RENEWABLE ENERGY: ADVANTAGES AND DISADVANTAGES

Reinhard Ploetz[1)], Rusdianasari [2)], and Eviliana [3)]

[1)]*Retired Staff of Environmental Ministry of Lower Saxony and the Regional Government of Hanover, Germany and Director of Stadt Marketing, Walsrode, Germany*
E-mail: mail@rpdata.de

[2)] *Renewable Energy Engineering Study Program, Politeknik Negeri Sriwijaya, Jl. Srijaya Negara Bukit Besar Palembang, Indonesia*
E-mail: rusdianasari19@gmail.com

[3)] *State Translator of Politeknik Negeri Sriwijaya, Jl. Srijaya Negara Bukit Besar Palembang, Indonesia*
E-mail: evi@polsri.ac.id and evilianapolsri@yahoo.co.id

Abstract: This paper aimed for elaborating aspects of the so called renewable energy as an option for the future energy needs: its advantages and disadvantages. The highlighted advantages were renewable energy as the replacement of fossil power plants by use of solar energy, the reduction of carbon dioxide and the decentralization of energy power generation. Meanwhile, the disadvantages were: the huge quantity of energy and the huge quantity of raw material (some of them rare) needed to produce all supporting facilities of solar, wind and biomass power plants and the inappropriate network grid and the problem with recycling.

Keywords: Renewable energy, advantages, disadvantages, grid, raw material, decentralization, recycling

I. INTRODUCTION

Energy has an important role in the development of a country if its availability and development are hand in hand and support national development. As we all know, the need for energy increases higher than the increase of population. Population growth means an increase in energy need. Advances and utilization of technology need energy, i.e. electricity and fuel energy.

The national and global problem of enegry is the rising cost of fossil energy; oil, gas and coal. Naturally, energy prices will continue to rise, along with the increasing scarcity of non-renewable energy sources and the increasing demand for energy.

The limitation of fossil energy requires diversification of energy resources in order to guarantee the availability of energy. Then the use of new and renewable energy must be intensified.

RE is one of the options for the energy needs of the future. Although it is based only on solar energy and the energy source is clean and infinitely, this solution has a number of problems in everyday life that have to be considered. The problems are related to resources, limited potential, base load, the grid, and primary resources.

II. RESOURCES

The productivity of a resource like machine, worker, process, etc. was very low 50 years ago and is much higher nowadays because of shortage of the resource, high prices or environmental reasons. For example, if the resource consumption should sink in the industrial nations until 2050 by a factor of 10 (what is consensus largely), and if - at the same time - you want a modest economic growth of 2 percent yearly, the resource productiveness (the amount in goods and services per unity of a certain used resource) must go up around the factor 27! An economic growth of 3 percent already assumes a 43-times higher energy and resources efficiency! This would mean, that a power plant that consumes a certain amount of coal (100 %) for the production of 1 KWh must be modernized and improved to produce this 1 KWh with a 43 times smaller amount of coal.[1]

Most of the resources like petrol, copper, rare earth elements are scarce, their availability worldwide is low.

But all RE objects need these resources very much. A PV system or a WPP need different materials for their production, e. g.: Iron, Bauxite, Silicon, Copper, Graphite, Cadmium, Gallium, Indium, Germanium, Selen, Tellur, Ruthenium, etc. Some of these materials are fraught with problems for the environment and are known not to be recyclable.

III. RENEWABLE ENERGY: LIMITED POTENTIAL

RE is not able to fully replace fuel power plants [2], as all RE systems are not viable, we will need standard energy generation technics to supply society with electricity (coal, gas, fuel, etc.). The main question of the future is: Which system delivers the energy to produce all the solar PV or WPP? For example, about 1 percent worldwide of the electricity is generated by means of wind energy. If only the USA want to increase this level until 2030 up to 20 % then they will have to install 20.000 WPP per year! This means: You have to consume very much of rare and expensive primary energy just only to produce a RE systems. [3] Beside that the energy density of sunlight is low compared to gas, coal or fuel.

The diagram shows the ratio between the input of primary energy (coal, gas, sun, wind) in KWh prim and the generated electric energy in KWh el. The best result is that of wind and hydro power plants.

The main reasons are due to the fact that on one hand, solar electricity is very material-intensive, labour-intensive and capital-intensive and on the other hand the solar radiation exhibits a rather low power density. [4]

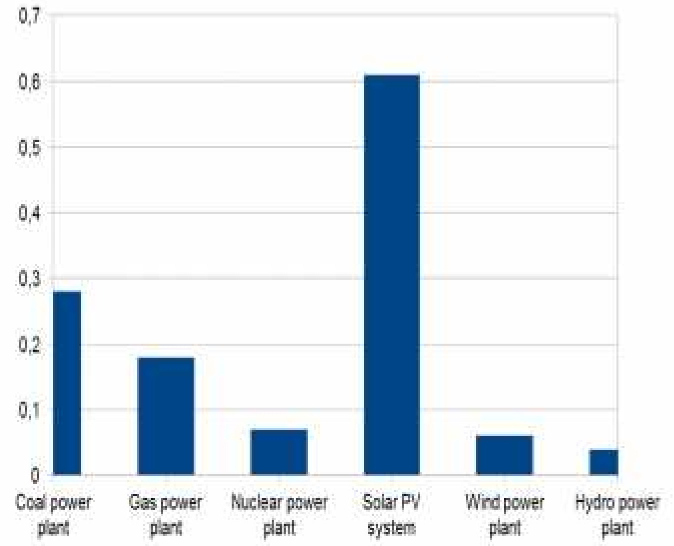

Illustration adapted by R. Ploetz, 2015[5]

Fig. 1. the ratio between the input of primary energy (coal, gas, sun, wind) in KWh prim and the generated electric energy in KWh el.

IV. The Base Load Problem

The facts: The base load requirements are 50 to 60 % of all energy produced. In Germany the base load is 40 GW, the peak load 75-80 GW.

During the day and while there is much wind, the rate of RE is very high. At night and without wind it is zero! Meanwhile during this period of the day the domestic consumption of electricity for lights, cooking, radio, tv, etc. is higher

Imagine a percentage of 30 % of RE:

The consequences for the electricity production are: During the day and with wind the thermal/hydro etc. power plants bring down their production about one third and at night they restart it again.

This is not economical and a big problem for the function of the power plants.

What you need instead is a possibility to store the RE electricity and to provide it in times of higher energy needs.

V. RE and the Grid

Today the structure of the standard grid looks like this:

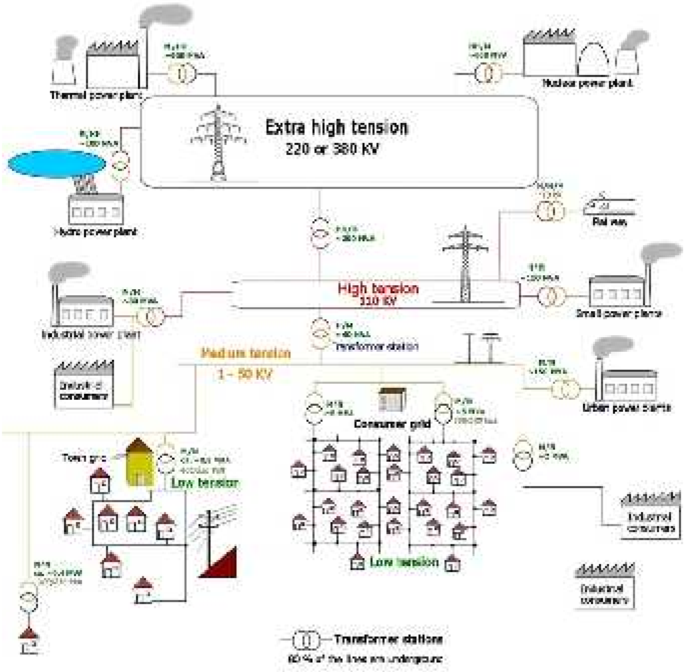

Illustration by S. Riepl, 2007 [6]

Fig. 2 Today Structure of Standard Grid

There is a certain amount of central power plants that are connected by 380, 220, 110 or 50 KV lines. The main grid (380, 220 and 110 KV) is designed to transport and distribute the generated electricity. The customer grid (50 to 1 KV) is designed to deliver electricity to the clients (domestic, commercial, agriculture and industry). With RE you have another situation: Instead of central generation you have a decentral production of electricity - thousands of PV and WPP - that feed the electricity into the customer grid - and normally not into the main grid. This grid is not designed to transport and distribute this amount of electricity. Consequence: You will have to install a complete new grid (e.g. smart grids).

Grid frequency

The two fundamental characteristics of power delivered to a customer are frequency and voltage. The short run supply-demand balance is indicated by frequency. Frequency is a 'public good' having large external effects. Stable operation of the interconnected power system, requires that frequency be maintained within a certain tolerance as defined by the standards adopted in a country. [7]

The normal frequency of the grid is 50 Hz. On a clear sunny day the electrical input of the PV system goes up very fast. The frequency reaches a critical value above 50.2 Hz. This will cause an alarm within the grid. [8]

Example: Blackout India 2012

The frequency before blackout-1 on the 30-July-2012 was 50.46. The blackout-1 occurred in the NR grid around 2:33 hrs followed by blackout-2 on 31-July-2012 (around 13:00 hrs) which occurred in the NEW grid, after the NR was restored from the previous black-out and synchronized with the NEW grid.

This led to over-drawl. The over-drawl may be due to the frequency approaching 50.46 Hz just before the event, which provides apparently free power to the over-drawing states as per the UI mechanism. This happened to overload the transmission lines, resulting in line tripping and power re-routing through the other connecting lines. [9]

If you have an unstable input of electricity into the grid, then this can happen very often: more input then consumption- the frequency goes up; less input than consumption - the frequency decreases under 50 Hz.

In Germany for example, the costs for holding the grid stable regarding the unpredictable amount of RE is more than 1 Mrd Euro per year. [10]

VI. RE AND PRIMARY RESOURCES

The unbeatable argument for RE is of course that the primary energy is free (sun). You never have to pay for solar energy, its quantity is far big enough to feed the worlds demand of electricity. Nevertheless this source is not stable - whenever there are clouds and of course during the night there isn't any solar energy from one moment to another.

A second argument for RE is the decentralisation. In the future we can have ten thousands of small power plants all over the land. This will stabilise the grid and minimise the technical losses (short distance between the place of energy generation and the customer. If one power plant is out of order there are many others to replace it fast).

The third argument for RE is the technic: It's smart (PV), simple (hydro) and well tested (WPP).

VII. CONCLUSIONS

The limitation of fossil energy requires diversification of energy resources in order to guarantee the availability of energy leaded to the intensification of renewable energy.

The renewable energy has many advantages but also a lot of disadvantages. It is one of the options for the energy needs of the future. Although it is based only on solar energy and the energy source is clean and infinitely, this has a number of problems that have to be considered. The problems are related to resources, limited potential, base load, the grid, and primary resources.

So it is impossible, just to switch from fossil to solar energy. There are important issues to solve, like the lack of material, the inappropriate grid and the storage technology.

NOMENCLATURE

Subscripts

Hz	Hertz
GW	Giga Watt
KV	Kilo Volt
KWh prim	Kilo Watt per hour primary
KWh el.	Kilo Watt per hour electricity
Mrd	Billion
NR	Northern Region
PV	Photovoltaic
RE	Renewable Energy
UI	Unscheduled Interchange

ACKNOWLEDGMENT

We would like to thank SES (Senior Experten Services) Germany and Politeknik Negeri Sriwijaya especially Informatics Management Department (Assigned Department of Mr. Reihard Ploetz from 5 to 25 September 2016) for providing support in enabling this international jurnal writing collaboration.

REFERENCES

[1] Prof. Dr. Fred Luks, “Öko-Populismus”, Marburg, 2016
[2] Francis Cheng, Renewable Engery Can’t Replace Fossil Fuels Entirely in Newpaper of The Straits Times, 17 .12.2016
[3] Bruno Kern, “Streifzüge 46/2009”, Mainz, 2009
[4] Report Tennet in Newspaper of Walsrode, 18.1.2016, page 10
[5] Reinhard Ploetz, Material RPDATA, Hannover, 2015
[6] Stefan Riepl, Own Material under Public License, Saltendorf, 2007
[7] S.K Soonee, S.R. Narasimhan and V. Pandey, Significance of Unscheduled Interchange Mechanism in the Indian Electricity Supply Industry, ICPSODR-2006, Dept. Of electrical Engineering, ITEHU.
[8] Gerhard Neidhöfer, “Der Weg zur Normfrequenz 50 Hz - Wie aus einem Wirrwarr von Periodenzahlen die Standardfrequenz 50 Hz hervorging” VDE-Verlag, 2008
[9] Desi Smart Grid, “Indias Power Grid Blackouts”, in “Desi Smart Grid News Item, Expert Views, Industry and Research”, Delhi, 2012
[10] Ferruccio Ferroni and Robert J.Hopkirk, Energy Return on Energy Invested (EroEI) for Photovoltaic Solar Systems in Regions of Moderate Insolation, Enery Policy, Elsevier, 26 April 2016