A CHALLENGE TO INTRODUCTION OF RENEWABLE ENERGY IN SERBIA

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Abstract: *A shift to renewable energy sources has gained momentum in the past decade. With an aim to jump on the bandwagon, and with a more important goal of fulfilling the obligations to European Union, accepted by various documents in the direction of joining the EU, Serbia has adopted a National Renewable Energy Action Plan (NREAP) in 2013, with a goal to reach target of 27% for a renewable portion of Gross Final Energy Consumption, as set per documents of European Union. Starting from 20.9% in 2012, the results from the last published compiled report of 2016, however, show no progress at all in the four years covered by the report. The insight in the existing projects, and a projection of future energy needs, show no proof that the situation is going to improve in the near future. Probably with all this in mind, and with a clear understanding of predicted energy needs, an expansion of Kostolac power plant has been initiated, regardless of European plans to gradually phase out this type of electricity generation facilities. Apart from the fact that this power plant is going to provide a short-term solution to an urgent problem, it is self-evident to the authors that significant changes to the approach to renewable energy adoption have to be made. In this paper some suggestions are given that might mitigate the problem and take us closer to the target that we accepted as ours.*

Keywords*:* *Renewable energy, Energy efficiency, European renewable energy targets, NREAP*

1. INTRODUCTION

A shift to renewable energy sources has gained momentum in the past decade. Although renewable sources of energy, like hydropower and solid biomass, (mostly in the form of logwood) might represent a significant portion of energy balance, depending from country to country, new ways of renewable energy exploitation are becoming more and more affordable and applicable every day. In addition to this, renewable sources of energy are, in most cases, more environmentally friendly, and represent less danger to the nature. On the top of it all, renewable sources of energy are mostly locally generated, and therefore helpful in the energy independence sense. All this makes renewable sources of energy optimum solution for the future.

For this reason, all around the world, governments have hatched plans to increase portion of renewable energy in their energy balance. European Union is no exception, and Serbia follows this policy as the part of its stabilization and association agreement plan. For this reason, in 2013 government has accepted National Renewable Energy Action Plan (NREAP) [3], with an objective to reach 27% as a portion of renewables in Gross Final Energy Consumption (GFEC)

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by the year 2020, as per European directives. Plan did not appear unrealistic, as for the year 2012, this portion was already 20.9% by Eurostat data [4]. There is, however, certain discrepancy between the data registered in Eurostat, and data in NREAP. There is an explanation to this, which we do not find of significance for this research. In this paper, we will refer to data as listed by Eurostat reports.

2. CHALLENGE

So, where is a challenge? To understand it, we have to see where we are now, at the threshold of 2019, compared to 2012. As per Eurostat data, renewable energy portion of the GFEC in 2016 (last year with compiled data) is 20.9%. As per official data of European Union, Serbia has not achieved anything in this field, in the four years that are compiled, at least. Reports for 2017 are not compiled yet, and 2018 is still to be collected, but we did not find any data to support the theory that something changed significantly since 2016.

Progress report on NREAP, compiled in 2016 [5], admits this fact, (only for the period 2014 and 2015), and gives some explanations for the reasons why it is so. It does not, however, gives a proposal on additional measures to be taken, and technically speaking, as a report, it is not necessarily intended to do so. But, in that case one would expect some update to NREAP, which authors failed to find, with a reasonable assumption that it does not exist, at least not as an official document.

At this point, we find it illustrative to analyze situation in other European countries, using the Eurostat data. Most of the countries in this report showed a significant progress - For example, countries with lowest RE penetration, like United Kingdom and Netherlands, managed to increase its RE portion from 4.6% to 9.3%, and from 4.7% to 6%, respectively. Countries with traditionally high RE penetration, like Norway and Sweden also increased their achievements from 64% to 69.4%, and from 51.1% to 53,.8 % respectively.

Table 1. Percentage of Renewable Energies in Gross Final Energy Consumption for some EU countries

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Target**
Lithuania	17.2	16.8	16.9	´16.5	17.8	19.8	19.6	19.9	21.4	22.7	23.6	25.8	25.6	23
Luxembourg	0.9	1.4	1.5	2.7	2.8	2.9	2.9	2.9	3.1	3.5	4.5	5.0	5.4	11
Hungary	4.4	6.9	7.4	8.6	8.6	11.7	12.7	14.0	15.5	16.2	14.6	14.4	14.2	13
Malta	0.1	0.1	0.1	0.2	0.2	0.2	1.0	1.9	2.8	3.7	4.7	5.0	6.0	10
Netherlands	2.0	2.5	2.8	3.3	3.6	4.3	3.9	4.5	4.7	4.8	5.5	5.8	6.0	14
Austria	22.5	23.7	25.4	27.0	27.8	30.0	30.2	30.6	31.5	32.4	33.0	32.8	33.5	34
Poland	6.9	6.9	6.9	6.9	7.7	8.7	9.3	10.3	10.9	11.4	11.5	11.7	11.3	15
Portugal	19.2	19.5	20.8	21.9	23	24.4	24.2	24.6	24.6	25.7	27.0	28.0	28.5	31
Romania	16.3	17.3	17.1	18.3	20.5	22.7	23.4	21.4	22.8	23.9	24.8	24.8	25.0	24
Slovenia	16.1	16.0	15.6	15.6	15.0	20.1	20.4	20.3	20.8	22.4	21.5	21.9	21.3	25
Slovakia	6.4	6.4	6.6	7.8	7.7	9.4	9.1	10.3	10.4	10.1	11.7	12.9	12.0	14
Finland	29.2	28.8	30.0	29.6	31.3	31.3	32.4	32.8	34.4	36.7	38.7	39.2	38.7	38
Sweden	38.7	40.6	42.7	44.2	45.3	48.2	47.2	48.8	51.1	52.0	52.5	53.8	53.8	49
UK	1.1	1.3	1.5	1.8	2.7	3.3	3.7	4.2	4.6	5.7	7.0	8.5	9.3	15
Iceland	58.9	60.1	60.8	71.4	67.4	69.6	70.3	71.5	72.4	71.6	70.4	70.2	72.6	-
Norway	58.1	59.8	60.2	60.1	61.7	64.8	61.1	63.7	64.0	65.9	68.6	68.4	69.4	-

On the other hand, there are countries that did not achieve any progress in the period observed-

Iceland, Montenegro, Former Yugoslav Republic of Macedonia, and – Serbia. Iceland, with over 70% penetration of RE is another league, however.

Table 2. Percentage of Renewable Energies in Gross Final Energy Consumption for some NON-EU countries

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**TARGET**
Switzerland	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Montenegro	-	35.7	34.8	32.9	32.3	39.4	40.6	40.6	41.5	43.7	44.1	43.1	41.5	-
FYROM	15.7	16.5	16.5	15.0	15.6	17.2	16.5	16.4	18.1	18.5	19.6	19.5	18.2	-
Albania	27.8	30.3	32.1	32.7	32.4	31.4	31.9	31.2	35.2	33.2	31.5	34.4	37.1	
Serbia	12.9	14.4	14.6	14.4	16.0	21.2	19.9	19.2	20.9	21.4	22.7	21.8	20.9	

In the same Eurostat table, one can see the target that was set by authorities for most of the countries in this table. It is possible to observe that some of the targets were little too optimistic, but to the authors, progress achieved seems to be a more important than actual result itself. There is no target for Serbia in this table, but from NREAP we know that it was set to 27%

In the same time, Serbia has undertaken a serious project of enlarging a Kostolac coal fired power plant. Extension is essentially a whole new power plant. It is understandable from governmental point of view - an economy which is going to need electricity in the future needs an urgent solution. Renewables do not seem to be up to the pace, and lignite deposits are domestic source of energy. In addition, extensive experience in coal fired power plants that exists in Serbia offers a quick solution, so much needed in a situation that threatens to become urgent. The only problem is that, up to our knowledge, it is the only new coal fired power plant in construction in Europe, and for a good reason. Without going into details, European Union decided to phase out coal fired power plants, and not to build new ones, regardless of coal deposits that exist in some European countries. That decision is a part of EU documents. So, what conclusion can we draw from a decision to support a new one in Serbia?

With all this in mind, it is self-evident that Serbia needs a new approach to the problem of renewable energy. What we suggest is an approach in different levels, both for the national strategy decision makers, and for the individual consumers.

Serbia, with an assistance of UNDPR, has a compiled a number of documents designated as “investor guide”, for different renewable energies: Thermo solar [6], Photovoltaic [7], Wind [8], Biomass [9], Mini Hydraulic [10], and Geothermal [11]. These documents are supposed to be information for possible investors in the field of renewable energies. The thing that we cannot see in this document are the obstacles that are obviously falling on the path of the investors on their road to completion. For example, Wind Park Nikine Vode has signed its first documents to be made public in February 2012. In December 2018, after nearly seven years, investment seems to be nowhere near to completion, with paperwork still being on the table. Regardless of the reason for such a slow pace, there is no project in renewable field that would withstand such a long investment period. (There are few projects in any field, for that matter, that could survive this).

In the individual household consumption, authorities have failed to provide simple legislative frame that would enable households to make use of “on-grid” solutions for their electricity production. At this point, the only way for households to make use of surplus energy produced

on their roof, just to take one example, is to start a LLC company, and register it with state electric distribution company as an electric energy producer. Having this as a solution, and with company maintenance costs involved, it is clear that individual households have no financial benefit from this approach. A situation where surplus energy is given away is, on the other side, legally questionable in actual legal framework. As the feed-in quota for photovoltaic is long gone, and being ridiculously small in the first place, barriers to photovoltaic energy producers seems to be impossible to overcome.

Situation is not much different with other renewable energies, regardless of the investor guides published. Biomass plants can hardly benefit from agricultural waste, while setting fire on that waste on the fields is a common, although illegal practice in Serbia.

Recently, mini hydraulic power plants received attention of the public, and, unfortunately, not in a desirable way. The current cadaster of water sources applicable for mini hydraulic power plants has been compiled in 1987. If we put aside reliability of the data back than (and there are possible doubts in this sense), there is a strong possibility that water flow of today is not the same as it was back then, to mention only the most obvious problem. A new cadaster is to be compiled by the beginning of 2019, but the facilities are already being constructed, and we do not know at this point if the timeframe for a new cadaster is going to be respected. Using a comparative analysis there are good chances that we are going to wait for it while longer. Meanwhile, we witnessed public outcry on the local level, with claims that mini hydraulic plants are making devastating impact to the nature. Even ministry in charge of environment supported this opinion. So, we have the situation that, instead being an improvement in environmental sense, renewable energy is devastating the nature. This being the only widely publicized renewable source of electricity, the negative PR in relation to renewable energy is certainly not taking us in desired direction.

For all renewable facilities that are producing energy there is common problem of connection to the grid. This problem is less pronounced for small facilities that are connected to local distribution grid. If a connection has to be performed via EMS owned lines (EMS - Elektromreža Srbije - the company in charge of distribution facilities of 110 kV and up), situation becomes significantly more complicated, and seemingly not only to the simple fact of higher voltage level. Nonexistent or barely existent guidelines and timeframes in both cases present an obvious problem, with seemingly complete lack of understanding of importance and/or concept of renewable energy as a whole within public enterprises in charge.

If we talk about renewable energy for general population, that represent roughly about 1/3 of Gross Final Energy Consumption, one would expect solutions for thermo solar, photovoltaic, biomass, heath pumps and small wind turbines. These clients ask for those solutions on the open market, so it would be interesting to see what offer is there on the market.

In that sense, authors have asked for a quotation from the companies that advertise on the internet, believing that this would be a logical choice for an average customer. We have sent a request for a quotation to first five companies that appear on google. The request was for a 400 square meter house located in Stara Pazova, and asking for a suggestion to their choice, from five different fields of renewables: thermo solar, photovoltaic, biomass, heath pumps and small wind turbines. The request contained results from energy efficiency analysis, performed to legal requirements. Additionally, we requested the suppliers to specify estimated energy production by month for system they would offer. We checked by telephone to be sure that companies received our request.

The result was disappointing: from five companies, we received only two quotations and one promise over the phone, which never came in a form of actual quotation. None of them attempted to estimate energy production for the systems they were offering.

One reason for this might be a low level of knowledge on the side of possible equipment suppliers. The other might be a low demand. In general, there is a common knowledge in Serbia that electricity is cheap, and that until it is so, no renewable technologies can compete with low prices from the grid. There are few things that are further away from the truth than this claim.

Table 3. Prices of electric energy for household for different consumptions and tariffs in Serbia

Energy consumed kWh	Tri phase Single tarrif	Installed power 11.04 kWh	Total billed RSD	Actual total price per kWh	Energy consumed kWh	Tri phase Two tarrif 2:1	Installed power 11.04 kWh	Total billed RSD	Actual total price per kWh
1			760,27	760,27					
2			767,12	380,56	3			771,08	257,02
5			787,68	262,56	5			780,95	156,19
10			821,93	82,19	10			814,22	81,42
20			890,42	44,52	20			869,28	43,46
50			1.095,92	21.92	50			1.045,93	20,92
100			1.438.42	14,38	100			1.344,18	13,44
200			2.123.40	10,62	200			1.919,19	9,60
300			2.808.40	9,36	300			2.519,95	8,40
350			3.150.89	9,00	350			2.818,22	8,05
400			3.920.95	9,80	400			3.513,25	8,78
500			4.942,50	9,88	500			4.387,61	8,77
750			7.496.39	9,99	750			6.583,61	8,77
1000			10.050,26	10,05	1000			8.779,60	8,77
1250			12.604.14	10,08	1250			10.966,93	8,77
1500			15.158,02	10,10	1500			13.162,93	8,77
1600			16.179,56	10,11	1600			14.043,06	8,77
1700			18.210,54	10,71	1700			15.782,75	9,28
2000			24.303,47	12,15	2000			21.010,48	10,50
2500			34.458,35	13,78	2500			29.726,23	11,89
3000			44.613,23	14,87	3000			38.424,67	12,80
4000			64.922,99	16,23	4000			55.856,20	13,96
10000			186.781,55	18,68	10000			160.410,70	16,04

If we look in table number 3, we can see the actual prices that are paid by electricity customers on household level per kWh. One can notice that electricity price in Serbia is set in three different tiers, “green tier” up to 350 kWh per 30 days, “blue tier” from 350 to 1600 kWh per 30 days, and “red tier” over the 1600 kWh per 30 days. There are different options, one being a “flat” daily rate, on the left of the table, and the other being low and high tariff counter during the day. To the right we see this situation, if we presume one to two ratios for low/high tariff

during the day. We can see that the cheapest electricity price is if one uses up to 350 kWh per 30 day, and it costs 6.82 euro cents per kWh. This is already a price that could support photovoltaic installation on house roof. But, more importantly, if a household uses such installation to shave off its peak consumption, higher estimates could be used, like 11.8 euro cents for kWh, for consumptions up to 4000 kWh per month.

This paper would not be complete if we do not mention energy efficiency. Current Action Plan for Energy Efficiency is number 3, compiled in 2016 [12], and seemingly has no operational connection with NREAP. There is no mention of renewable energy in this Action Plan, and in the other direction, Energy Efficiency is mentioned in NREAP, but when we read NREAP, one can realize that this is only because EU guidelines insist on this. This leads to conclusion that there is no common understanding of importance for joint action in those two fields. As for energy efficiency for households, all the knowledge in this area seems to come from press or the Internet. Thermal insulation for housing is installed by "general practice" construction workers, with no formal education in the field. And this accounts for a waste area of private or collective housing.

On the other side, households could highly benefit from energy efficiency, only if this information would be conveyed to them in an appealing form. To understand it better, here is the energy calculation for a house without insulation, and a calculation for the same house with a well installed insulation. A difference between 43922 kWh and 9644 kWh for heating only could easily convince any client when converted into price of energy, and price of insulation installing. No measures for sanitary hot water heat recuperation were considered, as it is still regarded as exotic (not only in Serbia), but this could also make an easy to defend investment.

Table 4. Energy consumption for non-insulated household of 400 square meters in Stara Pazova

Annual heating demand	**43.922,16 kWh**
Annual losses in the heating system	**27.846,07 kWh**
Annual demand for sanitary hot water	**3.340,80 kWh**
Annual losses in sanitary hot water system	**0,00 kWh**
Annual cooling demand	**0,00 kWh**
Annual losses in the cooling system	**0,00 kWh**
Annual energy demand for ventilation and air conditioning	**0,00 kWh**
Annual energy demand for light	**20,00 kWh**
Total Annual energy delivered	**290.312,82 kWh**
SpecificAnnual energy delivered	**2.119,07 kWh/mkv**
Allowed primary energy consumption	**0,00 kWh**
Annual Carbon Dioxide emmisions	**150.056,88 kg**

Table 5. Energy consumption for well insulated household of 400 square meters in Stara Pazova

Annual heating demand	**9.644,08 kWh**
Annual losses in the heating system	**4.023,84 kWh**
Annual demand for sanitary hot water	**3.340,80 kWh**
Annual losses in sanitary hot water system	**0,00 kWh**
Annual cooling demand	**0,00 kWh**
Annual losses in the cooling system	**0,00 kWh**
Annual energy demand for ventilation and air conditioning	**0,00 kWh**
Annual energy demand for light	**20,00 kWh**
Total Annual energy delivered	**97.198,83 kWh**
SpecificAnnual energy delivered	**709,48 kWh/mkv**
Allowed primary energy consumption	**0,00 kWh**
Annual Carbon Dioxide emmisions	**50.240,13 kg**

And, at the end, we have to mention education for both energy efficiency and renewables. As for energy efficiency, the only comprehensive education is performed by chamber of engineers, in order to certify engineers for energy certifications of buildings. Apart from this, insulation material suppliers have some courses focused to promotion of their products, but in some cases, it proves useful - URSA is providing engineers with practical software tools for building energy certification (tools that are provided by relevant officials in other EU countries, by the way). As for renewable energy, this area is even less covered.

CONCLUSION

To summarize the situation, portion of renewable energy in GFEC currently seems to be going nowhere in Serbia. Renewable energies on a larger scale have most prominently being deployed in the field that has been conceived in 19th century- derivative mini hydraulic. It is like that from all the renewable technologies on the market, we decided to focus on one that has most significant environmental impact. Other, more modern technologies are being constructed, but all of them have a problem of connection to the grid, in some cases nearly a decade long problem, that cannot be explained by any acceptable logic.

On the household level, everything is left to press, Internet and equipment suppliers. No wonder that renewable energy is still considered exotic and complicated by individual homeowners.
As for energy efficiency, it is gaining its position in the building society, but at this pace, it is not going to reach satisfactory levels any time soon. In addition, it is completely detached from renewable energy, and we know that success in this field is only achieved if appropriate energy efficiency measures are taken. We could easily claim that our most perspective source of renewable energy is energy efficiency.

On the level of education, things seem to be as low as it can get. The only comprehensive education is there because of building code requirements, and as a support to equipment suppliers.

So, what could be done in order to improve the situation? Authors would like to suggest certain measures that could easily push the situation forward:

Changes in legislative are needed. Some are already improving the situation- recently adopted changes in legislation prevent individual owners from blocking construction works for linear infrastructure. It is yet to be seen what would be the effects of this. In addition to this, as a very significant measure, legislators should provide “off the shelf” legislative and technical solutions for connection to the grid. This should prevent relevant authorities from arbitrary procedures that are costly and time consuming.

Education would be a second field. Relevant educational programs should be compiled, addressing separately authorities, experts, equipment suppliers and consumers. Some of them could be done with the help of NGO, others need more detailed approach, that is suitable for universities and institutes.

An appealing offer for individual households should be put on the market. This offer has to indicate clear cost benefit to the client, and should overcome exotic and complicated impression that consumers have toward renewable sources of energy. This measure, if made correctly, would make very fast impact to the overall performance. Energy efficiency and heat recovery units, solar and photovoltaic collectors, heat pumps and highly efficient biomass burning

equipment are already available, the households only have to understand the cost/benefit and to start to use it more intensively to its own progress.

At the end, we would like to stress the fact that now is the right time to join this technology wave. It is mature enough to support itself, and still simple enough to be easy for catching up. Pretty much like computer technologies back in the sixties, when Serbian industry was comparable with best achievers in the world. We find renewable energies to be one such chance of today.

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