hm : Global average sum of irradiation per meter square emitted from system's modules. (kWh/m^2)
$\mathbf{H_h}$: Horizon irradiation plane. (Wh/m^2)
$\mathbf{H_{opt}}$: Irradiation optimum inclination (Wh/m^2)
H(90): Irradiation angle 90°. (Wh/m^2)
$\mathbf{I_{opt}}$: Optimum inclination (degree)
T_L: Linke Turbidity Factor (-)
D/G: Ration of diffuse to global irradiation(-)
T_D: Average daytime temperature(°C)
$\mathbf{T_{24h}}$: Average 24 hour temperature (°C)
$\mathbf{N_{DD}}$: Heating degree days (-)

Table 4(2)

Fixed system: incl.=34°, orientation= -2° (optimal)				
Month	Ed	Em	Hd	Hm
January	2.25	69.7	2.79	86.4
February	2.73	76.4	3.43	96.0
March	3.44	107	4.46	138
April	4.06	122	5.37	161
May	4.44	138	6.03	187
June	4.53	136	6.31	189
July	4.80	149	6.72	208
August	4.70	146	6.61	205
September	4.32	130	5.87	176
October	3.41	106	4.51	140
November	2.58	77.3	3.26	97.9
December	1.85	57.3	2.29	71.0
Yearly average	3.60	109	4.81	146
Yearly sum	***(kWh)***	***1310***	***(kWh/m^2)***	***1760***

Table 5(2)

2-axis tracking system

Month	*Ed*	***Em***	*Hd*	***Hm***
January	2.79	**86.5**	3.51	**109**
February	3.35	**93.8**	4.24	**119**
March	4.32	**134**	5.60	**174**
April	5.36	**161**	7.05	**212**
May	6.16	**191**	8.30	**257**
June	6.64	**199**	9.16	**275**
July	6.93	**215**	9.60	**298**
August	6.63	**205**	9.24	**286**
September	5.74	**172**	7.77	**233**
October	4.33	**134**	5.74	**178**
November	3.25	**97.5**	4.15	**125**
December	2.27	**70.5**	2.86	**88.7**
Yearly average	4.82	**147**	6.45	**196**
Yearly sum	***(kWh)***	***1760***	***(kWh/m²)***	***2350***

Ed: Daily average of electric energy generated from system. (kWh)
Em: Monthly average of electric energy generated from system. (kWh)
Hd: Daily average sum of irradiation per meter square emitted from system's modules. (kWh^2)
Hm: Global average sum of irradiation per meter square emitted from system's modules. (kWh/m^2)

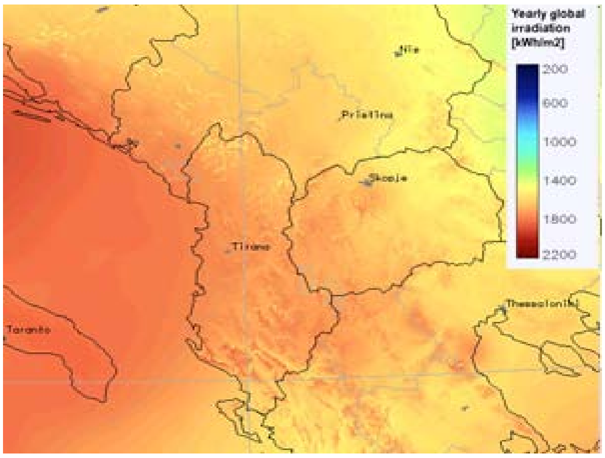


Fig. 1(2) Yearly global irradiation in optimum inclination - ALBANIA

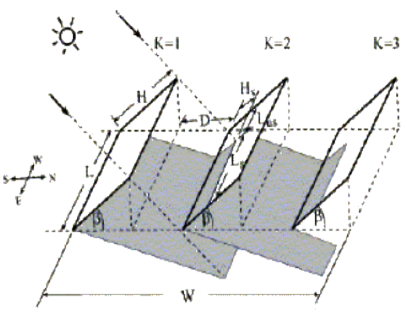


Fig. 3(2) Optimum angle scheme

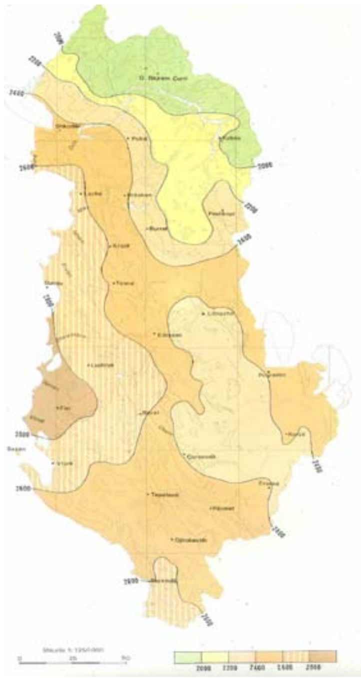


Fig. 2(2) Map of solar irradiation zones in Albania

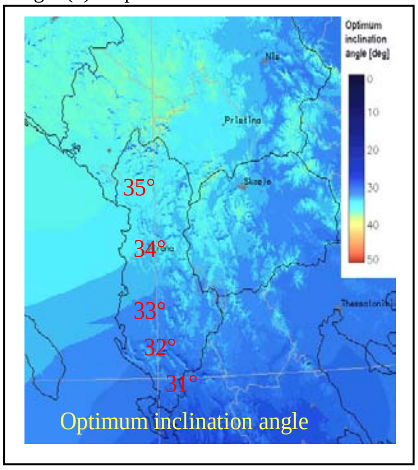
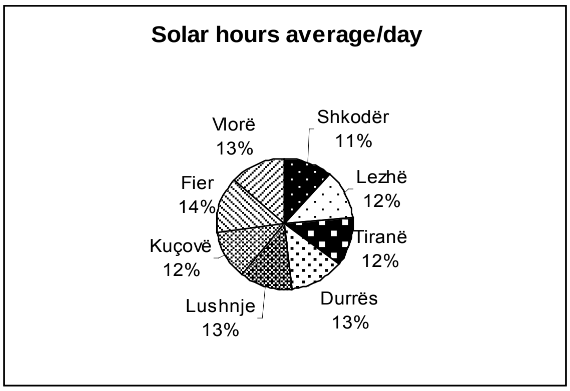


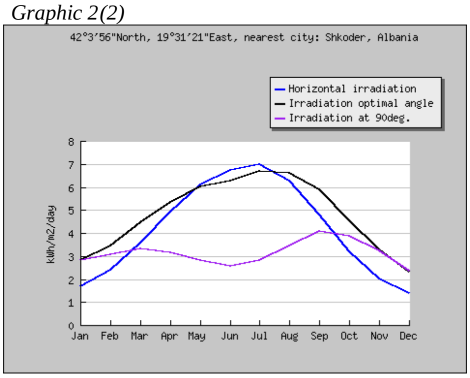
Fig. 4(2) Optimum inclination angle in some Pre-Adriatic locations

3.2. Graphics



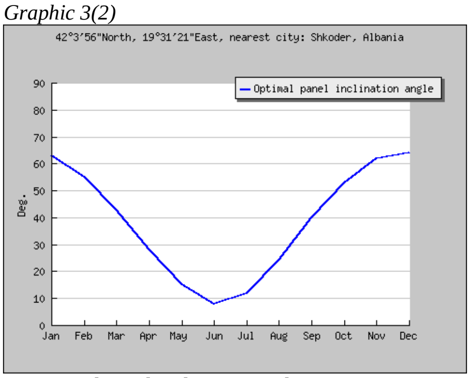
Graphic 1(2) Solar hours average/day in Pre-Adriatic lowland locations

Graphic 2(2)



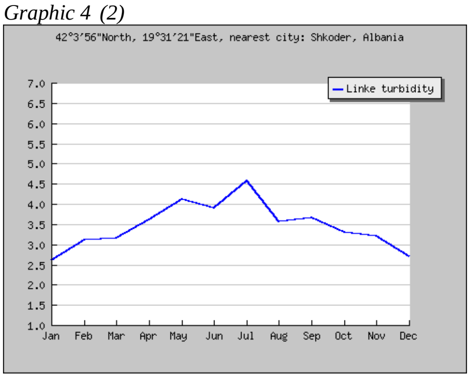
— Horizontal irradiation
— Irradiation optimal angle
— Irradiation at 90°

Graphic 3(2)



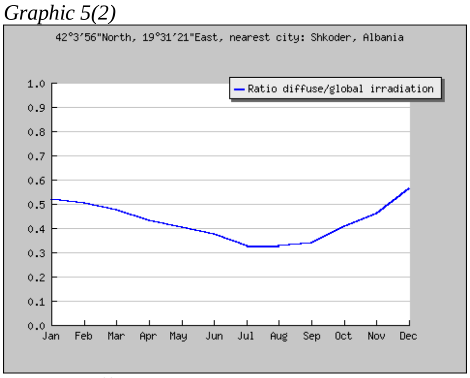
— Optimal panel inclination angle

Graphic 4 (2)



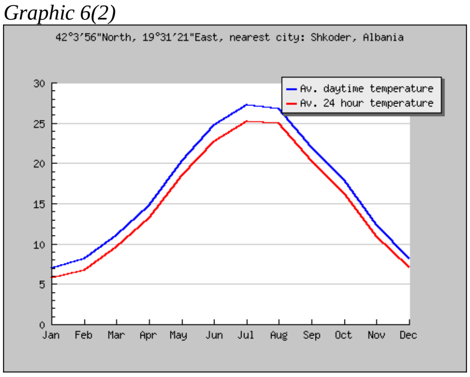
— Linke Turbidity Factor

Graphic 5(2)



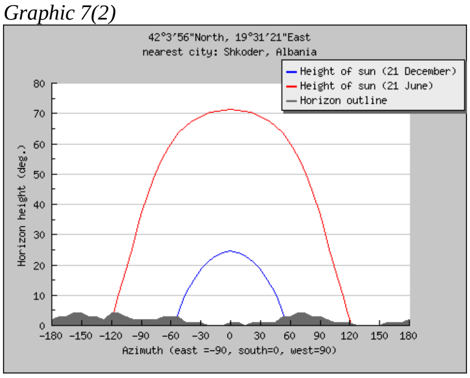
— Ratio diffuse/global irradiation

Graphic 6(2)



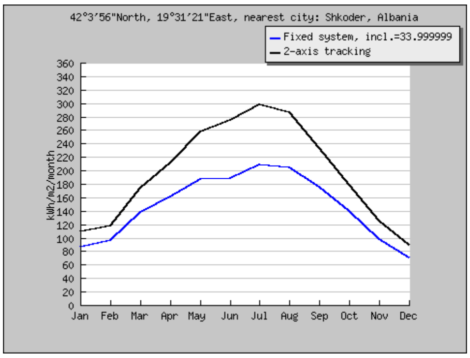
— Av. daytime temperature
— Av. 24 hour temperature

Graphic 7(2)



— Height of sun (21 dhjetor)
— Height of sun (21 qershor)
— Horizon outline

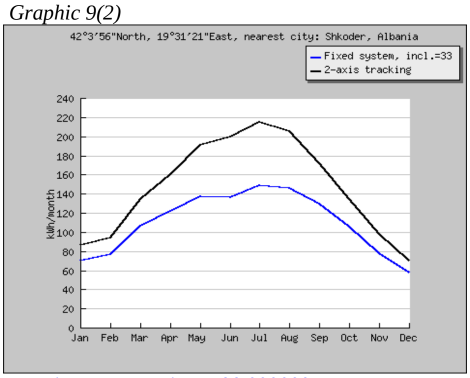
Graphic 8(2)



— Fixed system, incl.=33
— 2-axis tracking

ELECTRICITY GENERATED

Graphic 9(2)



— Fixed system, incl.=33,999999
— 2-axis tracking

4. Conclusions

The Albanian territory, especially Preadriatic zone, has the optimum climatic conditiones to implement the PV systems. As we can see, Shkodra in optimum inclination of 35º, can provide a satisfied quantity of energy with 2-axis tracking PV system, compared to fixed system. The study will continue with Fieri and Lushnja locations (as Shkodra), where the meteorogical stationes are installed. Based on data accumulated and processed in years, for the two zones, conclude that this zone of Albanian territory, such as western lowland part, is in optimal condition to upply similar projects installing photovoltaic systems.

Acknowledgement
The author express gratitude to Prof.Dr. Petrit Zorba, Polytechnic University, Institute of Energy, Water and Environment, for his constant encouragement and motivation on this paper.

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