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THE NEXT FUTURE OF SOLAR ENERGY GENERATION

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Abstract- Currently, some countries are deciding to retire the financial support that have been doing to the solar energy industry and to the customers that decided to implement this energy. On the other hand, solar technology has been developed by this industry and research groups of universities, improving all parameters from costs to performance. In this paper, solar energy generation is presented as an affordable and possible source of energy and it will able to compete with the now traditional energies. The next future of this energy in comparison with others is discussed.

Keywords: Solar Energy Generation, PV, STE, Photovoltaics, Solar Thermal Energy, Concentrating Solar Energy, Feed-In Tariff.

I. INTRODUCTION

Nowadays there are some problems related to energy that, perhaps in the very next future, are not very urgently to take into account and try to solve, like climate change, energy security, and universal access to modern energy services. We know that it is not really true because although if these tasks are not taken and solved in the next 5 years, during these 5 years energy systems will work enough successfully and population that now has good access to electricity will continue having these satisfactory access; but we will be creating a big inertia that will be very difficult to correct it [1, 2].

It is not our aim to scare anybody, but although new oil reserves are discovering and we are sure that they will continue being discovered [3], and performance for petrol consume, etc. is improving and energy from the oil has still long life, we think that if effective and continued support policies [4, 5] are put in place in a high number of countries during ten to twenty years, solar energy in its various forms, such as solar heat, solar photovoltaic, solar thermal electricity or solar fuels, can make considerable contributions to solving some of the previous cited problems.

II. SOLAR ENERGY GENERATION

Solar energy generation offers a cleaner, that not absolutely clean, climate-friendly, very abundant and inexhaustible energy resource. We must think that solar energy generation is not only to design a system with solar panels, photovoltaic or thermal, with storage devices, covert DC/AC system and connection to the network, but we must also consider that these devices, mainly the solar panels as difference with other power generation systems, have to be manufactured in factories with their respective pollution generation. Other advantage point of the solar energy generation is that it is relatively well-spread over the world.

Besides, it is more powerful in warm and sunny countries, and it may be economically profitable between latitudes from 0º to 55º. It is an important matter because in this wide region of the globe there are placed the countries that will experience most of the world's population and economic growth over the next decades. They will likely contain about 7.000 million inhabitants by 2050 versus 2.000 million in cold and temperate countries (including geographically most of Europe, Russia, and parts of China and the United States of America). On the other hand, in the last years costs of solar energy have been falling fast and are entering new areas of competitiveness, like solar fuels. Solar thermal electricity (STE) and solar photovoltaic electricity (PV) are economically competitive against oil-fuelled electricity generation in sunny countries and economical and ecologically competitive against oil-fuelled and nuclear electricity.

Regarding nuclear electricity, do not forget the cost of building the nuclear plant, the cost of the uranium (and its transport), the maintenance of the plant, the cost of dismantlement of the plant, and the cost of the nuclear residues during hundreds of years (obviating the risk of the installations that saved and custodian these plants and facilities of radioactive residues). For non-typical customers, such as those of some islands or places more than one kilometer far from the nearest electrical connection point, solar panels is a good option. Even roof-top PV in sunny countries can compete with high retail electricity prices [7]. However, in spite of reduction of costs and its high natural competitiveness, solar electricity is not yet able to compete without specific incentives in majority of countries.

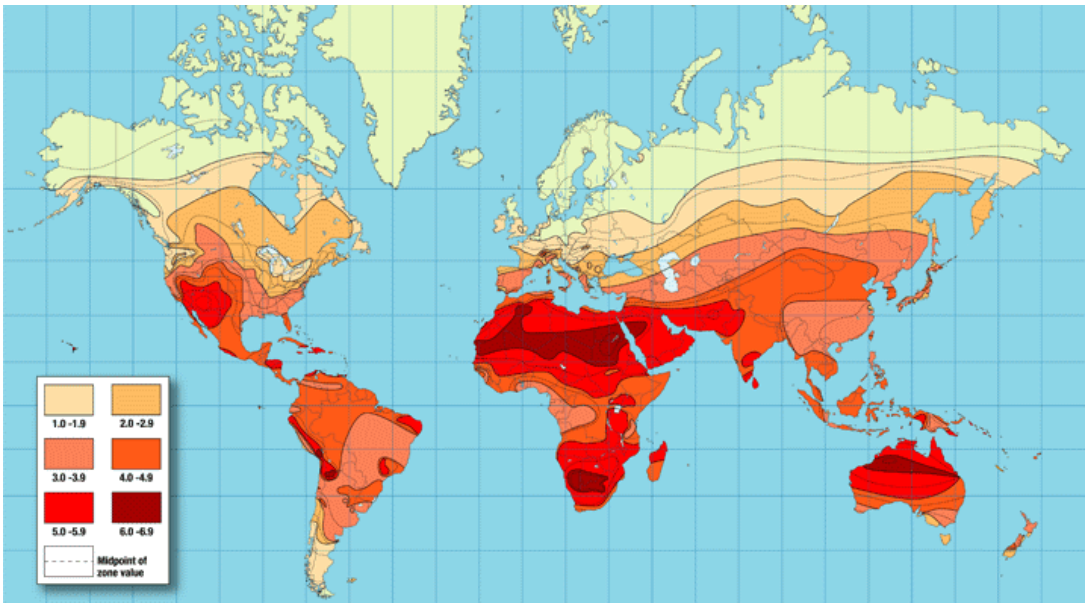

Figure 1. This map shows the amount of solar energy in hours, received each day on an optimally tilted surface during the worst month of the year [6]

III. DIFFERENT TECHNOLOGIES

Among different technologies for solar energy generation, implementation of PV systems has taken a particular success related to the geographical installation, growth percentage of installation, electricity generation, and reduction of manufactured costs. The main reason has been the government's policy with the feed-in tariffs. Other reasons have been that on the one hand PV is extremely modular, so easy and fast to install (both for individual systems and for energy farms) and accessible to the general public. This means among other things that PV projects have usually, or at least they can have, short implementation times. On the other hand, the fast cost reductions have produced, because the speed in the reduction, the potential for the other changes.

All of these changes power the confidence of the customers, markets and governments expectations on this kind of energy generation. But we remark that it has been possible due to the suitably established policies that have been continued in the time. Obviously, governments can take decisions to keep out the support, partial or totally, as they are doing, or relate them, the incentives, to cost reductions; but they would act in a way that market will not collapse and customers will not go back to non-renewable energy systems. Using storage systems, PV can contribute not only to the demand peaks from morning to afternoon but also to the medium peaks of the evening and to the consume of the early night [8].

In this way, solar thermal electricity (STE) allows helping to the system in the production of solar electricity to the above mentioned peaks, or even spreading it to base-demand hours during night, through the use of thermal storage [9, 10, 11]. If it is combined with other conventional or non-renewable systems of energy generation like the use of fuel, STE can be considered reliable and dispatchable on demand, and it would be possible to include solar energy in the electricity mix.

STE concentrates the solar power using dark colours and small tubes system for general panels that can be used in normal houses. The system is improved for big generation plants based on concentrating solar power (CSP) technologies, which take advantage where the sun is very bright and the skies clear, like it is the case of open places between 0º and 35º of latitude [12, 13, 14]. Transmission lines can transport clean STE from favourable areas (for example North Africa) to other large consuming areas (like Europe) [15, 16].

As such, while PV systems can be built close to consumers (even on the consumers, that is, on the roof of the consumer's house), and STE is possible to use for far generation places, both systems can work in a complementary way. Obviously, large-scale PV plants can be developed, and in fact they are being developed (mainly in south of Europe, south of USA, and India). In this case both technologies, PV and STE, are competence.

IV. CUSTOMERS OF SOLAR ENERGY GENERATION

The largest solar contribution to our energy needs is currently through solar heat technologies. For this purpose STE and PV can be used. However, it is usually chosen STE technology because its direct connection with the water system that normally is used in heat systems, both for heat needs in houses or office buildings and for healthy hot water. But really the potential of both technologies for solar water heating is considerable. And when you speak about heat technologies, you can also speak about cooling systems with the use of heat pumps.

Regarding the consumption in buildings, the best quality energy building must combine excellent thermal insulation, smart design and the exploitation of free renewable resources, such as the solar energy generation systems. We can use a mix of radiant ground, heat pumps, solar water heating, solar space heating, solar cooling and PV panels to feed directly electrical machines and satisfy the energy needs of a building with a minimum of losses.

Although some types of companies can need very high temperatures in their processes, and solar generation cannot obtain these temperatures as itself, we can say that, in general, solar PV and STE can combine to obtain these amounts of electricity and heat that industry usually requires. It would be more efficient if it would be combined with concentrating solar technologies. Sometimes, it can be necessary to combine also with other types of traditional sources of energy in order to cover with enough guarantees the industrial process. These industrial activities can be of different types such as agriculture, craft industry, cooking and desalination. This solar process heat is currently only used in simple processes for cooking when it is the only way to do it, but it would be a real, simple, easy and cheap option for many sectors of the economy.

But nowadays concentrating solar technologies can provide high-temperature process heat in certain regions of the world (obviously with clear skies and during day hours, being non-available the process during night hours). Moreover, the electricity generated by concentrating solar technology or other types of solar generation can be used for the same purpose in other areas far from the generation region.

Related to the sector of transport, when the substitution of oil seems without a near future, we must consider that on one hand the oil reserves are finites and will be exhausted over time and moreover the price of this type of fuel will be more and more expensive and it is the most dependent on political affairs in different regions of the world. And on the other hand, solar and other renewable electricity can contribute significantly to fuel transport systems when converted to electricity, for example for the electric car, and the contribution from biofuels can be enhanced by using solar as the energy source in processing raw biomass that will be able to use for flights in the future.

Recent environmental, economic and energy security trends point to major challenges: energy related CO_2 emissions are at an historic high, the global economy remains in a fragile state, and energy demand continues to rise. The past two years (2010 and 2011) also saw the Deepwater Horizon oil spill off the Gulf of Mexico, the Fukushima nuclear accident in Japan, and the Arab Spring, which led to oil supply disruptions from North Africa. Taken together, these trends and events emphasise the need to rethink our global energy system. Whether the priority is to ensure energy security, rebuild national and regional economies, or address climate change and local pollution, accelerated transition towards a lower-carbon energy system offers opportunities in all of the areas [17].

IEA says in its high-renewable scenario that PV and STE together could provide up to 25% of global electricity by 2050. In such carbon-constrained scenario, the levelised cost of solar electricity comes close to those of competitors, including fossil fuels, at about USD 100/ MWh by 2030. If solar energy, in all of its various forms (PV, STE, concentrating technology, solar-fuels), takes or not the first place in the energy mix can be debatable, but nobody can deny that it is an affordable source of energy. In sunny and dry climates, solar thermal electricity will be able to overcome variability issues thanks to thermal storage. In the least sunny countries, as well as in sunny and wet climates, the variability of PV electricity and wind power will need to be addressed through a combination of grid expansion, demand-side management, hydro power, pumped hydro storage and balancing plants [18, 19].

In big cities or very populated places, management of the sites for solar panels (PV and/or STE) can be a problem since there would be little space for a lot of neighbors, or the site would not be suitable for maintenance on roofs with difficult access, or shadows are created by adjacent buildings. In these circumstances, and provided all necessary policies are implemented rapidly, solar energy could provide a third of the global final energy demand after 2060, while CO_2 emissions would be reduced to very low levels.

V. TASK FOR GOVERNMENTS

Solar energy needs a strong support of regional and state governments to maintain the growth rate that has taken until now, to achieve improved production of panels and energy collection systems, to achieve a feasible storage from the economic standpoint and also competitive with oil and nuclear energy.

It needs support for generators are not only crazy about renewable energy, or card-carrying environmentalist, or companies that invest money that might not recover by arbitrary decisions of governments. It needs support from the international community to make possible the installation of large plants in sunny and dry areas and transfer this energy through power lines to areas of consumption.

So, it is necessary establishing incentives for early deployment, removing non-economic barriers, developing public-private partnerships, subsidizing research and development, and developing effective encouragement and support for innovation. Incentives that have been managed by governments have done in the solar industry prices have fallen. This price decrease has affected both from the point of view of manufacturing (industry that produces the components) and from the point of view of the seekers of solar systems. Then, if profit margins are reduced, the government incentives could be reduced. But they should not disappear, at least for the next ten years.

The decision by some governments, with Germany leading the way, to develop policies of feed-in tariffs boosted the demand of the solar industry to multi gigawatt levels. Although the grid-connected application remains driven by government subsidy programs (Europe's feed-in tariffs, US tax, production and capacity incentives, for example), as incentive rates decrease and budgets run low, governments are increasingly looking to the solar industry to keep the grid parity promise. Without government subsidies, the market for grid-connected PV products could fall, margins would be constrained, and investors could decide to step back from sector.

The early deployment of solar energy technologies entails costs. Support policies include a significant part of subsidies as long as solar technologies are not currently fully competitive. They must be adjusted to reflect cost reductions, in consultation with industry and in as predictable a manner as possible. Incentive policies must not be abandoned before new electricity market design ensures investments in competitive solar energy technologies, grid upgrades, storage and balancing plants.

VI. CONCLUSIONS

The development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise.

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Javier Bilbao obtained the degree in Electrical Engineering from University of the Basque Country, Spain, in 1991. At present he is Ph.D. in Applied Mathematics and professor at the department of Applied Mathematics of that university. He has been General Chairman of some conferences of WSEAS organization. Current and previous research interests are: distribution overhead electrical lines compensation, optimization of series capacitor batteries in electrical lines, modelization of a leakage flux transformer, losses in the electric distribution networks, artificial neural networks, modelization of fishing trawls, e-learning, noise of electrical wind turbines, Light pollution, Health risk of radiofrequencies. He is the General Chairman of the International Conferences on Engineering and Mathematics (ENMA) and member of the committees of International Conference on Technical and Physical Problems of Power Engineering (ICTPE).

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