OPPORTUNITIES IN THE CARBON MARKET WITH A SOLAR-HYDROGEN-SYSTEM

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ABSTRACT

The implementation of sustainable energy generation applied to a house, not only brings the benefit of environmental care, but also it generates the possibility to be involved in the carbon credits market. Currently, México ranks fifth worldwide in implementing projects of Clean Development Mechanism that form the carbon credits market (CCM) established in the Kyoto Protocol. China has the first place with 57% of projects, México with 1.4% of projects is not intended to be outdone, and it has the prospect to grow in the coming years as reported by SEMARNAT.

This paper describes how to build a sustainable system for the carbon credits market; it also details how the design and installation of a solar system in a house was carried out in the first stage of the project. This project can contribute to the Mexican position in the CCM, as the proposal of a hybrid power generation comprising solar system, electrolyzer and fuel cells can enter the CCM. If such system is applied to 1000 houses with 1 kW solar installed and 5 effective hours of sunshine, it may stop the emission of 292 tons of CO_2 per year into the atmosphere that could be generated in a thermal power plant, generating 292 carbon credits.

Key words: Carbon Credits, hydrogen, solar system

1. INTRODUCTION

The constant growth and accelerated development of the population has brought with it the increment of energy demand for the production of goods and services, this has brought at the

same time a high cost in economic and environmental matters as we live today, such is the example of global warming and the increase in electricity costs.

Based on the problems previously mentioned, it has proposed the integration of a solar system-hydrogen house, where the average power consumption is 5 kW/Day. This system include the following components: photovoltaic modules (PVM), electrolyzer and fuel cell; in such a way that the energy generated by the PVM, which is not used in home, is transferred to the electrolyzer to produce hydrogen, store it and then use it as clean fuel when the sun already doesn't have enough solar incidence on the day or when the electricity is required.

With this solar system-hydrogen implemented on a determinated number of houses, it bring us the opportunity of stop the broadcasting CO_2 to the atmosphere that could it be generated by a thermal power plant. On the other hand, adopt this system give us the chance to break into the carbon market, which is an economic incentive established in the Kyoto Protocol (KP) to achieve the imposed objectives to reduce greenhouse gas emissions (GHG) with various actions and through these friendly technologies to the environment. It is noteworthy that the issue about being able to understand and implement carbon finance is very extensive; this study presents some basics relating to how to break into the carbon market via a solar system–hydrogen [1-4].

2. CLEAN DEVELOPMENT MECHANISM

The clean development mechanism (CDM) is an agreement on the Kyoto Protocol set out in article 12, which allows the Governments of the industrialized countries, companies, individuals or legal entities, to sign agreements to meet greenhouse gas reduction targets.

Annex B of the KP, establishes quantified emission limitation or reduction of GHG in each country signed on the basis of the percentages indicated in that Annex, the projects may be submitted to countries committed to this Protocol in annex I, to achieve its objective with a view to reducing the total emissions of these gases at a lower level by no less than 5% of reported emissions in the year of 1990, in the commitment period from the year 2008 and 2012. In this first period, the CDM is the only one that provides for the participation of countries no-anexo I in

emissions trading, as sellers of certified emissions reductions (CER), based on projects of registered mitigation.

The benefit is reciprocal, since Parties included in Annex B to the KP-supported parts No-Anexx I to meet their reduction commitments, at lower cost insofar as the latter receive additional funds to encourage cleaner production processes and drive sustainable development. México, as a country belonging to the Group of countries No-Anexx I, can develop CDM projects.

A CER is equivalent to one metric ton of carbon dioxide equivalent (t CO_2 e) and reduced or abducted through a proposed emissions reduction or carbon sequestration that has been developed based on the modalities and procedures for the CDM. Each CER issued boasts unique identifying information through a serial number comprising the following elements:

- The commitment period for which airs the CER;
- The host country where it has held the country using the country code of 2 letter defined by ISO 3166;
- The type of unit (eg.) (CER);
- A unit number that is unique to the CER in the host country and the commitment period and;
- A project that is unique for this project identifier CDM for the host country.

To invest the Governments or enterprises in these projects for the CDM, are not only contributing in the caring for the environment but also have the opportunity to be part of the carbon market.

3. SOLAR-HYDROGEN SYSTEM

Solar-hydrogen system integrates the benefit of the use of light solar via the photovoltaic effect and the option of using the energy not used or surplus to carry out the process of electrolysis of water, to produce and store hydrogen as a clean fuel then when needed, feed a cell of fuel, in this way the generation of energy is constant and sustainable [5-8].

The proposed system is estimated to generate 1 kW hr^{-1} solar, whereas an average of 5 hours of operation effective of solar radiation during the day, there is a power of 5 kw day delivery.

These characteristics may be given approximately 150 kWh $month^{-1}$, this energy can be managed by means of electrical appliances in low power consumption, taking a responsible and sustainable use of the energy generated by result. The following describes each component that makes up the solar–hydrogen system proposed:

3.1 Photovoltaic system

A conventional photovoltaic system (PVS) requires additional accessories such as: Bank of batteries, battery controller and DC/AC power inverter. The established PVS has the following characteristics:

3.1.1. Photovoltaic panels

For proposed energy demand are proposed 215W polycrystalline silicon modules which have a nominal 18V voltage and maximum voltage of 26.6V with a maximum current of 8.09A and 1000 W m^{-2}. 52 Modules connected in series for each settlement arrangements are required, this system provides a maximum current of 40.45 A delivering a power of 1.46 kW.

The dimensions of each solar panel is 1.5 m long and 1 m wide, resulting an area of approximately $15m^2$, this area could generate problems in the field of space in houses located in highly populated cities, however in the studies, they shows the possibility of reducing the area of the conventional flat solar panels from 33 to 52% of the original area using a model of mathematical simulation that determines the amount of light received by a structural configuration of solar panels that resembles a shoot plant model, Figure 1 [8].

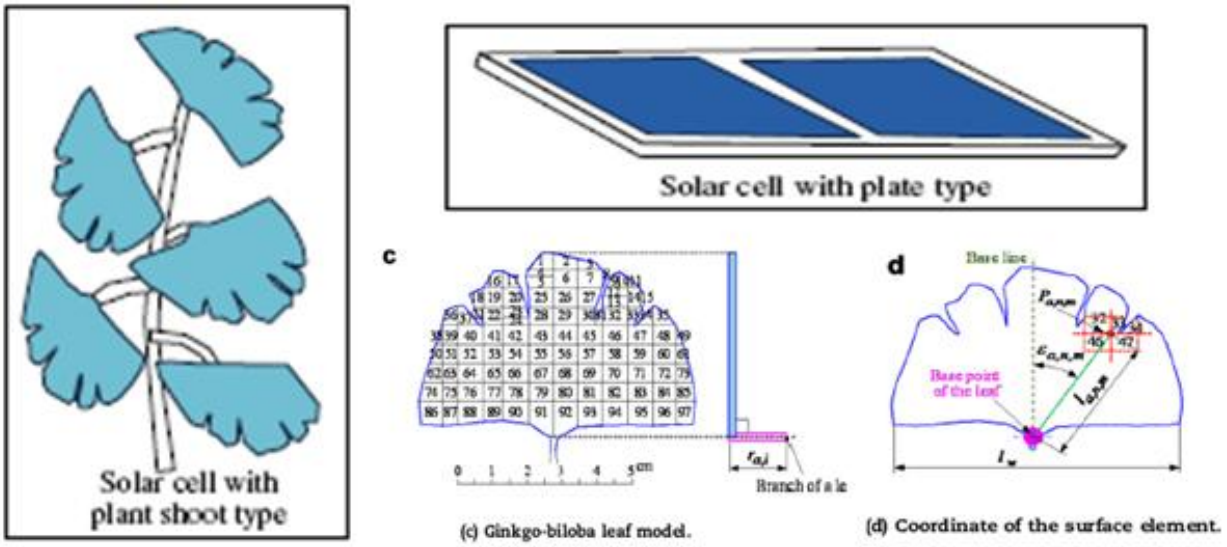

Figure 1. Study of water electrolysis system using a compact solar cell module with a plant shoot configuration [8].

3.1.2. Battery bank

The capacity of the batteries system is 22.22 kWh for two days of autonomy. If this batteries system delivers nominal voltage to 24V, we will need 6 batteries with 12V and 357Ah. Three arrangements in parallel with every settlement containing two batteries needed.

3.1.3. Battery charger and inverter from CD to CA

We proposed two controllers of 48V batteries system that it can handle currents of up to 60 A and the use of an inverter 1500 W and 12 V. In this first stage of the project it was necessary consider a bank of batteries while it works in the way of stop to use auxiliars.

The whole system is shown in the figure 2:

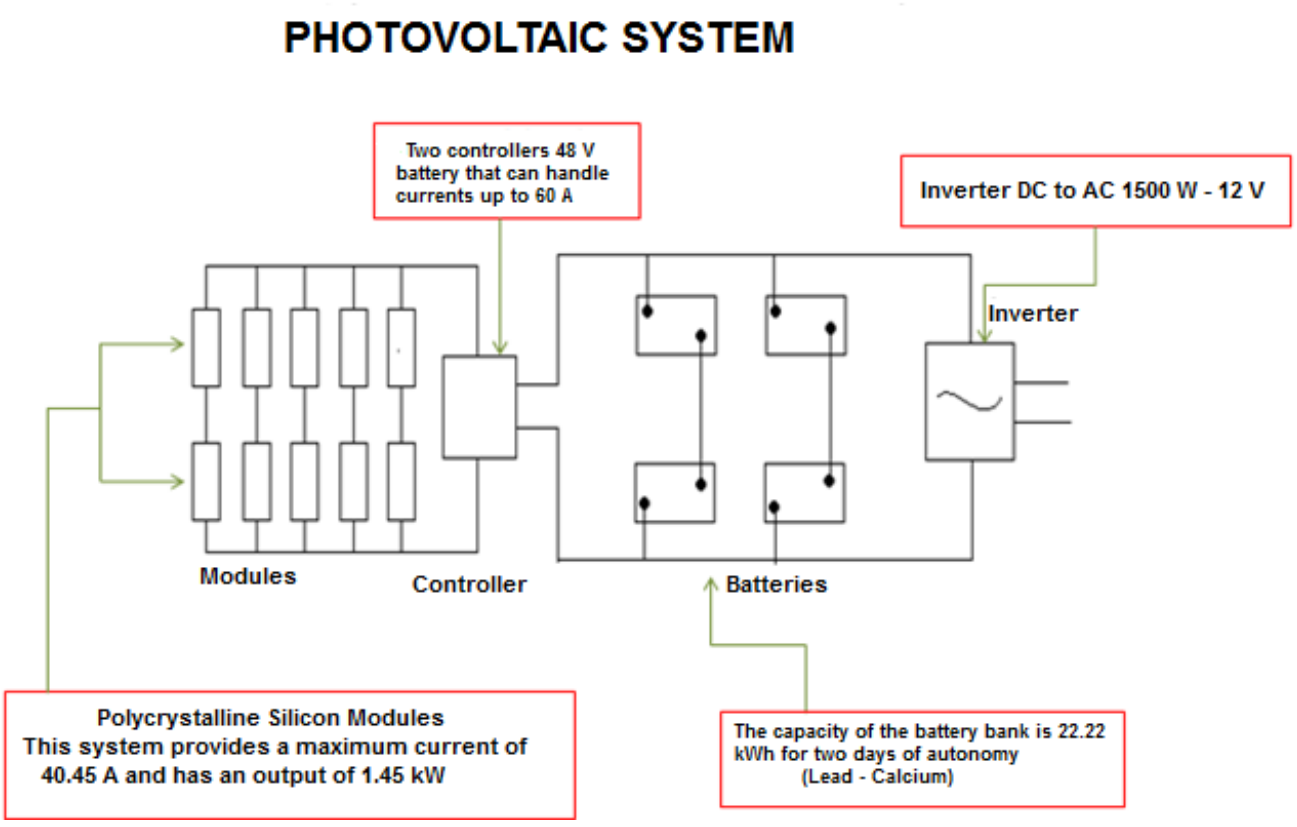

Figure 2. Photovoltaic system

On the basis of the above, a publication of the International Journey of Hydrogen Energy entitled "Direct coupling of to solar-hydrogen system in Mexico" were consulted, where it shows that it may be possible to attach a solar system - hydrogen directly to the electrolyzer leaving without any auxiliary system, such is the case of the Bank of batteries, it is currently based in left this article to be able to optimize the system in the solar part, also the article mentions that is important takes the characteristic performance of the solar system curve reference and it is available to work in the area of optimal performance.

3.2. Electrolyzer

The electrolyzer referred to in this system uses electric current supplied photovoltaic panels to convert the water deionized in pure hydrogen. One of the important features of the selected electrolyzer is the capacity to deliver 200 psig of discharge pressure at a speed of 600 cc min^{-1}.

3.3. Fuel cell

The stack of PEM fuel proposal has valves and fans controlled by means of microprocessor electronics managed (ECU). You only have to connect it to the system of the hydrogen sourse generation (electrolyzer) or tanks of this fuel cell and hydrogen supply will deliver 1 kW of electric energy clean.

4. PROCCES FOR SUBMITING A CDM PROJECT

CDM projects have a process or cycle of detailed modalities and procedures established by the United Nations Framework Convention on climate change (UNFCCC), involving different actors and institutions. A typical CDM project contains several stages, described in figure 3.

4.1 Mexico CDM projects

At the international level, progress located Mexico in fourth place by the number of registered projects, in fifth place by the average annual reduction of her emission of greenhouse gases, and in fifth place for certified obtained emission reductions.

In the projects submitted through the CDM is not currently the integration of a Solar-Hydrogen System a house, is therefore that of applying this system to an average of 1000 houses in strategic areas can be achieved stop broadcasting 292 tons of CO_2 year into the atmosphere that would occur in one plant thermoelectric, managing to deliver approximately 292 CERs, these incentives would achieve long-term finance this system and continue contributing to the care of the environment.

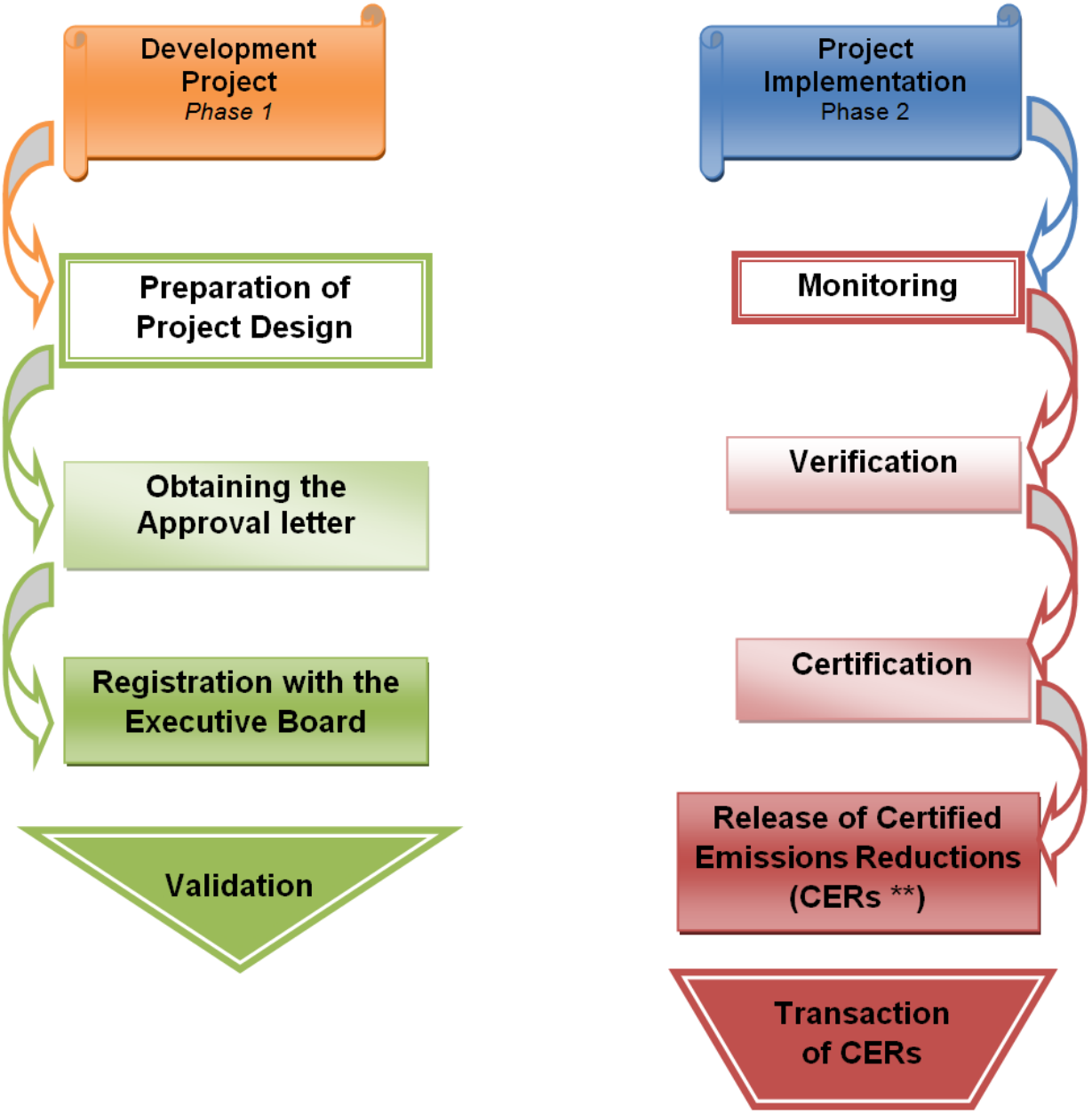

Figure 3. Stages of clean development mechanism (CDM)

The designated national authority is an entity (part of a Government that has ratified the Kyoto Protocol) that authorizes and approves the participation of this or other CDM projects

Its function is to issue the letter of approval to the participants of a project CDM. In the case of Mexico, this function has been commissioned to the inter-ministerial Commission on climate change.

For that a draft CDM could be verified (prior to registration), it requires a letter of accepted issued by the designated national authority. This letter makes note that the participants do so voluntarily and that the project contributes to the sustainable development of Mexico. Procedures for obtaining approval letters were published in the Official Gazette of the Federation on October 27, 2005.

5. CONCLUSIONS

Mexico has started some action to develop the hydrogen technologies: integration of a multidisciplinary research team made up of professional in areas of chemical, electrical, mechanical and electronic experts in renewable energies, development of experimental installations, lines of research, and supply of services end technical assistance to companies, research center and other entities. Finally, it is necessary to carry out project in collaboration with other research centers and R&D departments.

This project could contribute to the México position in the carbon credits market (CCM). The proposal of a hybrid power generation comprising solar, electrolyzer and fuel cells system can help to enter the CCM.

6. ACKNOWLEDGEMENTS

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