



UNIVERSIDAD DISTRITAL
FRANCISCO JOSÉ DE CALDAS

Visión Electrónica

<https://doi.org/10.14483/issn.2248-4728>




VISIÓN ELECTRÓNICA

A RESEARCH VISION

Renewable energies, cost reduction in wind turbines and solar panels

Energías renovables, reducción de costos en aerogeneradores y paneles solares

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INFORMACIÓN DEL ARTÍCULO

Historia del artículo:

Enviado: 28/08/2022

Recibido: 11/09/2022

Aceptado: 02/11/2022

Keywords:

Benefits

Costs

Economics

Energy

Renewable



Palabras clave:

Beneficios

Costos

Economía

Energía

Renovable

ABSTRACT

The main economic problems of renewable energies are observed, analyzed and studied, problems that affect a large part of the poorest population worldwide and not only harm this population but also the energy industry, since the implementation costs are not favorable compared to the energy prices for companies and investors do not represent large profits, the most promising projects are studied in terms of providing a viable solution to the reduction of implementation costs in the sectors of wind turbines and solar panels.

Solving these problems would change the reality of a large part of the population, both the most vulnerable populations such as the African populations, which in energy cases are the most affected, this would give a better lifestyle to these populations, not to mention the economic improvement that would have the energy producing companies or companies that want to be self-sufficient with the help of renewable energy, as this would provide them with a more viable option to achieve this goal with lower costs.

RESUMEN

Se observan, analizan y estudian los principales problemas económicos de las energías renovables, problemas que afectan a gran parte de la población más pobre a nivel mundial y no solo perjudican a esta población sino también a la industria energética, pues los costos de implementación no son favorables comparándolos con los precios de la energía para las empresas e inversionistas no representan grandes ganancias, se estudian los proyectos más prometedores en cuanto a brindar una solución viable a la reducción de costos de implementación en los sectores de los aerogeneradores y los paneles solares. Dar solución a estos problemas cambiaría la realidad de gran parte de la población, tanto a las poblaciones más vulnerables como las africanas que en casos energéticos son las más afectadas, esto daría un mejor estilo de vida a dichas poblaciones, sin mencionar la mejora económica que tendrían las empresas productoras de energía o empresas que desean ser autosuficientes con ayuda de las energías renovables, pues esto les brindaría una opción más viables para alcanzar dicha meta con costos más bajos.

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1. Introduction

The purpose of this article is to highlight one of the most important problems of renewable energies such as how beneficial they are at the time of implementation, because their implementation cost is not always so affordable for all types of population such as the African population that has a very poor economy and not only these populations are affected but also companies and industries that need a short-term profitability.

Initially, the current status of renewable energies such as wind turbines and solar panels, other types of renewable energies and projects that eventually promise some kind of change will be presented.

The reality of the current energy situation in some parts of the world, the shortcomings of some populations and how the high cost of implementation of these energies is the main obstacle to get out of the energy misery of certain sectors of the population, which sometimes live in energy poverty, will be presented in a more direct way. Looking ahead to possible solutions to this problem, projects will be presented that really promise a change in the economic aspect, proposing more economically favorable methods for all sectors and giving the opportunity to the poorest populations to improve their lifestyle. Even so, these projects have some shortcomings that make them unsuitable for certain types of environments [1].

The objective of the article is to provide viable solutions to the defects of these projects to make them suitable in more areas in which they would also represent a viable economic improvement for people and companies. In this way to achieve a favorable change in the reality of everything and also to reach a favorable change in the future of renewable energy because the cost reduction would attract much more interest and would give a boost to the growth of these.

2. Economics in the renewable energy sector

In the field of renewable energies there are many issues to discuss and to take into account, within the energies there is always a margin for innovation, a margin that leads to improvements in the field and energy production, such as new implementation materials among others, but one of the most important aspects to be addressed within this sector is the economy of this.

The benefits that this sector can bring to our society as Dania Gonzales (2014) says “The affirmation that solar energy helps reduce poverty also coincides with the idea expressed 20 years ago by Turrini that the path of the sun is the only democratic and solidary way to the future”. As Dania describes it not so long ago, Turrini was already doing it long before her, affirming the importance of renewable energies in the world economy and benefiting the great majority of the society, reducing the costs of the most used energies nowadays [2].

The economics of renewable energy, in this case more specifically wind and solar energy, is responsible for establishing statistics based on general analyses of these energies, looking at the costs of the materials used to build the energy sources, the transportation of the materials from where they come from, then the construction and installation of the sources.

In addition to analyzing and generating statistics on sales prices or revenues generated from these, thus giving us a clearer view of the entire economic environment surrounding renewable energies and the entire environment involved with them.

2.1. The economy in the hands of the energies of the future.

The renewable energy sector is made up of different energy options to be taken into account, in this case we will talk about wind and solar energy, which together with hydroelectric energy are the most used nowadays by the world's population.

Despite representing only a small percentage of the energy consumed worldwide today.

These energy sources are a necessary commodity for our world as made known in the text *1999 - 2020 - 2041: Past, Present and Future of Energy in Europe* (08 October 2020). “The impact that the production of all this electricity has on the environment has also changed over the last 21 years. CO₂ emissions due to electricity and heat production fell by 21% between 1999 and 2018 [3-4]. This drop in emissions has been mainly due to an increase in electricity generation from renewable sources of 135% since 1999, from representing 16% of all electricity produced to 33% in 2018.” this serves as a clear example of the good that renewables can represent.

These energies that represent a percentage of the world's energy sources are mostly hydroelectric, wind

and solar. These dominate the renewable and clean sector by far, having the most attention from investors and researchers interested in further improving the production and percentages in favor of these sources.

Even so, these are not the only renewable energy alternatives available to us, for example, a very innovative idea is the one presented by Pablo G. Bejarano in: *How the fall of a drop can light 100 LED bulbs*. *How the fall of a drop can light 100 LED bulbs* (March 5, 2020). “The City University of Hong Kong research is interesting because it involves taking advantage of an existing phenomenon. In fact, this is the philosophy of renewable energy as a whole. Solar harnesses the impact of the sun’s rays, while wind harnesses the spontaneous blowing of winds. The droplet-based electric generator could work with rainwater harvesting. But it could also work with stored water. This shows how we can get clean energy from things we wouldn’t imagine in most circumstances [5].

Talking about the small percentages that these energies represent worldwide. Something that other countries in the world could take as an example is Costa Rica, exemplary is the process carried out in that country in which the percentage of energies that supply the country is almost entirely renewable as seen in *The case of Costa Rica: renewables cover 99.62% of energy needs*. (February 17, 2020) by Pablo G. Bejarano. “The situation of renewables in Costa Rica is an example. As much as a country where waterfalls bear the main burden of energy generation can be. This small Central American state has achieved one of the greatest feats of sustainability. Renewables in Costa Rica produce 99.62% of the electricity needed for the country to function”. This fact carried out in Costa Rica if you think about it is a viable option for other countries in the world, perhaps some countries have the amount of waterfalls that Costa Rica has, but have different climatic factors in favor, as could be the strong winds, the sun or in countries like Iceland that uses subway gases as energy sources and then transforming these gases into solids so that they do not affect nature[6].

But all this is part of something bigger, something that is not easy to achieve. The locations where the clean energy producing sources will be installed must also be taken into account, this having a very noticeable effect especially in hydroelectric and wind energy, which must be strategically located to increase their production or to have a constant production. In addition to the production variables sometimes the consequences of

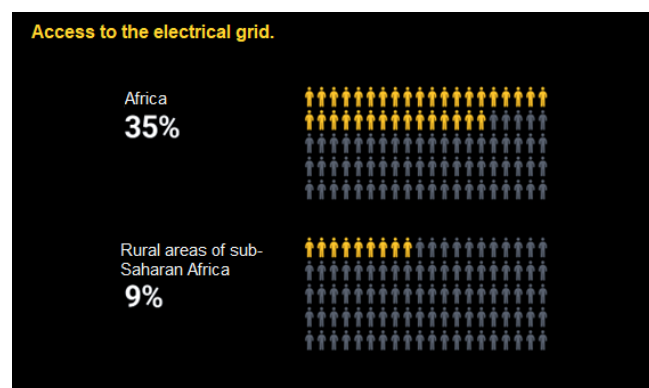
these sources on the surrounding environment are also taken into account as for example in *How wind farms can be resting points in the migration of fish*. (August 10, 2020) by Pablo G. Bejarano [7]. “This wind farm (coast of Delaware, Maryland and Virginia) is in the middle of a migration route of different species. Hence, scientists decided to dig a little deeper into the impact. The conclusions are encouraging. Wind turbines can serve as a resting point in this fish migration”. These energy sources not only benefit us, but also the entire ecosystem that surrounds them.

All these are things that directly affect the economics of renewable energies, their production and manufacturing prices, among others, which in turn substantially affect all the sectors that surround them or are part of them.

3. The energy reality of the poorest population.

Renewable energies are undoubtedly an important part of the present for the world and will be even more so in the future. At present, they are already the energy support of different countries such as Costa Rica and Iceland, but this is not the fate of the rest of the population, places or countries such as most of the African peoples, The European Investment Bank or EIB estimates that 57% of the African population does not have a reliable source of energy or in more extreme cases does not even have it, even with the great potential that the African continent contains to implement renewable energies such as wind or solar energy [8].

Figure 1. Access to the electrical grid.



Source: own.

But this problem of energy inequality, although it is more evident in Africa due to its magnitude, is not the only place where this is experienced, as Angelica Hernández Téllez explains in *Panorama of the energy situation in Latin America*. (April 15, 2020) “Although it is estimated that in Latin America 97 percent of the population has access to electricity, about 10 percent (i.e. 65 million people) still do not meet their basic energy requirements for a decent life, that is, they live in energy poverty”, one of the countries with the worst energy conditions in Latin America is Haiti where 92% of the population still depends on the most traditional cooking systems such as coal or firewood. In countries such as Guatemala, Honduras and Nicaragua, less than half of the population has access to quality energy [9-10].

This type of problems seen throughout the world are raised as goals to overcome by different entities such as the EIB, which in the last five years has made an investment of 4,000 million euros in sub-Saharan Africa, contributing to already established projects that work in the production of renewable energies, even so the vast majority of the population continues to have no access to electricity.

All these problems have a trigger, as are the alarming rates of corruption in the vast majority of countries worldwide, in Africa these rates soar through the roof in the vast majority of their nations and if we add to this the high prices that must be paid to properly implement renewable energy sources that due to these high prices of implementation and low sales costs are not profitable for investors who end up moving away from the environment or ending up in the energy system that end up being harmful to our environment, all this only ends up in a mix that does nothing to favor the most vulnerable populations and even leaves them worse off than they already were [11].

To all this, the most viable solution that would achieve a break-even point is to reduce the implementation costs of renewable energies such as wind and solar energy, which would attract more investors to a market that would promise a higher rate of growth and profit with less waiting time. In addition to encouraging investment in research projects that seek solutions to all kinds of problems with clean energy, projects of this type have already borne fruit and have even been implemented to some extent.

Certain types of projects have managed to reach a point of effectiveness that has led them to be implemented

in some parts of the world, a case in point is the Modvion project, a Swedish engineering and industrial design company that develops modular designs in wood products.

Figure 2. Modvion modular design



Source: own.

An important point to consider in energy sources is its construction, the materials used for it and how good or bad these materials can be for the environment and the production of these energies, as evidenced for example in the Modvion project that is interested in solving such problems focused on wind energy towers, Modvion's goal is to improve the logistics of construction of wind towers of more than 120m, in which its structure is made almost entirely of wood that allows them to reduce both the costs of processing and transportation costs [12]. This being highlighted in *This is what wind turbines made of wood look like* by Pable G. Bejarano (June 25, 2020) “Modvion, known for its engineering solutions for wind energy, has installed the first of the upcoming wooden wind turbines. These are infrastructures similar to those that can be seen in the fields today, but their construction has been done in wood. In this way they are more sustainable and also cheaper.” With this the project aims to solve the clearest shortcomings in this sector as they themselves describe on their official website, “Since wind towers rise above 100 meters in height, transportation poses considerable problems since the base diameters of towers over 100 meters exceed 4.3 meters, the limit for transport width in most of the USA AND the EU [13].

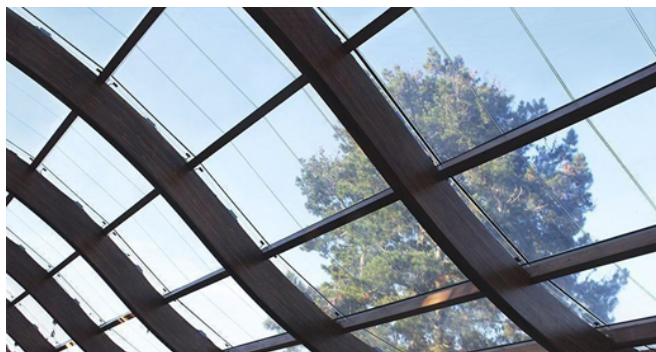
In addition, conventional steel tower buildings become dramatically more expensive with height due to the increasing need for thicker walls. To realize a significant return on investment in wind technology, organizations will need to dramatically improve both costs and efficiency.” These are the points for

improvement on modvion's part, and it has done so with great success, these strategies are really profitable seen from different points, because if it is seen from the point of view of construction and transportation of materials is something really beneficial making the work a little easier and economically less demanding, since less machinery and labor is required for installation. This also making them much more ecosystem friendly due to the fact that building materials such as wood, by the time the appliances or fountains are no longer physically profitable due to the times of use already fulfilled, materials such as wood are biodegradable and do not harm the surrounding ecosystem as they are not pollutants like some other building materials [14]. To this point Modvion has clear goals and really favorable in terms of costs and accessibility for the most needy sectors who would see a reduction in energy costs, but this system could only be implemented in some wind farms, more specifically in the fields installed on land this would provide a viable option for the African population for example, But in cases such as Haiti being part of an island would have to have some fields established in the sea and Modvion wind turbines would not be profitable in these circumstances so really only provide a solution to the fields that are on land[15-17].

All this happens at the same time as in another renewable energy sector such as solar or photovoltaic panels, which are capable of generating clean energy that in turn reduces emissions of gases such as CO₂. One of the main problems of this energy source, as well as wind energy, is its transportation, as these structures are rigid and fragile to a certain extent. This type of drawbacks have encouraged the start of a large number of projects that focus on finding solutions to these problems and others such as cases in which the energy produced by these panels are not fully utilized, for this type of problem arises a project called "Virtual power plants" which focuses on installing small electrical storage plants near populated areas that are responsible for storing and distributing the energy stored by various sources located in a nearby environment, what is expected with this project is to reduce the loss of energy that is had to transport it over long distances, installing a virtual power plant that would be in charge of storing all the energy of a sector, in addition to distributing it according to the need of each enclosure, that is, if an enclosure generates more energy than it consumes and another enclosure has energy shortages, the plant would be in charge of supplying the electrical needs of its sector,

this system would not only reduce the loss of energy due to the distances that must travel on some occasions but would also increase the possibility of obtaining a self-sustainable environment energetically speaking which would mean a reduction in energy costs [18].

Figure 3. Voltaic glass produced by Onyx Solar [19]



In this same way another really innovative project and is already implemented in some parts of the world is the proposal of Onyx Solar a Spanish company that has become a world leader in the manufacture of photovoltaic glass, a material that is used to produce energy in the same way as solar panels but that adapts more easily to large constructions such as buildings and factories, but without losing the quality of being able to adapt to small buildings such as homes, this project provides a much more aesthetic option compared to traditional solar panels, plus not only are responsible for producing energy for the enclosure in which they are located, allows the passage of natural light but in turn provides thermal and acoustic insulation from the outside.

These photovoltaic glasses are also responsible for filtering light as they manage to absorb 99% of ultraviolet light and up to 95% of IR radiation, in addition, it is an economically viable idea in the long term and so they assure it on their website "Our photovoltaic glass works as an income accelerator [20]. Enjoy long-term energy savings, tax credits and incentives." This leads them to be leaders in this sector and a great option for people living in cities, but this type of panels are only beneficial in large cities, as they would not be profitable for low-income populations for people who are in rural areas or more distant from the rest of the world, this type of project can not be implemented in areas such as sub-Saharan Africa where climatic conditions are much more hostile and long-term profitability of these panels would not bring any benefit.

4. The hope and economic evolution of renewables.

These projects are generally very promising proposals, but also in most cases they provide solutions in only one sector, this is the main drawback of these proposals that sometimes with some changes to them it is even easier to implement them in sectors for which they were not initially designed, cases like this are Modvion or Onyx solar. Modvion provides a solution for wind turbine fields located on land, but wind turbines in marine fields are not seen within this project, so a viable solution would be to place the wind turbines on foundation bases higher than normal, i.e. that have sufficient height to keep the base of the wind turbine out of extreme contact with seawater, In addition to this and could be sealed with waterproofing paint that protects the wood and a higher durability time to the structure of the wind turbine, to further protect the entire interior of the wind turbines could even resort to methods such as those carried out in the wooden boats to prevent leaks, in this process all the cracks between each wooden plate is covered with materials such as cotton to the point of sealing the entire structure hermetically.

These solutions together would achieve to implement the idea of Modvion in an easier and more effective way in the fields of offshore wind turbines, in this way the non-polluting factors would be maintained, considering that the paint that would be applied to the wind turbines would be pure acrylic latex or epoxy, which would provide security to both the wind turbine and the environment around it, the method of sealing the old or rather the method used in wooden boats would be an even cheaper option but a more arduous labor, but still any of these can be a very reasonable option according to the idea of reducing costs and does not pollute, it would also maintain the factor of a much cheaper transportation and assembly than with conventional wind turbines, to all this the only factor that increases the value a little but still being more economical this idea is to increase the height of the foundation bases of the wind turbines.

But seeing the great results of materials such as epoxy paints and the great use that have projects such as aquariums among others, there is no doubt that it would be perfectly viable, so is the idea of waterproofing the structures with the method of wooden boats being these viable and economical alternatives to maintain the same Modvion project in more than one ecosystem.

Onyx solar and its proposal of photovoltaic glass is another project focused on a single urban sector in which large buildings are found in the long term to reduce the cost of energy paid in these buildings supplying a portion of the energy consumed by these buildings, these panels or glasses are cheaper and aesthetic, but how to make these panels improve the efficiency to be installed in a better way in places like sub-Saharan Africa. Increasing the opacity of these glasses would increase the ability to receive them and therefore increase the amount of energy they would produce, increasing the opacity of this glass as stated on the website **Sustainable Architecture** with an opacity that allows a vision of 10% glasses would be able to produce 40Wp/m^2 this taking into account that you want to maintain a minimum of vision through the panel, being less opaque also ensures that the resistance of the glass increases, because it contains a little more internal structure, if in addition to this we consider that these will be installed as glass or windows also ensures that they will be exposed but will be and / or will be part of something a little bigger than just panels, will be incorporated into the houses which gives them less exposure, of course, also taking into account that increasing the opacity of these panels does not increase its cost.

And if we could add this project to the “virtual power plants” project, we would not only be increasing the efficiency of these panels, but we would also be reducing the time of productivity of the same and generating less losses of unused energy, in this way we could install Onyx photovoltaic glass and a virtual power plant for each certain land or even in small towns or villages in the African region, thus achieving without energy losses and therefore economic increase the profitability of these systems for small populations in different parts of the world.

The improvement that these projects would have with these changes would result being radical in its economy and therefore in favor of the populations with less economic possibilities of acquisition of projects or equipment of more magnitudes, this would manage to give to a certain point a balance more to the sector of the renewable energies being objective of more investment view and as a much more accessible solution for the populations of low resources that would end up obtaining a better quality of energetic life and what this entails to be able to maintain the populations more isolated with the rest of the world, the solutions given in addition to maintaining the economic benefits, also manage to maintain another important aspect which

is that of not harming the environment as in the case of modvion and the alternative presented to be able to implement this project in the sea, this benefiting countries with coasts or marine areas suitable for wind farms, such as Haiti, which being an island could see this as a great alternative solution to achieve energy stability more suitable for its population.

This is why we can expect a great change in the reality of different sectors of the world's population since these solutions could not only be implemented in the sectors already mentioned, but could also be implemented almost anywhere in the world, even imagine having a large population such as a small city or town that becomes 100% supplied by Modvion wind turbines, Onyx glass and also that the energy produced by these sources is managed in the best possible way by the virtual power plants.

5. Conclusions

With the changes already implemented in these projects, a great change is expected in the reality of the world population, as these changes in the economy of renewables could have as a consequence attract more interest from investors, which could detonate in a great growth of the industry and lead to the generation of more projects that in the future could further improve both the production and costs of this type of energy that are our best alternative for the environmental good compared to the different methods of energy generation. It is also expected that the reality that the poorest population currently live, eventually should be able to acquire some of these means of production that will provide them with a better energy lifestyle and in some way give them a connection to the life that leads the rest of the world, since sometimes these populations do not have a real connection with the rest of the world and remain in exile or technological backwardness.

In the long term these types of solutions and projects could give us a great boost in the fight to reduce the production of greenhouse gases that pollute our ecosystem, the progress that these energies can have with reduced costs could lead us to achieve goals that many of us have dreamed of, for example the idea of a large city totally sustainable with renewable energy, are ideas that until today we have not achieved but with projects of this type that can be improved this would not

stop being a truly achievable goal that could become a reality for everyone.

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