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The Challenge of Clean Energies in Latin America: Between Energy Efficiency and Responsible Production

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Abstract: According to the sustainable development goals of the united nations, it is now necessary for the world to commit itself to the production and adoption of clean energies. However, in order to meet this goal, the new challenge is the accessibility to this type of technologies and the implications that the process of cost reduction brings with it. Therefore, this study seeks to reflect on the pollution resulting from the production of solar panels by companies from countries with lax regulations and how this can affect the social responsibility projects of Latin American companies.

Key words: Solar panels, social responsibility, energy accessibility, contamination, regulations, Latin American companies

INTRODUCTION

The further the new millenium advances, the more accepted the sense of social responsability becomes in developing countries. While regions such as Europe and North America have been focusing on improving production and energy processes for some time in Latin American countries the idea is still relatively novel, although, little by little it is becoming part of local government agendas (Casar, 2014).

The current agendas of international development organizations prioritize the implementation of policies and practices in favor of environmental protection. In addition, due to the approach of the Sustainable Development Goals (SDG) of the United Nations, commitment to sustainability and social and environmental development have become international priorities with these types of challenges encompassing both public agencies and private initiatives (Anonymous, 2015). This push includes the incorporation of environmentally-friendly practices by the business sector, above all those businesses which are technology-based and which recognize in the international discourse the crucial role played by organizations in both reaching agreements to protect the environment and working towards achieving sustainable development (Martin *et al*., 2013).

For this reason, although, some of the SDG may appear to be rather general in terms of specifying responsible agents, all of them acknowledge the role that businesses must develop in order to achieve the stated aims (Table 1).

As can be appreciated, one of the challenges confronting organizations is that of resource exploitation and sustainability, although it is impossible to talk about sustainability when the exploitation of natural resources is done unconsciously and with no regard to long-term needs. One of these resources is energy, a resource which not only implies consumption but which also encompasses everything to do with eco-friendly production or generation (Couret, 2012).

Unfortunately, although, the proportion of renewable energies appears to have increased in respect of consumption in recent years, this does not necessarily signify that the coming decade will not present challenges. In addition, the further improvement of renewable energy sources brings with it new challenges related to production and the tools required for generation (Recalde, 2017).

The purpose of this article is to reflect upon the contamination resulting from the production of solar panels in countries where the use of silicon and lithium is not adequately regulated. Based on a content analysis methodology of sustainability reports of socially responsible Latin American companies, we intend to reach conclusions which allow for an expanded vision of the new challenges facing the production of renewable energies in the region.

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Table 1: examples of the responsibilities of businesses in respect of selected SDG

SDG	Business participation (Goals)
Objetive 6: Guarantee the availability of water and its sustainable management to ensure sanitation for all	From the present until 3020, improve the quality of water by reducing contamination, eliminating wastage and minimising the emission of chemical products and dangerous substances having the percentage of untreated waste water and substantially increasing the recycling and reuse of water on a global level without prejudicing supply
Objetive 7: Guarantee access to affordable, secure, modern and sustainable energy for all	From the present until 2030, substantially increase sources of renewable energy, as well as the amount of renewable energy used
Objetive 12: Guarantee sustainable consumption and production patterns	Encourage businesses, particularly large and transnational businesses, to adopt sustainable practices and incorporate information about sustainability in their reporting cycle
Objetive 13: Adopt urgent measures to combat climate and the effects of climate change	Improve education, awareness and human and institutional capacity in relation to change mitigating climate change, adapting to it, reducing its effects and early warning
Objetive 15: Manage forests sustainably, fight against desertification, stop investing in degradation of the earth and halt the loss of biodiversity	For 2020, ensure the conservation, restoration and sustainable use of terrestrial ecosystems and inland freshwater ecosystems and the services they provide, particularly forests, wetlands, mountains and arid zones in line with the obligations undertaken in accordance with international agreements

(Anonymous, 2015)

MATERIALS AND METHODS

Theoretical framework

The energy that moves the world: When discussing energy, making statements about the level of world development is unavoidable. Those countries with the most advanced sources of energy are also those with equally well-developed industries (Destek and Aslan, 2017). Historically, one of the factors favoring the industrial revolution was the knowledge of how to manage and develop energy efficiently in order to increase productivity. Prior to this key moment, energy sources were rudimentary, being based primarily upon the use of animals, combustion and human beings themselves. Natural resources such as the wind or water currents which powered mills, were exploited to a much lesser extent. Later on steam power was added to the list but even so, the production of energy continued to imply the consumption of resources, a consumption that, on occasion, was greater than what was produced from the energy generated. In this way there was an evolution in energy generation, initially going from wood to coal, to later Include oil and all its derivatives as well as nuclear energy (Ramos *et al*., 2017).

The sustained growth in both energy consumption and economic development as evidenced by the growth in GDP has not been equal globally. According to UN statistics in 2012 1,100 million people worldwide lacked electricity (Anonymous, 2015). The availability of fuel reserves is not the same everywhere and in addition, the extraction and use of the principal sources of energy (coal, petroleum and natural gas) negatively affects the environment (contamination) and in some cases, society (wars, sickness) (Cortes and Arango, 2017).

The circumstances outlined above are the main reasons why international organizations are seeking to start an energy revolution, one which is not only based on the capacity to generate energy efficiently and sustainably but one which seeks to ensure that the benefits are enjoyed by the vast majority of the population (Sanhueza, 2011). Nevertheless, this desire to socialize access to renewable energies leads to the need for efficient and ever-cheaper production processes. This also includes the tools necessary to take advantage of energy such as solar panels for example. Today it is possible to speak of an industry focused on the production of renewable energy, one that includes technological development and production enabling exploitation of solar, wind and water energy in addition to the generation of biofuels (Losada, 2017).

A new industry with new energy requirements: In Latin America the growth in solar energy, use, despite the favourable geographical conditions is still very slow. In the case of Mexico for example, the country has seen significant investment in this type of energy (Perez-Denicia *et al*., 2017), since, 2014. From 2014-15, Mexico increased the number of installations for exploiting solar energy by 49%, and this includes not only those 8 solar parks installed in 6 states but also a clear interest on the part of the population in installing solar panels in homes and businesses for independent generation of their energy needs (Mascotte *et al*., 2016).

In terms of private initiatives and as part of the modernization of the industry and the tendency to join together socially and environmentally-responsible projects, Latin American organizations are currently undergoing a process of improving the energies they use and this takes the form of the adoption of green energy technologies. As the region is severely affected by desertification and deforestation as well as by the effects of climate change, both national and international businesses are increasingly seeking to contribute to a healthier environment (Simon *et al*., 2018).

Table 2: Practices of socially-responsible businesses in the area of sustainable energy

Areas	Practices of socially-responsible businesses
Lego A/S	Investment of 6 million USD in the generation of 546 mW of renewable energy in 2017, an amount greater than that used by the offices, stores and factories belonging to the company. In addition, Lego has 25% participation in the Burko Bank ecology park (UK) which generates clean energy for over 230,000 British homes
Microsoft	In addition to having policies on energy efficiency which also have an impact on their products, Microsoft has entered the biogas energy generation market. The Microsoft data centre in Cheyenne, Wyoming is powered entirely from biogas energy generated off-grid in a nearby water-treatment plant
BMW	BMW uses various types of renewable energies in its manufacturing centres. One example would be its Mexican factory which is powered by energy generated by a photovoltaic plant within the installations and which was an integral part of the building design. Another example is the South African operation which uses biogas generated from waste produced by chicken and cattle farms in the region
Intel	Intel has over 60 projects which utilize solar energy, wind energy, cellular fuels and other sources of alternative energy. An example of this is the main company car park which is covered with photovoltaic panels and has the largest array of microwave wind turbines in the United States
Bosch	The Bosch headquarters in Nashik, India is the world's largest solar energy automotive plant with over 36,000 solar panels installed on the roof, the car park and open spaces within the location. The panels produce 10 mW of power, over 40% of the energy needs of the plant

Researchers own using information drawn from the Global Compact (Anonymous, 2017a, b).

The use of technology for energy production, even if it is for one's own consumption, allows organizations to not only contribute to lessening the use of other production methods such as the use of hydrocarbons but also brings benefits in terms of reduced consumption and the costs associated with the chain of production (Gonzalez and Jasso, 2017).

In order to further clarify the commitment involved for businesses in the region which are interested in using renewable energy, these are outlined in Table 2. This Table highlights the practices adopted by the five companies evaluated as the most committed to social responsibility in 2017. The list is compiled from an analysis of more than 170,000 businesses carried out by the Boston Reputation Institute. The practices outlined are drawn directly from the social responsibility reports submitted by these companies as signatories to the United Nations Global Compact (Anonymous, 2017a, b).

This international tendency, one that is starting to become observable in industries located in developing regions such as Latin America has arisen from the need to offer countries better options for energy exploitation. This includes the production of more economical solar panels than those available from Japan or Europe, which can be expensive and require maintenance which effectively makes them cost-ineffective for industry and negatively affects competitivity (Serrano-Guzman *et al*., 2017). This has meant that, in an effort to reduce costs, manufacturers of solar panels have increasingly relocated to countries such as China, Malaysia and the Phillipines. Although, costs have been reduced due to the deregularization of processes, this has also meant little oversight and severe contamination.

RESULTS AND DISCUSSION

The solar energy boom; New environmental challenges: Solar panels are manufactured from silicon, a mineral, which is abundant globally but one which requires energy-heavy processing and refining before it can be turned into panels (Kuo *et al*., 2001). Polycrystalline silicate, the raw material used in photovoltaic panels, is obtained from quartz which is the most abundant form of silicon (Kiranmayi *et al*., 2008). Quartz is mined and pulverised before initially being refined in giant ovens, which ironically consume enormous quantities of energy (Guechi and Chegaar, 2007). The product obtained is known as metallurgy-grade silicon and needs to be chemically refined, generating a highly toxic waste product known as silica tetrachloride: 4 tons of silicon tetrachloride is generated per ton of polycrystalline silicate (Buresch, 1983). The final step is for the polycrystalline silicate to be cut into plates which then need to be cleaned with hydrofluoric acid which is highly corrosive and potentially deadly to humans (Mascotte *et al*., 2016).

The use of these chemicals as well as the process in general is strictly controlled by the countries in which these industries are based. Unfortunately, however, countries which have become involved in the production of solar panels, more recently have environmental policies which are much less strictly enforced, than those in Europe, US and Canada (Beltran-Telles *et al*., 2017). To give a concrete example in China, the world's principal producer of photovoltaic cells, there is insufficient supervision and regulation of manufacturers and as a result, silica tetrachloride waste is dumped in areas close to the factories. Smith (2015) cites the case of Luoyang Zhonggui High-Technology Co. which caused eye and throat inflammation in residents living near to the factory as well as the destruction of their fields. Another example from China, one resulting from a different process involved in the production of photovoltaic cells is that of the Jinko Solar Holding Co. which was involved in a protest to which the police had to be called when hundreds of agricultural workers surrounded company

installations after hydrofluoric acid leaked into the local river, killing animals and destroying crops (Mulvaney, 2014).

As if the preceding examples were not enough, the energy cost of metallurgical-grade silicon smelting in different parts of the world can be measured in terms of the amount of kilograms of CO_2/kW/h produced by the generation of that energy (Rauschenbach, 2012). It is important to mention that smelting is not the only process which uses significant amounts of energy as part of solar energy panel manufacturing: in fact, 6 of the 10 largest producers of solar panels are located in China where according to Mulvaney (2014), electricity is nearly twice as dependent on carbon as it is in the United States. According to a Smart Green Scans study carried out by Wild-Scholten *et al*., (2014) China's carbon footprint is 1.164 kgCO_2/kWh, 37% more than in the US, 42% more than that of Germany and 55% more than that of Spain. It is therefore evident that the toxicity of these production processes is not the only concern or area which should be given importance in the shift towards clean energy (Araujo and Marti, 1994).

In the same vein, a further issue, although with a different product is that raised by lithium batteries. These batteries as their name indicates are produced by the mining of lithium an extremely light metal extremely suitable for the production of electrochemical batteries (Howard *et al*., 2010). Lithium is obtained from salt flats, and comes principally from the Andean region of South America where enormous quantities of water are required in the mining process. The Uyuni salt flats on the border of Bolivia and Chile have been the focus of attention for the economic potential they signify for the region (McManus, 2012). Despite this however, the San Cristobal pilot mine in the south of the Uyuni region has been both an ecological and social disaster. The San Cristobal Mine uses 50,000 L of water daily, despite a 3 year drought in the region and threatens to contaminate the water table and affect the agricultural resources of the zone which consist principally of quinoa plantations (Anonymous, 2016). In addition, a study carried out by Ellingsen *et al*. (2014) shows that the total carbon dioxide emissions produced in the manufacture and useful life of an internal combustion engine for a Mercedes A180a and a 256kg lithium battery of the type used in an electric vehicle are 6.1 and 4.6 tons, respectively. This represents only a 25% saving in carbon emissions over the petrol motor it replaces. Seen from this perspective the saving is not particularly significant if we consider how much environmental damage is caused in the production process.

The lithium industry has placed much emphasis on the potential that the mineral has, due to its widespread geographical distribution, to be the "gold of the 21st century". It is believed that, much as petrol transformed the countries of the Arabian Peninsula, lithium has the capacity to transform countries such as Bolivia, Chile and Argentina, ending poverty and being the industry that can promote industrialization and development (Zegada, 2016). Unfortunately, the reality is very different with the future panorama of these countries actually looking what can only be described as horrific. The world's most developed countries are reliant on lithium to produce batteries and the effects of this are becoming apparent (Anonymous, 2018). The Hollender and Schultz report mentions some of these effects, for example, destruction of the habitat of 3 of the world's 6 species of flamingos, worsening of existing regional conflicts and corruption of the payments made by the San Cristobal mine to the municipal government of Potosi (Bolivia) which was installed on land sacred to community inhabitants who were themselves relocated in order to permit the mining operation to take place.

Decarbonization of the economy and reduction in hydrocarbon dependency is urgent and with the projected growth in the middle class, it will be essential to have a solid economic base capable of producing sufficient energy, while simultaneously eliminating the secondary effects of producing it (Uwaisulqarni *et al*., 2017). It is illogical to think that the alternative to carbon-generated energy in fact generates more contamination problems than it solves and that airborne contamination is replaced with contamination of water or agricultural resources. Improvement in the quality of life in some countries should not be predicated on the destruction and wholesale exploitation of resources in others: this is not sustainability but simply a new economic element of traditional models of exploitation.

The challenge of producing renewable and eco-friendly energies: The consumption of energy in the world is vital for social and economic development. However, it has important repercussions for the environment. Where the energy resources employed principally to address the necessities of the population are increasingly produced from alternative sources, this also requires conscious regulation such as is the case for any other industry.

The renewable energy industry is not exempt from the strictures of sustainable and responsible production and reaching the clean and accessible energy goal, which is the seventh objective of sustainable development, should not prejudice compliance with the twelfth objective: responsible production and consumption.

It is therefore necessary to put into place legally enforceable regulations in every country which has the intention of producing energy or technology for energy production, changing manufacturing processes for those which are genuinely environmentally-friendly (Ganouni *et al*., 2016). There are alternatives which currently exist to reduce the contaminating effects of the photovoltaic industry, for example the recycling of silicon tetrachloride or the manufacture of fine-film solar panels which produce almost the same amount of energy per square meter but have less than half the carbon footprint of polycrystalline silicon and which do not utilize acid as part of the manufacturing process (Yoshikawa *et al*., 2017). Similarly, cutting-edge research is being undertaken into the use of microorganisms for the processing of the electrolytes necessary in batteries which could substitute the current requirement for lithium (Molina *et al*., 2017). If these alternatives are not fully exploited, pthe new energy industries currently being employed with the stated objective of generating clean energy could instead result in the mass destruction of habitats and ecosystems.

CONCLUSION

The reality facing the world today should not be seen as a crisis in the production of renewable energy but more of an opportunity to redirect processes in order to make them truly eco-friendly. In the same way as the industrial revolution, there will be moments of both progress and setback but this does not imply the abandonment of the possibility of an energy revolution. The implications presented in this research are clearly challenging for the environment but much more serious is the current warming of the planet caused by the emission of greenhouse gases generated in large part by traditional energy-production methods.

In conclusion, renewable energies are the solution but they need to be developed in conjunction with responsible business practices and commitment from all those involved, nations need to put into place legislation which punishes those who contaminate, whether these are industries who need to be held accountable for their processes or private citizens in order to ensure full compliance.

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