RES Efficiency Indicators for Portugal, Slovakia and Czech Republic

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Annotation
Increasing resources and energy demand has changed energy sector, leading to new policies and strategies. Many countries around the world including European Union Member States see RES (renewable energy sources) as a key solution factor to the energy challenge and have been making investment in that area. However it is important to calculate and analyze efficiency indicators that relate energy production from RES and installed capacity. They can help to evaluate investments made and to decide what investments should be done in the future.

Keywords: *Energy, Renewable Energy Sources, Solar, Photovoltaic, Wind, Resources*

1. INTRODUCTION

The energy sector is nowadays a subject of great concern to European Union. Energy is an important issue concerning sustainable development since energy contributes to higher quality of life energy and is responsible for significant environmental impacts at global, national and local levels. The use of RES will favour present and future generations [1].

At least 138 countries, more than half of which are developing countries, have now renewable energy targets and a significant number of countries have policies to support renewables in the power sector [2]. In the world there are several instruments used to subsidise renewable energy: feed-in tariffs, quota obligations, fiscal incentives, public financing, etc.

The EU energy policy aims to reduce external energy dependency, increase supply security and to reduce greenhouse gas emissions. The Directive 2009/28/EC on renewable energy set a target of 20% renewable energy in gross final energy consumption by 2020 and for that reason all Member States have national targets.

Many efforts in strategic planning and financial supports have being done by many countries and these investments should be validated to define future pathways. Different scenarios for future are now being considered and studied however what the future power system will look like is not fully clear [3].

2. RES efficiency indicator - merit figure

Installed power capacity and energy production for RES are very common parameters used for evaluate and analyse RES evolution in European Union and in the World [2]. These parameters are very important to characterized present situation of RES in the several countries, regions or World. However is also important to relate installed capacity for a RES technology and the energy produced with that power capacity to better understand the integration of RES in current power systems and/or the efficiency obtained with current installed power capacity, defining an efficiency indicator, EI_{RES}:

$$EI = \frac{EP}{IPC}$$

Where EP is an energy production from a RES technology and IP is an installed power capacity for a RES technology. The EI relates the production of energy obtained with the installed capacity. It can be useful to understand how current investments and systems can be improved before decide, for example, to do new investments in a RES technology that has not achieved its full potential at current state. These indicators can also be very useful to decide what new investments should be made in a country.

3. Analysis of RES efficiency indicators for some countries

From the analysis of electricity production for countries considered namely Portugal, Slovakia and Czech Republic it is possible to conclude that Portugal presents the highest production, followed by Czech Republic and Slovakia (Table 1).

Table 1 RES electricity production (data from [4] and [5])

	Wind Million MWh			Solar,Tide, wave Million MWh			Hydro Million MWh			Biomass and Waste Million MWh			Geothermal Million MWh			Total Million MWh		
Year	PT	SK	CS	PT	SK	CS	PT	SK	CS	PT	SK	CS	PT	SK	CS	PT	SK	CS
2005	1.77	0.01	0.02	0.00	0	0.00	5.12	4.59	2.36	1.98	0.06	0.74	0.07	0	0	8.94	4.65	3.12
2006	2.93	0.01	0.05	0.01	0	0.00	11.47	4.36	2.53	2.00	0.42	0.93	0.09	0	0	16.48	4.78	3.50
2007	4.04	0.01	0.13	0.02	0	0.00	10.45	4.41	2.07	2.14	0.50	1.20	0.20	0	0	16.85	4.91	3.40
2008	5.76	0.01	0.25	0.04	0	0.01	7.30	4.00	2.00	2.13	0.54	1.46	0.19	0	0	15.42	4.54	3.72
2009	7.58	0.01	0.29	0.16	0	0.09	9.01	4.32	2.41	2.38	0.55	1.86	0.18	0	0	19.31	4.88	4.64
2010	9.18	0.01	0.34	0.21	0.02	0.62	16.55	5.20	2.76	2.90	0.69	2.19	0.20	0	0	29.04	5.91	5.90
2011	9.16	0.00	0.40	0.28	0.02	2.12	12.11	3.65	2.12	3.22	0.69	2.70	0.21	0	0	24.99	4.36	7.33

In Portugal major contributors for RES electricity production are by order hydro (57.2% in 2005 and 48.5% in 2011) and wind (19.8% in 2005 and 36.7% in 2011) energy. In the year 2012 wind produced more energy (50%) than hydro (32%). Biomass and waste contribution has been below 14% except for the year 2005 (22%) and 2012 (15%). For Slovakia hydro sources produced about 84% and biomass and waste about 16% in 2011. In past years hydro has been the main source but percentage related to biomass and waste has steadily increased along the years. In Czech Republic major contributors have been by order hydro and biomass and waste but percentage related to biomass and waste has increased when comparing with 2005 (13 percentages points higher for 2011). Percentage related to hydro has decreased along the years and the one related to solar has significantly increased in the last two years. The percentage related to wind also increased but it was never higher then 6.7%.

Table 3 presents efficiency indicators for the several RES for the selected countries between 2005 and 2011. From the analysis of results presented it is possible to conclude that for the same RES that are variations within a country and between the several countries. Some of these variations could probably be explained by climate and weather conditions as most RES are highly dependent of these characteristics. Wind, Solar and hydro energy are examples of such RES. But for neighbour countries such as Slovakia and Czech Republic it would be expectable to obtain similar values for efficiency indicators. It is important to correlate these indicators with climate and weather conditions and with other factors (power systems characteristics) to evaluate RES integration and RES investments..

Table 2 RES efficiency indicators from 2005 to 2012 for selected countries

	Efficiency Indicator (Wind) MWh/kW			Efficiency Indicator (Solar.Tide wave) MWh/kW			Efficiency Indicator (Hydro) MWh/kW			Efficiency Indicator (Biomass and Waste) MWh/kW			Efficiency Indicator (Geothermal) MWh/kW			Efficiency Indicator (Total RES) MWh/kW		
Year	PT	SK	CS	PT	SK	CS	PT	SK	CS	PT	SK	CS	PT	SK	CS	PT	SK	CS
2005	1.67	1.20	0.72	1.00	0.00	0.00	1.06	2.88	2.31	4.15	1.08	5.23	3.94	0.00	0.00	1.40	2.82	2.62
2006	1.72	1.20	1.11	1.47	0.00	1.00	2.37	2.73	2.49	4.10	3.65	5.18	2.95	0.00	0.00	2.33	2.78	2.82
2007	1.64	1.60	1.10	1.66	0.00	0.50	2.15	2.76	2.02	4.35	3.44	5.25	6.98	0.00	0.00	2.15	2.81	2.48
2008	1.88	1.40	1.63	0.61	0.00	0.33	1.50	2.45	1.95	4.88	3.36	5.08	6.67	0.00	0.00	1.83	2.53	2.47
2009	2.13	2.00	1.52	1.45	1.00	0.19	1.84	2.75	2.32	4.75	3.22	5.25	6.39	0.00	0.00	2.12	2.80	2.27
2010	2.35	2.00	1.54	1.60	0.85	3.14	3.38	3.25	2.63	4.07	3.71	5.05	6.84	0.00	0.00	3.00	3.27	3.11
2011	2.09	1.33	1.86	1.63	0.04	1.11	2.27	2.27	2.02	4.53	3.48	5.13	7.29	0.00	0.00	2.35	1.90	1.98

4. CONCLUSIONS

The analysis of the efficiency indicators can be very important to the different stakeholders as it allows the efficiency evaluation of current investments and future investments, relating energy production from RES and power capacity. In order to make the evaluation it is also crucial to relate these indicators with climate and weather conditions to determine its influence in the values obtained. If the decrease in an efficiency indicator in one RES technology is not due to climate and weather conditions then it is necessary to rethink the power system before doing new investment in that RES. It is essential to analyse and evaluate the investments done and the plans for the future related to RES and efficiency indicators can be a powerful tool to achieve optimised sustainable models and solutions.

5. REFERENCES

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