ANALELE UNIVERSITĂȚII
"EFTIMIE MURGU" REȘIȚA
ANUL XVII, NR. 2, 2010, ISSN 1453 - 7397

Cristian P. Chioncel, Leo Schiefermueller, Petru Chioncel, Nicoleta Gillich

# Complex Technical Solution for Renewable Energy

*This paper presents a complex technical solution for implementing renewable energy, namely: wind, solar photovoltaic and hydraulics. Because wind and solar photovoltaic energy have a highly random character, it is required to find solution to store the product energy for unfavorable periods, without wind or solar radiation. This could be achieved using the third type of renewable energy, the hydraulic one, obtained form an hydroelectric pumped storage plant (HPSP), located in the immediate vicinity of the wind and solar photovoltaic plant.*

***Keywords***: *renewable energy, wind, solar photovoltaic, hydraulic*

## 1. Introduction

In terms of a planned high growth of electrical production from renewable resources in our country as in the entire European Union, it's needed that the available renewable resources have to be approached in a unified and complex form.

So that, the locations chose for wind farms, where the decisive factor is the wind average speed and its annual distribution, should also have in focus to be in region with a high solar radiation, favorable for solar photovoltaic systems and the proximity of an important watercourse which allow building a hydroelectric pumped storage plant.

## 2. Complex technical solution for renewable energy

The solution proposed in this paper, have in mind a convenient location from the Banat Mountain region, that in the Danube area. Based on the specific topography of this area, it exist an regional wind that allows a development of wind parks with high capacity, the wind turbines can be located on the hills in the immediate vicinity of the Danube.

The region have in focus is located on the $45^0$ North latitude, having a benefit of favorable insolation conditions to create a photovoltaic solar plant. The average distance of around 3 - 4 km to the Danube River, allow to design hydroelectric pumped storage plant, using as downstream basin right the Danube river, from were, in pumping scheme, the water is brought in the upstream basin, located in the hilly area of the wind park.

Figure 1 presents the scheme of this complex arrangement for using the three types of renewable energies.

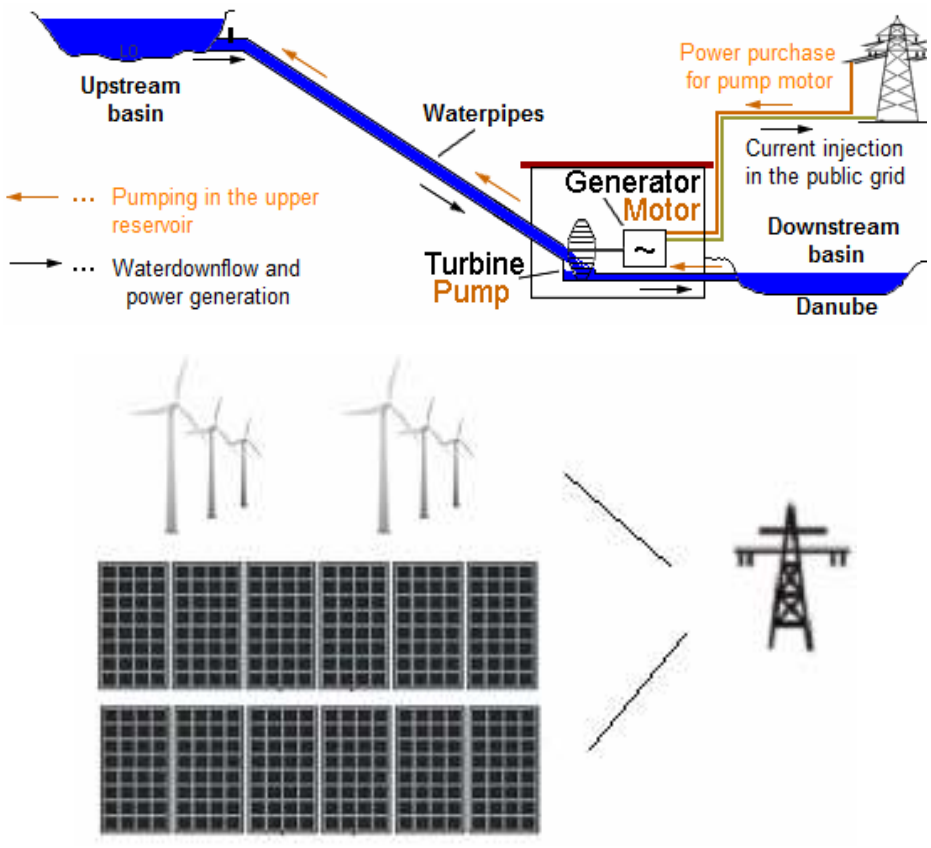


**Figure 1.** Complex scheme of using renewable energies: wind, solar photovoltaic, HPSP

The first phase, expects the realization of a wind park with a total power of around 100 MW, with wind turbines of an installed power of 3 MW, that assure a

yearly electrical energy production of around gross 227.000 MWh, minus 8%, represented of technical loss.

The wind turbines have a guaranteed disponibility of 97%. The technical loss are composed from: 3% of technical unavailability of the wind turbines, 1.7% electric loss caused by the transformer station and the transport cable, 0.8% unavailability of the electric transport grid, 2% losses due to frost and 0.5% regular maintenance time, that makes together 8% of technical losses. Based on this, the net produced and injected energy in the electric grid, is around 209.000 MWh / year.

The proposed wind plant, produced by ENERCON, type E82 3 MW, is characterized by following parameters: rotor diameter 82m, hub height 108m and a nominal power of 3.000 kW.

In the available space of each wind turbine, the region without shadowing, solar photovoltaic modules, with a unitary power of 700 Wp, can be build. The target is to install around 2000 kWp of solar photovoltaic plant. This capacity can be developed, based on the available surface and the grid potential to transport a higher amount of produced energy, within a number of approximate 3000 modules. This would allow a yearly energy production of 2.500 MWh.

To avoid at one hand, great peaks of load, and at other hand the possibility to stock the produced energy from the wind and solar plant when this is energy is not needed on the market, for example by night, within the wind and solar network, the arrangement of an hydroelectric pump station, of around 10 MW, will be provide.

This plant will ensure, when it works as a pump station, to fill the lake located upstream with the river water. The lake dimensions will be correlated with the maximum installed power in the wind park and the solar photovoltaic plant, about 10%. In this way an potential hydraulic energy is obtained that will be transformed in electrical energy from the hydropower unit (turbine generator) of the hydroelectric pumped storage plant (HPSP) in the periods with reduced wind or solar radiation.

The aggregates from HPSP are designed to function in a reversible system, as for the waterpower aggregate (turbine - pump) and for the electric one (generator - motor). In this way it is considered possible that the load curve can be flatted, with favorable technical -economical effects, in sense of secure energy, reducing the dependence on the randomness of wind and solar insolation.

## 3. Conclusion

The complex technical solution for renewable energy proposed in the paper, is o hybrid solution, using three types of energy: wind, solar and hydraulic that can assure, through their complementarities, a continuous supply of electricity, reducing appreciably the randomness character of each energy type.

To all this, the importance of the conservation of the environment can be added, all three types of energy are without toxic emissions or other polluting waste, having also favorable effects on the tourism potential of these places.

**References**


[1] Chioncel P., *Conversia energiei, energii regenerabile*, Ed. Eftimie Murgu, Resita, 2001.

[2] Chioncel P., Chioncel C.P., *Despre potenţialul energetic eolian în sudul Banatului şi soluţie tehnică de utilizare în gospodării individuale* Proceedings of the VIIth International Symposium Interdisciplinary Regional Research ISIRR, Romania, 2004.

[3] Chioncel P, Chioncel C.P, *Monitorizarea si controlul instalatiilor energetice cu resurse regenerabile*, Analele Universitatii "Eftimie Murgu", 2002.

[4] Gillich N., *Producerea, transportul si distributia energiei electrice,* Ed. AGIR, Bucuresti, 2003.


*Addresses:*


- Sl. Dr. Eng. Cristian P. Chioncel, "Eftimie Murgu" University of Reşiţa, Piaţa Traian Vuia, nr. 1-4, 320085, Reşiţa, c.chioncel@uem.ro
- Dl. Ing Leo Schiefermueller, Verein "Energiewerkstatt" Ausrtria, Heiligenstatt 24, Friedburg, leo.schiefermueller@energiewerkstatt.at
- Prof. Dr. Eng. Petru Chioncel, "Eftimie Murgu" University of Reşiţa, Piaţa Traian Vuia, nr. 1-4, 320085, Reşiţa, p.chioncel@uem.ro
- Prof. Dr. Eng. Nicoleta Gillich, "Eftimie Murgu" University of Reşiţa, Piaţa Traian Vuia, nr. 1-4, 320085, Reşiţa, n.gillich@uem.ro