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Utilizing Renewable Energy Sources in Kosovo till 2020

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Abstract: -This paper presents the utilization possibility of Renewable Energy Sources (RES) for electricity generation in Kosovo based on governmental targets set by the Ministry of Energy, published in 2007, for the period 2007-2016 and extrapolated till 2020. Recently the Ministry of Energy has revised the Energy Strategy of Kosovo for period 2009-2018. Based on this strategy government has set a high priority to establish a regulatory framework to encourage the development of RES that is cost reflective, affordable for end consumers, efficient, and bureaucratic less – appearances that make RES regulatory policies more attractive to domestic and foreign investors. Furthermore it is presented an economic assessment of RES deployment options in Kosovo, in order to identify the policies needed for establishing a proper regulatory framework for the promotion of RES in electricity generation in Kosovo. The utilization of RES in Kosovo will be supported by feed-in tariff schema. 'Feed-in' tariff is a description of a policy, a "tariff" used to purchase RES generated electricity that is "fed" into or sold to the grid. Usually the price depends from the technology used such as wind, water, photovoltaic, biomass, geothermal, etc. The feed-in tariff is becoming the key policy tool used to shift the world's energy mix away from fossil fuels to renewable energies to address energy security of supply, climate change, and economic growth. Advantages of generation electricity from RES are widely accepted even the technologies used are not economically competitive with conventional technologies.

Keywords: Feed-in Tariffs, Energy, Renewable.

1 Introduction

Kosovo is a relatively rich country with RES, including the potential for biomass in form of wood, as well as water, solar energy, wind energy, biomass from waste, solid waste and geothermal energy. The prefeasibility study has been done for a part of energy hydro-potentials, and in 2008 assessment was done for solar energy, wind, biomass and geothermal energy potentials [1]. It is also completed the identification and preliminary assessment of all small, yet important, hydro-power plants which are available for Kosovo. With the aim of promoting the use of RES, is contracted the implementation of projects for the use solar energy for heating of sanitary water in the University Clinical Center of Kosovo and in the Student Center in Prishtina.

Ministry of Energy published in year 2007 the indicative targets to be fulfilled by RES till 2016. These values are extrapolated till year 2020, as presented in Table 1, and they would envisage RES production to reach 1 TWh (or 12% of total electricity consumption in Kosovo in year 2020).

Table 1: Kosovo RES targets set by the Ministry of Energy in 2007, extrapolated for 2020

Source of Energy	Indicative targets for RES electricity consumption (GWh)										Extrapolation
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2020
Hydro	125,8	134,6	145,0	156,3	167,0	178,4	190,5	203,2	216,7	230,4	302,1
Wind	0,0	0,0	0,0	32,6	68,7	108,5	151,9	199,8	252,1	309,9	652,1
Solar	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Biomass	0,0	0,0	0,0	0,0	11,6	17,5	19,8	23,3	29,1	29,1	38,4
Total	125,8	134,6	145,0	188,9	247,4	304,4	362,2	426,2	497,9	569,4	992,5

Net electricity demand in Kosovo reached 5.2 TWh in 2009 [2]. According to existing estimations, future net electricity demand may increase up to 7-7.4 TWh in 2018[3]. In order to obtain medium-term values, these data are extrapolated to forecast demand in 2020 at 7.4-8 TWh (medium- and high-demand growth scenarios respectively), as presented in Figure 1.

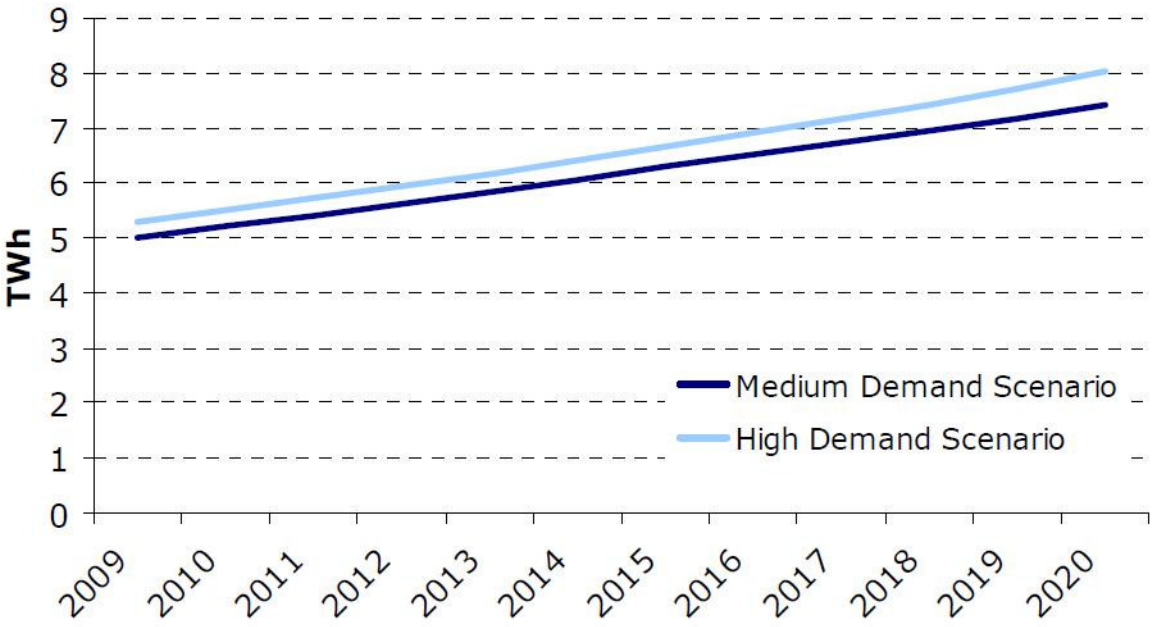

Figure 1: Forecasted energy demand in Kosovo till 2020

For the implementation of these indicative targets, as presented in Table 1, the Energy Regulators Office (ERO) has adopted the feed-in tariffs, an incentive schema for the generation of electricity from RES [4].

Feed-in tariffs should reflect possible electricity price increases, as result of inflation, or possible (but significant) impact of other relevant factors. Application of 'feed-in' tariffs is usually accompanied with a suitable system of certification of the origin of electricity sold/purchased with these tariffs. It is important that 'feed-in' tariffs are set so that they attract private investors, and for banks to fund RES investments. In EU countries, RES energy investors/purchasers are looking towards countries with the highest tariff rates. It is also important creation of the framework (as started in EU) for using the Photovoltaic Technology in combination with other renewable energies, as a suitable and cost effective option to provide sustainable access to electricity in the developing world and to help fight poverty and climate change [6]. Stand-alone Photovoltaic systems have been confirmed as an appropriate option for bringing electricity to scattered households.

2 Promoting of Renewable Energy Sources

Development of RES requires a series of incentives, because their technologies cannot compete in the energy market with conventional technologies of energy generation. However, it must be stressed out that part of RES technologies is increasingly becoming cheaper. The United Nations Development Programme (UNDP) conducted in year 2000 envisages that the cost of technology will be decrease over upcoming years, as presented in Figure 2 [9].

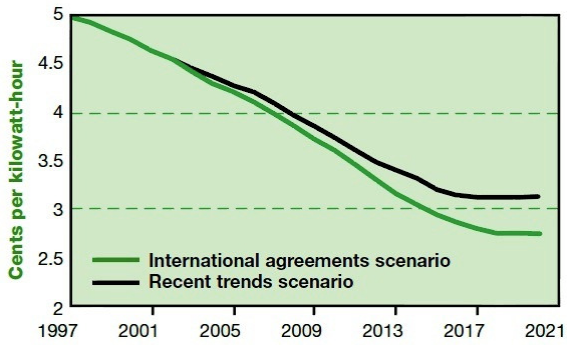

Figure 2: Forecasted technology cost by UNDP

RES incentives can be summarized in two categories [5]:

- Fiscal, and
- Regulative

The fiscal incentive mainly relates with the prices of RES energy sold to the grid and their facilitations for used technologies; and the regulative incentive is mainly linked with facilitations for the construction of the RES generation, conditions of their connection to the energy grid (when they ask to be connected), power purchase agreement (PPA) and also guarantees of contracts of energy trades, at least in the investment write-off period.

RES incentives are provided by some EU countries, USA, Canada, etc. We must stress out, that the RES incentive package has to be adjusted according to the conditions of each applying country, but best design models are already tested in the western world. Hence, in Kosovo, we don't have to invent a new approach, but rather to apply what is most suitable for our conditions, always in line with our applicable laws and European approach and acquis communautaire [7].

European experiences in supporting and encouraging RES development have evolved over time. Mechanisms used for their support can be grouped as follows;

- Price and
- Quantity

Below are listed the price based instrument and quantity based instruments.

- Fixed tariffs, also called 'feed-in' tariffs;
- Price premia (RES receive additional price component which is administratively set)
- Subsidies for a part of capital investments (it is a grand for investors to develop a RES capacities);
- Tax reduction;
- Fossil fuel taxis (carbon taxes or other pollutants, SO_x, NO_x);
- Bidding of a mandatory amount of energy deriving from RES;
- Mandatory quotes – (green) Certificates, and
- Tendering procedure

Green certificates are issued in respect to RES production and represent the renewable value of such production. This is also an obligation to produce or consume a specified minimum proportion of RES is imposed on generator or consumers. Tendering procedure will be organized by state or the regulatory authority for the supply of RES [4].

The instruments mentioned above are inherently mandatory. Another class of incentives is based on voluntary decisions by customers. One of the best such known systems is green pricing when costumers are given the option to support an increased level of utility company investment in RES technologies through payment of an additional amount on their electricity bills to cover the RES incremental cost [4].

The difference between these two categories is more in the way on which the price is determinate. More generally price based systems set a price per unit of RES and quantity based systems put an obligation upon customers/utilities to consume/generate a certain amount of RES. It can be said that both price- and quantity based instruments represent the dual approach and can achieve same outcome in case of certainty and perfect information by all involved parties. In Table 2 are presented the promotion instruments in EU Member States.

Table 2: RES Promotion Instruments in EU Member States

Instrument	RES-S	RES-H	Biofuels
Feed-in Tariffs and Price Premia	AT, BE, BG, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, LV, LT, LU,MT, PT, SK, SI, ES	FI, FR	
Investments Subsidies and Support Schemes	BE, CY, DE, LU, SI, ES, UK	AT, BE, BG, CY, DE, IE, LT, LU, NL, PT, SK, SI, ES, SE, UK	IT
Mandatory Minimum Quotas	LV	ES	CZ, FI, FR, DE, PL, SK, SI
Renewable Targets and Tradable (Green)	BE, IT, NL, PL, RO, SE, UK		UK
Tendering Procedure	PT		
Tax Exemptions and/or Rebates	FI, MT, PL, SK	DK, FI, FR, GR	AT, BE, BG, CY, DK, EE, FI, FR, GR, HU, IE, IT, LT, LU, MT, NL, PL, PT, SI, ES, SE, UK
Tariff Premia or Bonus	CZ, DK, NL, SI		

Feed-in tariffs have achieved the best performances for promoting the development of RES in comparison with mandatory quotes. These differences in performance may be due to the fact that support

mechanisms based on RES quotas and tradable certificates:

- are basically complexly, they require to launch a secondary market to trade the green certificates
- has not been achieved the proper implementation in all jurisdictions and participants, and still have to be informed about this mechanisms

3 Uses of Renewable Energy Sources in Kosovo

Kosovo is a signatory party to the Treaty for the establishment of the Energy Community (EnCT) of South-East Europe that entered into force in 1 July 2006. Within this context, the Government of Kosovo remains substantially committed to develop the energy sector in compliance with EnCT requirements. According to the provisions of the EnCT Kosovo is committed to increase the amount of energy generated from renewable resources in its generation portfolio. It is clear that the increase of the amount of energy generated from renewable resources is important for Kosovo in the aspect of diversification of energy sources and almost full dependence from lignite combustion generation capacities (98%). In order to achieve these indicative targets, the energy sector has initiated the approval of incentive tariffs (feed-in tariffs) for the use of RES, and in the near future will create a system for green certificates.

The accomplishment of forecasts for energy generation from RES is a long-term objective which also relates to the fulfillment of the ECT obligations and the Kosovo process of European integration. Increase of the use of RES will contribute to the realization of three objectives of the country's energy policy: support for the overall economic growth; increase of the security of supply; and, environment protection

Completion of the legal and regulatory framework for RES shall include the further harmonization with respective European directives and the adoption of the Law on Energy Efficiency, which also addresses RES from the standpoint of institutional and financial support for their development. Therefore Kosovo is required the implementation of the EU planned objectives 20-20-20 for energy; meaning that by 2020, there has to be:

1. Reduction of green gas emissions by 20%;
2. Increase of renewable energy resources participation in the energy consumption to 20%, and
3. Improvement of energy efficiency by 20%.

- to build the price of certificates to provide the signal to promote the investment.

In the recent years based on the Kyoto Protocol the Clean Development Mechanism (CDM) has become an option for stimulating RES investment. The drawback of this approach is that the CDM does not allow financing of RES project because of the negligible "carbon" credits it grants for the sale of greenhouse gas emissions cover a small part of investment costs.

Support for the achievement of these objectives in the long term should be programmed starting today. The support shall consist of a package of incentives in line with the European approach and best global practices.

Currently biomass in the form of wood, hydropower and small amount of wind are the main RES contributors to the energy supply in Kosovo. The use of solar energy is still in very early beginning, few pilot projects for water heating situated in some public buildings, financed from government. In Table 3 are presented RES potentials in Kosovo in year 2010 [10].

Table 3: RES potential in Kosovo

Type	Potential
Biomass, wood	0,9 million m^3
Biomass, livestock	352 000 cattle, 152 000 sheep/goats
Solid waste	0,44 million ton
Solar energy	1.500-1.650 kWh/m2/year
Wind energy	32,6 GWh
Geothermal energy	Unknown

4 Regional and European experiences with feed-in tariffs

Incentive mechanisms in EU member states differ significantly from one country to another [4]. In many countries, along with the main support schemes, such as 'feed-in' tariffs or 'green quotas and certificates' there are also other mechanisms. A visual presentation of incentives utilized in EU member states shows that predominantly they make use of 'feed-in tariffs' (also known as fixed tariffs), as presented in Figure 3.

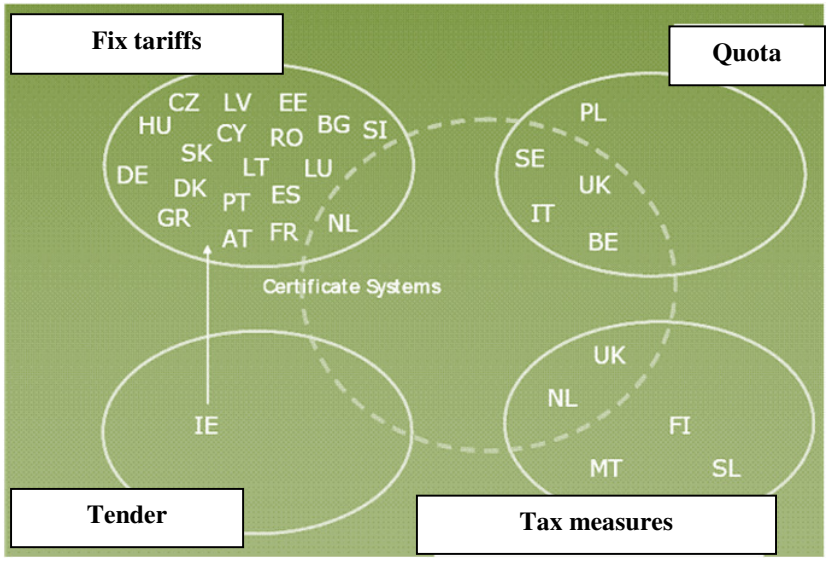

Figure 3: Incentives in EU member states

Kosovo is preparing and has presented a concrete plan for implementing the requirements of the Directive 2001/77/EC approved by the European Parliament and the Council on promotion of electricity produced from renewable energy resources for the internal (EU) market.

Croatia is a non-EU state where policies for promotion of RES and co-generation are significantly advanced, compared to other countries of the region. As noted above, 'feed-in' tariffs are simple to apply from an administrative viewpoint. They provide the investors with income guarantees from the project as well as an opportunity to relatively simply calculate the feasibility of investment projects in utilizing RES. Also, they provide financial institutions with means to directly assess gains from these projects and possibilities for loan return.

Usually, RES investments are accompanied by multi-year power purchase agreements (PPA) for electricity produced by them. This is another rather important incentive for this sort of investments. The PPAs are rather significant for the countries where the electricity market is under development.

Feed-in tariffs and premiums are used in different states of EU [8]. For each incentive scheme must be discussed as follows:

- the concept: a short description of the system
- advantages and disadvantages

The feed-in tariffs and premiums are regulated by government. Feed-in tariffs take the form of a total price per unit of electricity paid to the producer whereas the premiums are paid to the producer on top of the electricity market price. The tariff and premiums are normally guarantied for the period of 10-20 years, depending on state policy. In Kosova the guaranty period is 10 years. Even many of the EU countries apply the feed-in tariffs as main support scheme this scheme differs because of different tariff levels are used.

Advantages of this system as designed in different EU countries (Germany, Spain, and Denmark) is a longer term certainty about receiving support, which reduce the investment risks. Another advantage is the technology specific support. Many stakeholders expressed a preference for the countries with strong feed-in tariffs systems which tariffs are suitable as long-term stability and transparency [8].

A relevant summary of relevant experiences of certain EU member states and countries of the region on renewable resources incentives is provided in Table 4 [7].

Table 4: Experiences in EU countries

No.	Country	Incentive				Note
		Uniform fix tariffs	Long-term contracts	Concession (highest economic rent)	Quota obligation	
1	Germany	Yes				Fixed tariffs set by the Government
2	Italy, UK, Sweden				Yes	Marginal price in the electricity market
3	Ireland	Yes	Yes	Yes	Since end-2007	e.g. tariffs +35% incentive, set by the Government
4	Macedonia	Yes	Yes	Yes		Supported by WB; Fixed tariffs set by the Government
5	Albania	Yes	Yes	Yes		Supported by KfW

It should be noted that the surrounding countries, such as Macedonia and Montenegro and Albania apply an open concession awarding process for the utilization of small hydro potentials by private investors. This is done in an effort to achieve a rational use of these resources.
Macedonia and Montenegro have determined the main criterion for selection of private investors to construct small hydro power plants to be the highest "economic rent" for the budgets of the countries. This criterion practically eliminates the 'un-merited' subsidy that the 'feed-in tariffs' can provide to investors, thus providing the investors with benefits according to concrete conditions of the local energy market. This approach is also to be applied in Kosovo.

5 RES technologies in Kosovo and feed-in tariffs

5.1 Energy demand forecast till 2020

As stated in revised Energy Strategy of Kosovo, two most important indicators used in energy forecasts of any country are energy intensity and energy consumption per capita. Energy intensity is a measure of the energy efficiency of a nation's economy and it is calculated as units of energy per unit of Gross Domestic Product (GDP). Kosovo has medium level of energy consumption per capita, almost twice as high as Albania and its energy intensity is the highest in the region, after Bulgaria [3].
Two possible scenarios of the GDP growth rate till 2018 are supposed to be more realistic for planning the country economic development and forecasting the energy demand, as shown in Table 5.

Table 5: Growth scenarios of GDP in %

Scenario	2009-2010	2011-2014	2015-2018
Medium	3.20	3.10	3.00
High	6.20	5.29	5.00

Figure 4 presents Kosovo energy consumption from 2003 to date and the forecasted energy demand for the period until 2018 [3].

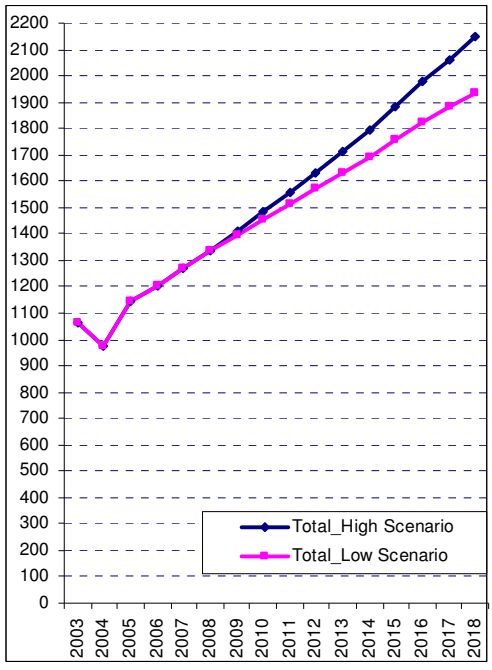

Figure 4: Energy demand forecast (ktoe)

The medium demand scenario (MDS) for electricity envisages a modest increase of demand, especially in the household sector, whereas high increase of demand is projected for the services and industrial sectors. Electricity demand in 2018 is projected at 7 TWh/year, associated this with a peak load of 1,543 MW in the power system. The high demand scenario

(HDS) envisages the demand of 7,4 TWh/year in 2018, with a peak load of 1,671 MW. Based on the revised Energy Strategy the supply of electricity during the period 2009–2018 will be achieved by domestic generation and imports which will be needed until around the mid of 2015. Government of Kosovo plans in 2016 to have operational the first unit of new thermal power plant (New Kosovo Power Plant) and after this time imports will no longer be needed

The electricity disbalance is represented in Table 6, and it can be significantly reduced by using RES electricity.

Table 6: Forecasted demand and generation of electricity

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Demand [GWh]										
MDS	4994	5226	5418	5621	5834	6059	6295	6500	6715	6939
HDS	5299	5514	5713	5929	6164	6422	6662	6898	7153	7431
Generation	4721	4779	4804	4979	5004	4529	6237	8702	10717	11627
Balance [GWh]										
For MDS	-273	-447	-614	-642	-830	-1530	-58	2202	4902	4688
For HDS	-578	-735	-909	-950	-1160	-1893	-425	1804	4464	4196

5.2 RES Technologies

RES technologies used for the analyses are:

Biogas is the gaseous by-product that results from a natural decomposition process of organic matter. This process includes the production of mixed gas:

- 50%-70% methane (CH4);
- 20%-40% carbon dioxide (CO2); and
- other elements.

Solid biomass, the definition of solid biomass includes four categories:

- Forestry products;
- Forestry residues;
- Agricultural products, and
- Agricultural residues.

Electricity generation from solid biomass is characterized by,

- high variable costs due to high volatility in the quality of biomass used as input;
- non-volatility of the power output as in thermal conventional generation, the generator can decide when to start or stop the plant in order to maximize profits;
- various energy conversion concepts, from 'simple' combustion;
- differences in efficiency;
- biomass transportation distances.

Electricity generation from **small hydropower** plants is characterized by;

- Proven technology, hydro represents the most widely explored option,
- Low short-term volatility, high medium-/long-term volatility of power output, It is characterized by a strong seasonal dependence
- High initial investment costs,
- Low social acceptance, especially those with associated large reservoirs.

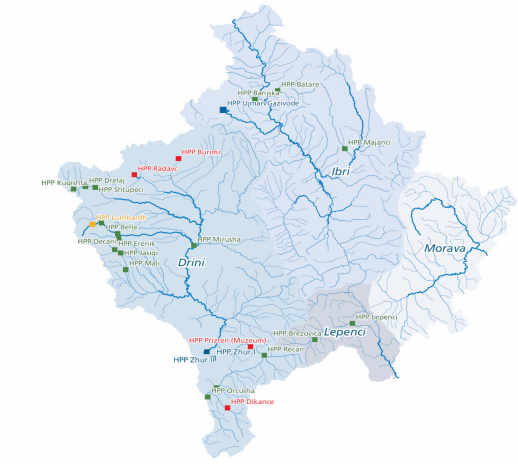

Figure 5: Location of hydro potentials sites

Electricity generation from **wind** is characterized by;

- High volatility of the power output, this is due to the strong dependence of the power produced on the wind speed
- Standardized and proven power conversion technology, sustainable and growing

demand for wind power, the largest available turbine is now in the 5MW class.

Figure 6: Wind map

Good wind sites have; wind speed 6.6m/s, measured at 30 m high, nominal wind potential 500MW (Estimation based on a 2 MW wind power generation turbine of 80 meters blade's diameter; 5 turbines are placed in 1 km^2), load factor in average 1,867 hours of operation.
Load factor is calculated based on formula for energy estimations on wind farms, equation (1):

$$E = (2 - \frac{V-7}{4}) D^2 V^3 \qquad (1)$$

Where
E – is the energy in MWh/yr,
V – is wind speed in m/s at 30 m height,
D – is the blade diameter
Best wind sites have: 7.5 m/s measured at 30m height, nominal wind potential 250MW (Estimation based on a 2 MW wind power generation turbine of 80 meters blade's diameter; 5 turbines are placed in 1 km^2), load factor in average 2530 hours of operation (is calculated as in formula 1) [4].

Photovoltaic (PV) power cells use a specific spectrum of sunlight to produce electricity through the photoelectric effect. There are four primary applications for PV power systems:

- As off-grid domestic rooftop PV systems
- As grid-connected distributed PV systems
- As grid-connected centralized PV systems
- As off-grid non-domestic systems

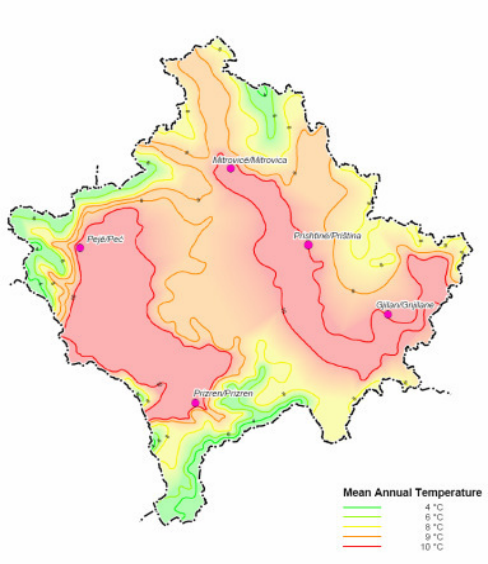

Figure 7: Solar map

Electricity generation from **waste** is characterized by:

- Low variable costs but high investment costs, due to the fact that these plants require a large investment in technologies for cleaning and purifying the input material;
- Non-volatility of the power output;
- Short distance for waste transportation being desirable.

5.3 Feed-in tariffs

Already approved 'feed-in' tariffs for energy generated from small hydro power-plants and wind are as follows [4].

Table 4: Feed-in tariffs small Hydro Power Plants

HPP Capacity	Price (cent/kWh)
Hydro Power Plants up to 2 MW	6.70
Hydro Power Plants between 2 MW and 5 MW	5.90
Hydro Power Plants between 5 MW and 10 MW	5.60

Whereas, the feed-in tariffs for energy produced from wind are as follows:

Table 5: Feed-in tariffs Wind

Incentivized tariffs (feed-in)	Price (cent/kWh)
All generators using new technology	8.4

Table 6 provides a summary of the feed-in tariff level required to achieve the technology-specific RES targets in 2020 [4].

Table 6: RES-E Targets and Multiple Feed-in Tariffs

Technology	Energy [GWh]	Price/MWh [Euro]
Hydro	167,50	54,86
Wind	652,06	90,85
Solar	0,00	n.a
Biomass	38,38	67,34

6 Conclusions

Feed-in tariffs comprise a stimulating mechanism for investments in the energy sector. They are dependent from RES technology used for electricity generation. In the future this mechanism will be accompanied with the application of other incentivizing mechanisms for successful development of RES in our country. The usage of renewable in case of Kosovo is twofold: (i) fulfilling EU and government targets of RES, and (ii) fulfilling the gap of electricity supply, which otherwise must be imported with very high electricity prices.

'Feed-in' tariffs have resulted particularly successful in the stimulation of electricity generation from hydro and wind energy. It is simple for application and is not associated with complex energy trade agreements. Feed-in tariffs should be different for different technologies (wind, water, solar, biomass, etc.), and often is different for various sizes of generation plants within one single technology.

This approach is the most preferred mechanism of the European Commission (EC) as noted in the EC Plan for the increase of energy consumption from RES and CO_2 emission reduction by 2020.

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An assessment of Greek legislative framework for photovoltaics

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Abstract: A new legislation (Law 3468) was enacted in 2006 in Greece, providing for first time an appealing feed-in tariff (FiT) scheme for photovoltaics (PVs). The response of the market was immediate with more than 7,947 applications for licenses having been submitted in less than 2 years' time. Thereafter the regulations of Law 3734/09, as well as the new development program for small-scale PV systems in buildings, formed an even more attractive investment and licensing framework for PVs, by introducing additional guarantees for feed-in tariff, improving licensing procedures and providing higher tariff and tax free income for building installations. However, the large number of applications submitted until today, which have already exceeded the national target for PVs' penetration in electricity market for 2020, caused tremendous delays (up to 3 years) in the assessment procedures carried out by the Regulatory Authority of Energy (RAE). Thus, the current government introduced a new Law (3851/2010), which aims to accelerate grid-connection procedures for the already applied PV parks but to facilitate also authorization processes for new applications of PV parks and building integrated systems.
Nevertheless, the effectiveness of this legislative framework cannot be judged solely by the response of prospective investors. Aim of this paper is to present and discuss an assessment of the FiT law in Greece, with respect to its ability to lift mainly bureaucratic barriers that led to significant delays in the diffusion of RES over the last 10 years.

Keywords: Photovoltaics, Feed-in tariff, Diffusion policy

21. Introduction

Photovoltaics (PVs) have been receiving, for almost a decade, new financial and regulatory support in many European Union (EU) countries, as they present a favorable case for clean energy, easy and fast installation, low maintenance requirements and the ability to produce electricity in the urban built environment. However, without the support of suitable instruments, the expansion of solar electricity markets worldwide will not take place at a satisfactory pace. Historically, Feed in Tariff schemes (FiT) have been the primary price-based policy instrument used to support RES development in Europe, since the early 1980's. The typical "Feed in Tariff" concept refers to the obligation of a utility to purchase renewable electricity, fed into the grid by private generators, at a specific tariff determined by a public authority, guaranteed over a given period of time and, as a rule, decreasing annually at a rate which will, at least in theory, act as a driving force for the RES industry to reduce production costs. Therefore, FiT seem to be an attractive diffusion system, at least for a low-level market, such as the PVs in order to help it take off.
In countries like Greece, with high and annually smoothly distributed insolation values, an enhanced FiT system might have the highest effect, since solar irradiation is at least 30.0% higher compared to northern Europe. Solar electricity cost could therefore be competitive to conventional peak power in the coming decade. Still, a diffusion system's success does not necessarily depend solely on rational parameters. In any case, the major objective of any PV FiT strategy, as Haas supported, is to call on the investors' willingness to pay (WTP) for PV systems (Haas, 2004).
Aim of this paper is to present an assessment of FiT system which implemented for first time in Greece in 2006, with respect to its ability to lift mainly bureaucratic barriers that led to significant delays in the diffusion of RES over the last 10 years.

22. Greek legislative framework for PVs

Until 2006, major legislative weaknesses, such as low tariff and short guaranteed periods, complex and long-lasting licensing procedures and regulatory and technical obstacles regarding the access to the grid, resulted in a discrepancy between objectives set and reality in relation to PV diffusion in Greece (Lazarou et al. 2007, Papadopoulos and Karteris 2009).
A new legislation (Law 3468) was enacted in 2006 in Greece, providing for first time after the initial deregulation of national electricity market (Law 2273/1999) an appealing FiT scheme for PVs. The response of the market was immediate with more than 7,940 applications (overall capacity up to 3.7 GWp) for

licenses having been submitted in less than 2 years' time, leading unexpectedly at the end of 2007, to the postponement of any further submission of PV applications to the Regulatory Authority of Energy (RAE).

Within this law, a national target until 2010 (namely 590 MWp in mainland plus 200 MWp in non-interconnected islands) was set, showing the political commitment towards solar energy's development, as part of its overall national target for RES.

Law 3468 predicted also that it is not mandatory to acquire a license to produce electrical energy as well as an installation and operating license, for a PV plant of less than 150 kWp; an exemption from this obligation was granted instead by RAE. The second authorization required, the Approval of Environmental Conditions (AEC) for the PV plant, is provided on a regional level by the Prefectural Directorate for the Environment. For PV plants with installed capacities of more than 150 kWp no significant changes were introduced compared to older legislation. However, no authorization and construction regulations were specified for small-scale building integrated PVs (BIPVs). Still, it should be noted that for the first time the law foresaw time limits for the actions of all authorities, bodies and organizations involved in the bureaucratic procedures. Furthermore, the Law involved a decree which introduced a land-planning map of Greece for RES and imposed for the first time specific conditions and terms that apply for the installation of RES. The decree's restrictions were rather recommendatory than mandatory for investors, in order to avoid delays in obtaining the administrative permissions, related frequently to local public resistance. More specifically, the decree foresaw that PV plants are forbidden in agricultural land of high productivity and if located in scar and arid land, in low altitude areas, at a distance from residential areas and with guaranteed accessibility to grid, they will be preferred and given priority in licensing procedures among other PVs' applications.

Thereafter, second FiT Law 3734 was introduced in early 2009, mainly due to the legal uncertainties, associated with the discrepancies occurred on a daily basis among authorities because of the total absence of planning and construction regulations for PV stations.

Within this law, a national development program for BIPVs was enacted (for small-scale residential systems below 10 kWp), applicable only for interconnected network, for first time but rather delayed, which provided BIPVs' investors with a remarkably high tax-free tariff and simplified grid-connection procedures to complete. However, this program concerned only PV installations on flat or sloped roofs and awnings, but not on shading devices and facades. Last but not least, construction regulations for PVs both for land and building applications were also specified, after three years' delay since Law's 3468/2006 introduction. These regulations foresaw that for the installation of photovoltaic systems no construction license is required, but approval of small scale construction work from the authorised Planning Directorate.

Nevertheless, since 2006, a large number of applications submitted, as it has been mentioned above, which resulted in much time-consuming authorization procedures carried out by RAE. Thus, Greek state was recently forced to introduce a new Law (3851/2010), for one more time within the last four years, which aims mainly to accelerate grid-connection procedures for the already applied PV parks but to facilitate also authorization processes for new applications of PV parks and BIPV systems.

Initially, a timetable with specific limits for PPC is established, which gives priority within grid-connection procedures to PV applications which have already been submitted for production licence since 2006. This kind of priority is also granted to professional farmers, who are allowed to apply for grid connection offers of new PV stations up to 100 kWp. On the other hand, time limits are imposed on PV investors for new PV applications for grid-connection offer, with a specific penalty clause included if the investors with signed grid-connection contract, delay to complete their PV projects.

Secondly, this new Law foresees that PV stations with installed electrical capacity smaller than or equal to 1 MWp are excluded from the obligation to obtain a license to produce electrical energy or any other certification decision. Apparently, these stations are also exempt from the obligation to obtain an installation license and an operating license as well as from the obligation of publication of the AEC decision as long as their installed electrical capacity does not exceed the limits of 0.5 MWp.

As far as BIPV are concerned, the national program, initiated in 2009, has been extended to the whole network including non-interconnected islands, and installations on shading devices and facades are, for now on, eligible for obtaining the high tax-free tariff.

The construction regulations for PVs are also modified, foreseeing an approval of small scale construction work only for PV stations sited on fields and BIPVs with installed capacity higher than 100 kWp. Planning terms about PVs on buildings and fields are also reconsidered, facilitating effectively planning and installation work. Moreover, in contrast with the existing land-planning map of Greece, PV stations are, for now on, allowed to be installed in agricultural land of high productivity, if only the land is located out of the boundaries of already enacted land use and development plans at municipal level. Details about current authorization procedures of PV stations are presented in Table 1.

Finally, national targets for renewable sources until the end of 2020 were revised based on Directive 2009/28/EC, as follows:

- The contribution of the energy produced from RES to the gross final energy consumption is set by a share of 20% and

- the contribution of the electrical energy produced by RES to the gross electrical energy consumption is set by a share of at least 40%.

Considering the above targets, the competent Ministry announced the cap of installed capacity of PVs until 2020 (Table 2).

Table 1. Authorization procedures of PV stations according to Law 3851/2010

Type of PV stations	Procedures / Mandatory approvals/licences
BIPVs' systems	
Capacity ≤ 10kWp (national development program of BIPVs)	i. Grid connection contract with network administrator (namely PPC) ii. Sale contract with network administrator (namely PPC)
10kWp < Capacity ≤ 100kWp	i. Grid connection contract with network administrator ii. Sale contract with network operator (TSO)
100kWp < Capacity ≤ 1MWp	i. Approval of small-scale construction work ii. Grid connection contract with network administrator iii. Sale contract with network operator (TSO)
1MWp < Capacity	i. Production license ii. Approval of small-scale construction work iv. Grid connection contract with network administrator iii. Installation licence iv. Sale contract with network operator (TSO) v. Operation license
PV parks	
Capacity ≤ 100kW	i. Certificate of exemption from the obligation of publication of an AEC decision ii. Approval of small-scale construction work (simplified process) iii. Grid connection contract with network administrator iv. Sale contract with network operator (TSO)
100kWp < Capacity ≤ 500kWp	i. Certificate of exemption from the obligation of publication of AEC decision ii. Approval of small-scale construction work (detailed process) iii. Grid connection contract with network administrator iv. Sale contract with network operator (TSO)
500kWp < Capacity ≤ 1MWp	i. Publication of AEC decision ii. Approval of small-scale construction work (detailed process) iii. Grid connection contract with network administrator iv. Sale contract with network operator (TSO)
1MWp < Capacity	i. Production license ii. Publication of AEC decision iii. Approval of small-scale construction work iv. Grid connection contract with network administrator v. Installation licence vi. Sale contract with network operator (TSO) vii. Operation license

Table 2. National targets for PVs until 2020

Investors	Targets in MWp	
	2014	2020
PV parks belonged to farmers	500	750
BIPVs	200	350
PV parks belonged to other investors	800	1100
Total	1500	2200

As it can be noticed, a rather high percentage (up to 34%) of installed capacity was granted to farmers, whereas the lowest share was obtained by BIPVs' applications.

23. Current status of Greek PV market

Recent introduction of Law 3851 set off the submission of new PV applications both in fields and buildings, which was postponed three years ago. For now, only PV applications in fields with capacity lower than 500 kWp (1 MWp if PV station is located within industrial area) are acceptable for grid-connection offers as well as BIPVs' systems lower than 1 MWp. Applications for PV stations with capacity higher than 1 MWp are also acceptable to be submitted to RAE for requesting production license, according to a ministerial decree which abolished an older decree of 2008 which ceased the submission of PV applications.

As far as current installed capacity of PVs is concerned, according to TSO only 100 MWp have become operational since 2006, although the applications exceeded 3.7 GWp until 2007. Among these applications 2.8 GWp has been approved by RAE in two years' time, whereas 1.1 GWp, due to the aforementioned delays, has not been assessed yet. For these PV stations, Law 3851, in order to facilitate their grid-connection processes, foresaw the publication of a catalogue with a list of them included, which allowed the investors to request a connection offer by PPC, without obtaining in advance RAE's approval. The deadline for the submission was set 60 days since the notification of this catalogue to them. So far no information is published about the amount of these applications submitted to PPC.

Considering the new PV investments, according to PPC (main network administrator), within three months, the applications below 500 kWp reached approximately a capacity of 1.4 GWp.

As far as farmers are concerned, 5,000 applications of approximately 500 MWp have been submitted within

only one week, as this was the interval during which PPC accepted them, and apparently, the target set for 2014 for farmers is already reached.
Finally, with respect to the national BIPVs' development program, 11 MWp of PV applications are, so far, submitted for getting grid-connection offer, whilst 1.8 MWp has already become operational.

24. Greek FiT system's analysis: Licensing issues and drawbacks during the last four years

An assessment of Greek FiT system, since its initial introduction in 2006, associated with the licensing procedures should involve all the relative modifications made within last four years, so as to lead to safe conclusions about the ability of FiT law to overcome bureaucratic issues and drawbacks.
Initially, one can remark the thousands of PV applications submitted to RAE for license approval in two years's time since 2006, thus, forcing RAE to cease the submitting procedure for further PV applications. The PV applications were so many that they could not be stored in RAE's facilities as well as registered on time because of the authority's limited available personnel.
Moreover, the law 3468 foresaw that renewables have priority over conventional resources considering the grid access. Still, in cases when renewable electricity cannot be absorbed due to congestion or for safety reasons the TSO was no longer committed to buying the generated renewable energy fed into the grid. Whilst this was a reasonable regulation, the fact that there were no technical and legal specified conditions, at least until the enactment of the second FiT law (3734/2009), implied additional risks for the investors.
A two years' delay of the enactment of the land-planning map of Greece for RES caused, also, tremendous discrepancies among local public authorities, regarding the land-using siting suitability for PV stations which had already been applied for license approval in Regulatory Authority of Energy (RAE). Similar issues were caused because the competent Ministry delayed also to set construction regulations for PVs' installations at least for 3 years. Eventually, grid-connection procedures for authorized PV stations by RAE were delayed or stopped when it came to construction permits and approval of environmental conditions by Prefectural Directorates. For instance, a large-scale PV plant (>150 kWp) required the permissions from some 32 public-sector entities on a central, regional, prefectural and local level. Thus licensing procedure could exceed in practice 24 months, whereas in theory, and according to the legislation's time limits, the procedures should be accomplished in no more than 9 months.
Last but not least, Law 3468 was criticized for its complexity considering residential applications. More specifically, PV investors, even if they were private households, were fiscally considered to be enterprises, and have therefore to submit periodically value added tax declarations. This major drawback has lead to practically no household systems being installed until 2010.
Second FiT law, which enacted in 2009, aimed at confronting all above barriers. One efficient measurement towards the acceleration of PV diffusion was the 18 month time limit for completing PV installation by the investors. Great results have been, also, achieved by the enactment of BIPVs' diffusion program that set off a large market which, so far, was in meager development. Moreover, the clarification, for first time, of the construction and siting regulations for PV parks and BIPVs, had great effect on the facilitation of bureaucratic procedures included in the construction permit and the approval of environmental conditions. However, a high percentage of submitted PV applications had already been located in forbidden areas such as agricultural lands of high-productivity, as long as the land-use siting regulations for RES had not been set on time, thus hundreds of PV systems could not be approved for their environmental conditions or obtain a construction permit.
Finally, Law 3734 has forbidden the sales of production licenses and approvals from one investor to another before the operation of PV system, in order to mitigate the tendency created because of the 3 years' delay in assessing PV applications on behalf of RAE and other competent public authorities, which led, apparently to the deterioration of hundreds business plans of PV investors, who had applied for PVs since 2006 and lost, eventually, their interest in this kind of investment. In particular, the transaction of licenses was one of the most crucial factors that have led to null development of PVs across Greece during last four years combined with the fact that the submission of applications for new PV investments had been ceased since March of 2008.
Nevertheless, year 2009 was the first year of actual development of Greek PV market, mainly, due to the settings of construction and siting regulations. In overall, as a result of Law 3468 and 3734, since 2006, a 3% of the initial PV applications have become operational, a 75% has been licensed by RAE in three years' time whereas a 22% has not even been assessed.
As mentioned in previous section, in summer 2010 the government introduced last FiT law (3851), as the large number of uncompleted and unauthorized PV projects brought national PV market on the verge of its breakdown and national targets of PV penetrations in supply electricity mix for 2010 had been already failed. This particular law has efficiently simplified the bureaucratic procedures for all kinds of PV systems, and especially BIPVs, excluding PV capacities up to 1 MWp from the obligation to acquire production license and construction permits and PV capacities up to 500 kWp even from the obligation to obtain an approval for environmental conditions. It has also permitted PV systems to be located in agricultural lands of high-productivity, unblocking a large amount of PV applications which were under environmental impact

assessment for a long time. Additionally, it simplified efficiently construction regulations for PV parks and BIPVs, thus firstly favoring easier installations on fields and buildings and secondly providing the investors with the ability to take advantage of smaller fields or all available areas on building envelope, as far as BIPVs are concerned.

The strict time limits imposed on competent authorities will have positive effect on time consuming bureaucratic procedures as well. The penalty clauses included in grid-connection contracts will also ensure that only serious PV investors, who possess the appropriate budget to support that type of high-cost investments and have the willingness to pay for PVs, will be entered into the PV market.

The BIPVs market has already been taken off, but is definitely improved by this law, as long as their diffusion program is, for now on, applicable both for interconnected and non-interconnected network, it includes facades and shading devices and there is no need neither for construction permits nor for approval for small-scale construction work for BIPVs' capacities lower than 100 kWp.

However, the problem with the thousands of PV applications since 2006 seems to remain. Although new FiT law foresees that all PV applications submitted before 2008 will have priority to grid-connection, one cannot ignore the fact that the same law refers that a production license or a grid-connection contract does not ensure, for now on, that the PV investor will be able to sign sale contract with the TSO. Namely, the sale contract is the key for PV investors to acquiring actual share within supply electricity market. Consequently, whilst the majority of PV applications are delayed to be assessed and licensed so far mainly due to the complex procedures and discrepancies caused among public authorities, the investors possibly will not be able to complete their investment in the end. Last but not least, within this bad bureaucratic environment, banks do not, any longer, offer beneficial loans to PV investors, but only with interest rates greater than 7%, or they do not offer any loan at all before the completion of PV station, thus it is impossible for the investors to afford in advance the capital required for the purchase of PV equipment.

All these above parameters caused, apparently, the meager development of internal PV market but also an increase in transactions of production licenses during the last two years and nowadays a 90% of these licenses are for sale.

Last but not least, within the framework of the last FiT law, the competent Ministry announced the national targets for PVs until 2020 (Table 3). Taking into consideration the shares provided to farmers and the rest of the investors, someone can easily conclude that the Ministry, firstly, has not improved its energy policy despite of the mistakes of recent past, and secondly, and most important, makes discriminations among the investors and does not follow the rules that are associated with a free market in electricity supply, given that a 34% of the final target should be covered only by farmers. Additionally, due to the fact that farmers, in their majority, do not have the sufficient economic resources to support that kind of projects, thus they indent to afford only from 10% to 15% of the total capital needed, someone will wonder what forced the Ministry to attribute this high share of PV market to farmers. The extraordinary point in this case, is the high response of 5000 farmers who applied for obtaining grid-connection offer by PPC within only seven days and the applications, apparently, reached the national target of 500 MWp set until 2014.

As far as the rest of the investors are concerned, according to the national targets, apart from the installed capacity located in buildings, in 2014, namely in three years' time, the aggregate of PV parks in operation should be up to 800 MWp. However, the submitted PV applications since 2006 are up to 3.7 GWp, as presented in previous sections, within which 1.1 GWp concerns unlicensed PV stations which are eligible for requesting grid-connection offers by PPC and 2.8 GWp is already authorized. In addition to this potential capacity of PV stations, there are also 1.4 GWp which have been applied after the enactment of last FiT law, thus the target of 2014 and 2020 is already exceeded. At this point, someone wonders what measures will be taken, as the applicants of nearly 4.5 GWp of PVs (both older and recent PV applications) are likely not to be allowed to sign sale contracts and complete their investment, although they have spent, so far, a great amount of money for the completion of the necessary studies, the application deposits required by authorities and other engineering and management expenses. Besides, when it comes to the older PV applicants, someone should bear in mind that within all these years of waiting for the public authorities to assess their applications, these investors lost the opportunity to reinvest a remarkable available capital in other business ventures. Though, this case is even worse for new PV applicants who put themselves into this situation, deceived, apparently, from engineers and consultants but also by the Ministry's false predictions and unjustified targets for renewable energy resources in general.

25. Conclusions

Feed in Tariff schemes (FiT) have been the primary price-based and most successful policy instrument tool used to support RES development in Europe, since the early 1980's. However, when it comes to Greek FiT system, the conclusions about the diffusion of PVs are not so positive. The fact that since 2006, only 100 MWp of initial PV applications (3.7 GWp) have become operational, whereas there are 4.5 GWp of PVs applications whose future is to a great extent questionable. This development shows that the four

year period since the initial introduction of FiT system for PVs in Greece was in reality precious time lost. If current governmental policies and administrative practice do not rationalize and streamline the procedure, if the government and the public authorities do not realize the actual drawbacks in the Greek PV market and revise the targets set for the future of PVs development according to market's demands, and if all this does not happen fast, then more time and financial resources will be lost, and this is the worst possible option, especially, in a period of economic crisis.

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