SOME PRINCIPLES DESIGN OF A LOCAL INTEGRATED SUSTAINABLE RENEWABLE ENERGETIC SYSTEM

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Abstract: In this paper the main renewable energy resources in order to design of an integrated renewable energetic system are first presented. Second, is presented the integrated energetic system concept. The integrated system has following characteristics: microclimate; envinroment integrated; sustainable; renewable; clean energy; software oriented; systemic structure. This principle is used for designing a proposed energetic system to produce renewable energy based on sun, water, wind and biomass in an environmental local microclimate context.

Keywords: microclimate, renewable energy, solar, wind, water, biomass, modeling and simulation.

Introduction

The simple definition of sustainability can be that: the quality of a process to be maintained in the same state boundless time. The sustainable development is a collection of methods in order to accomplish a sustained development of environment to protect the natural capital for long-term profits.

Such energetic system keeps a dynamical equilibrium between electrical energy extracted and environment protection. In this balance are taken into account the following types of renewable energy resources: solar energy; solar radiation; wind energy; hydro energy; biomass.

The possibilities to use *hydro energy* depend on the geographical and climate conditions. Several countries have a great potential in hydro electricity production. The Nordic countries have much potential comparing with others. The hydro-plants depend on the natural water cycle, in which the water evaporated due to solar radiation together with wind and clouds energy transportation falls back on Earth as precipitations.

On the other hand *wind energy* is very popular in electricity generation, because of very high potential in many countries. In many cases the costs are comparable to conventional energy cost. In European western countries the wind is the main renewable energy resource.

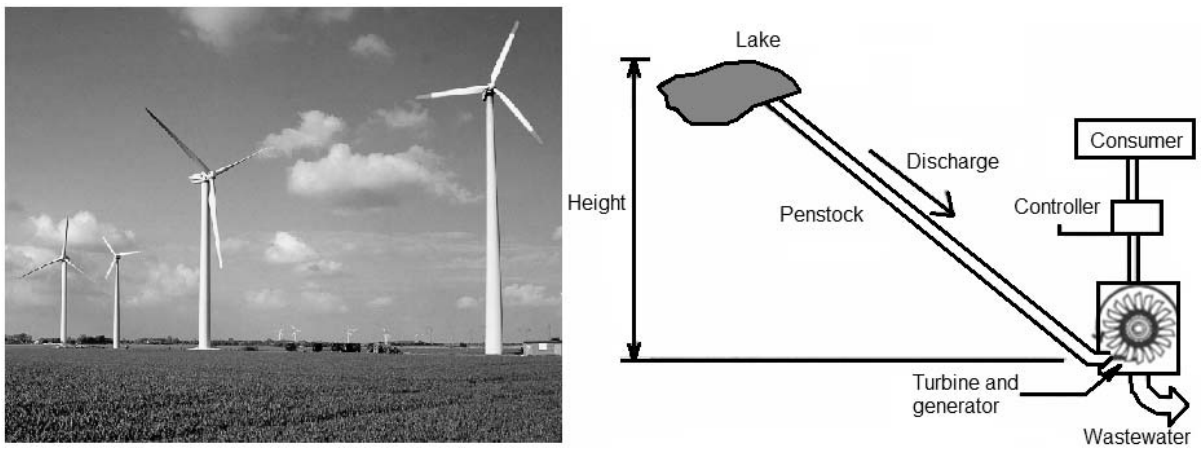

Fig.1 *Wind turbine and pico-hydro system*

The photovoltaic effect means the direct change of light in electricity by active use of *solar energy*. This is a completely new technology that was possible due to semiconductors technology improvements. Today, the solar energy is used today in many countries.

The *biomass* as an organic matter can be used directly (grass, grain, leaves, wood) or indirectly by fermentation (alcohol or the fuel oils). The use of biomass does not represent only a renewable energy source, but also an opportunity for rural places of a sustainable development.

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Fig.2 *Biomass plant and solar panels*

The achievement of an energetic system containing the main renewable energy sources integrated in the same location is an efficient and modern solution.

So, in fig.3 is presented a renewable sustainable energetic system consisting of the main four energy sources power plants, like pico-hydro, wind turbine, solar cells and biomass.

It is not so easy difficult to combine more different power plants together because of the environment conditions of having sun, water, wind, biomass in the same area.

But, it is possible to find some area where all the conditions or three of them can be created with a rational investment.

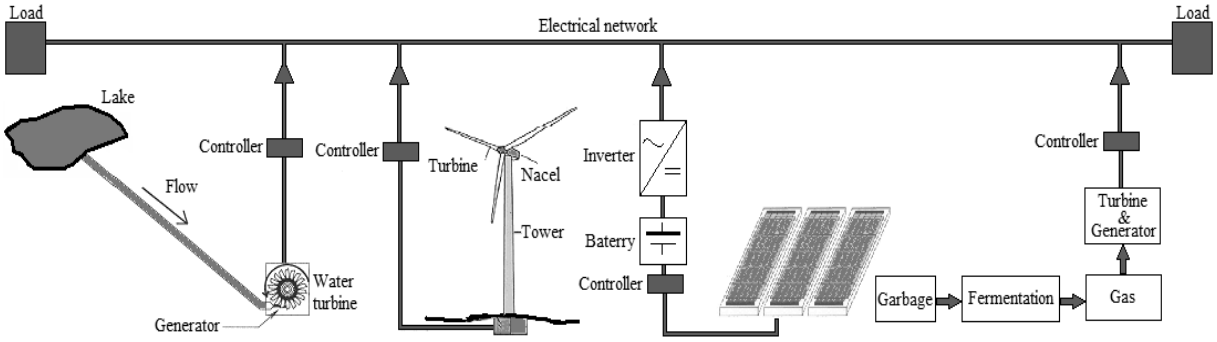

Fig.3 *Energetic system: wind turbine, pico-hydro, photovoltaic panels and biomass*

In order to apply the theory we consider a natural environmental area, which has a surface, a relief with a valley and water, some forestry and land. This area can produce four kind of energy based on water, wind, solar and biomass.

The problem is if the investments are rational and efficient to be done. It is necessary to study the different renewable power plants in order to see which the best for the real conditions are. Also, it is necessary to modeling and simulation before draw the conclusions regarding the implementation.

It is necessary to draw an integration plan in order to implement a renewable energetic system. It is necessary to study the local microclimate for finding the methods for positive influences.

In fig.4 you can see typically area discussed above. This area is in Mountain and are a surface of about 20 km^2, a valley with 35 degree slope, 40% of surface is covered by forestry and the albedo land.

The energetic productivity can be 0.025 W/m^2 and this area can produce 500 kW. This is not so match, but is enough for the isolated houses.

This situation can be improved by a good management as in fig.4 and the energy production can be improved, by implementing a water turbine, some wind turbines, a biomass plant and some solar panels, so in one word a renewable integrated sustainable energetic system.

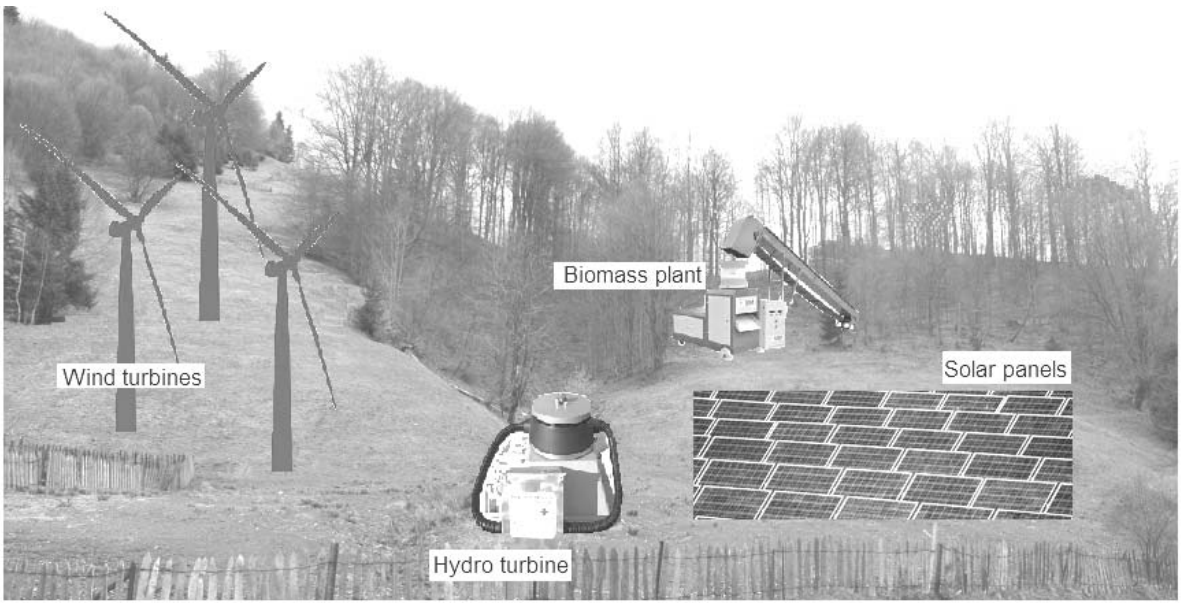

Fig.4 *Renewable sustainable integrated system - proposed situation*

Modeling and simulation of an integrated renewable energetic system

The rain energetic process is a complex phenomenon and in a simplified view can be represented as having two closed loops, as we can see in fig.5.

The first and main loop contains the following subprocesses: water and micro particles, land micro particles, evaporation, condensation, clouds microparticles and rain.

The second loop contains the following subprocesses: land microparticles and clouds microparticles.

The inputs and outputs of each subprocess represent the relative transformation rates between water states: water, microparticles, steam, ice and rain droplets.

In the block diagram above there are used the notations: q_s – sun delivered energy; r_p – rain particles forming rate; r_{mn} – clouds microparticles forming rate; r_m – water microparticles forming rates; r_s – microparticles sedimentation rate; r_{an} – clouds supply microparticles rate; r_{me} – evaporation microparticles rate; r_c – condensation rate; r_e – evaporation rate; z_t – wind rate.

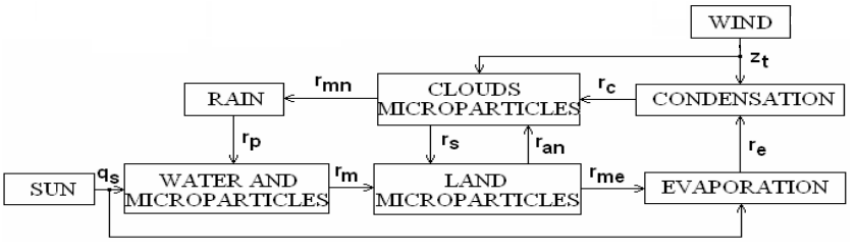

Fig.5 *Simplified rain energetic process*

An integrated sustainable renewable energetic system is an energetic system consisting of electromechanical equipments, unitary organized, in order to produce and distribute electric power using primary energetic resources obtained from a well delimited area. The principal elements of an energetic system are: interconnected electric power plants as micro-electric wind turbines, pico-hydro power plants, micro-solar electric power station together with distribution electric networking.

Based on these sources it is designed an integrated renewable sustainable energetic system. The concept consists in designing an energetic system to produce clean energy like: solar, hydro, wind, biomass based environment and local microclimate.

For each subsystem (wind turbines, pico-hydro turbine and solar panels) was written a mathematical model and below is presented the model of an renewable integrated sustainable energetic system and simulation results (fig.6). As we can see, the electrical power depends on solar radiation, wind speed and water flow.

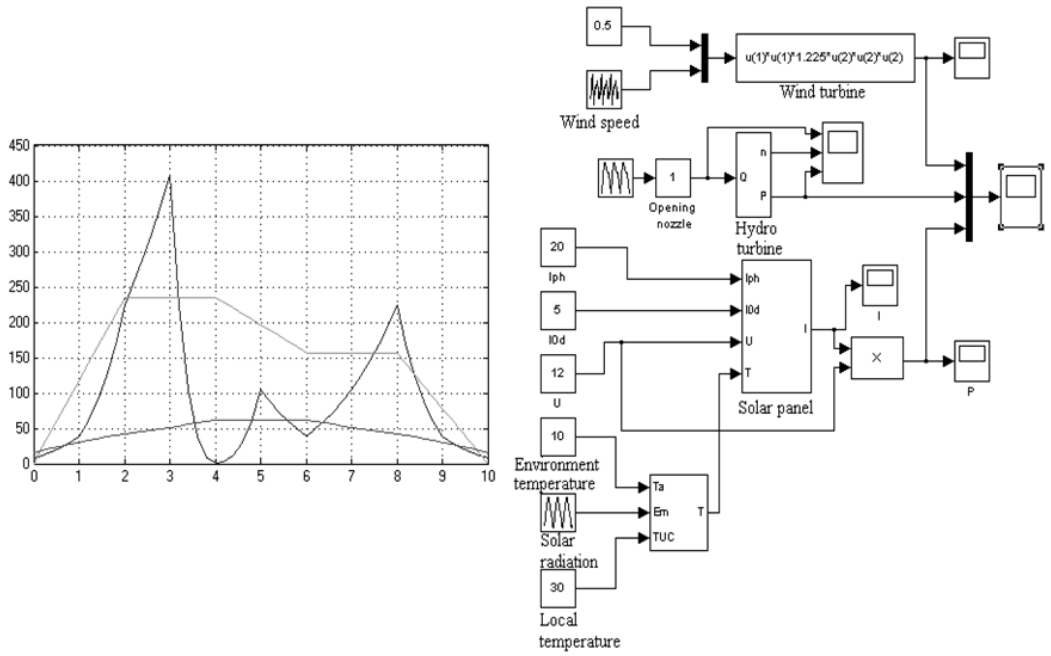

Fig.6 *Modeling and simulation of a renewable energetic integrated sustainable system*

Conclusions

- The structure of an integrated sustainable renewable energetic system is presented in this paper. The element components of this system are: pico-hydro, wind turbine, solar cells and biomass plant.
- Before designing and implementation of a renewable system is necessary to develop a local climate study and an integration management plan.
- Another important step is the modeling and simulation of entire renewable system before start to implement.
- In most of the cases, the initial investments are recoverable and this solution can be very attractive for the future.
- Based on the principles presented above it is possible to establish a mathematical model to determine the optimum of the environment management in order to extract the maximum electrical energy.

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