THE ENERGY SITUATION IN MEXICO

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1. Introduction

Societies around the world place their hope on Renewable Sources of Energy (RSE) in order to secure resources to achieve and sustain their standard of living. This hope is due to the fact that fossil energy resources are finite, and the awareness on the grave environmental effects of using fossil fuels. There are many mentions about the advantages of using RSE such as the cleanness of its use and its never-ending character. But in fact, this discourse has been around for many years, even decades, and the RSE do not yet reach this long-announced importance in its use.

There is controversy as what people understand as alternative energy, because to some, they are synonymous to renewable energies, and to others it includes some energies such as geothermal, or even nuclear energies. In some documents some forms of energy such as large hydraulic facilities are not considered renewable, and in others biomass can only be referred to as the energetic use of firewood.

Another great difficulty about alternative and renewable forms of energy comes from the fact that the language used to refer to them incorporate them all at once; almost as if they all had the same characteristics, advantages or difficulties, or like if all the available technological energies had the same degree of development, including its commercial availability. For example, when we speak about promoting solar energy, we need to know if we speak about flat solar panels to heat water for domestic and recreational purposes, or thermal energy for industrial processes, or electrical energy for isolated (or grid-connected) systems.

For all these reasons, any assessment of the energy situation of a region that takes into consideration the renewable energy supply must clarify from the beginning what is understood as renewable energy and what specific technologies are referred.

2. Renewable energies in the World and in Mexico

The role of renewable energies has been at the center of discussions about the world energy future, but the differences that we just pointed out and the lack of enough and reliable data complicate the analysis of its application. In November 2002, the International Energy Agency (IEA) published a document that included information about the use of renewable energies, with the intention of facilitating the debate of the role they have played in the world supply of energy. This document was again published in January 2007. For the IEA, renewable energies include renewable fuels and waste, hydraulic energy, geothermal, solar, wind, tide and other.

In the year 2004, renewable energies accounted for 13.1% of the 11 095Mtoe (1 toe = 41.868 GJ) of world total primary energy supply (Fig. 1). Combustible renewable and waste (97% of which is biomass) represented 79.4% of total renewable, followed by hydro (16.7%). In Mexico, the percentage is 10.4% according to this same source.

The total supply of renewable energies experienced an annual average growth of 2.3% during the last 33 years, same as observed by the total supply of primary energy (Fig. 2). However, “new” renewable including geothermal, solar, wind, etc. recorded a much higher annual growth of 8.2%. Wind experienced the highest increase (+48% p.a.) followed by solar (+28% p.a.).

The main users of renewable energies are the underdeveloped countries of Asia, Latin-America and Africa, due to the great share that biomass has in their energy offer (Fig. 3). We may also note that their main use is for cooking and domestic heating (Fig. 4), but industrialized nations use more hydraulic and “new renewable”: 44.5% and 66.1% in the year 2004.

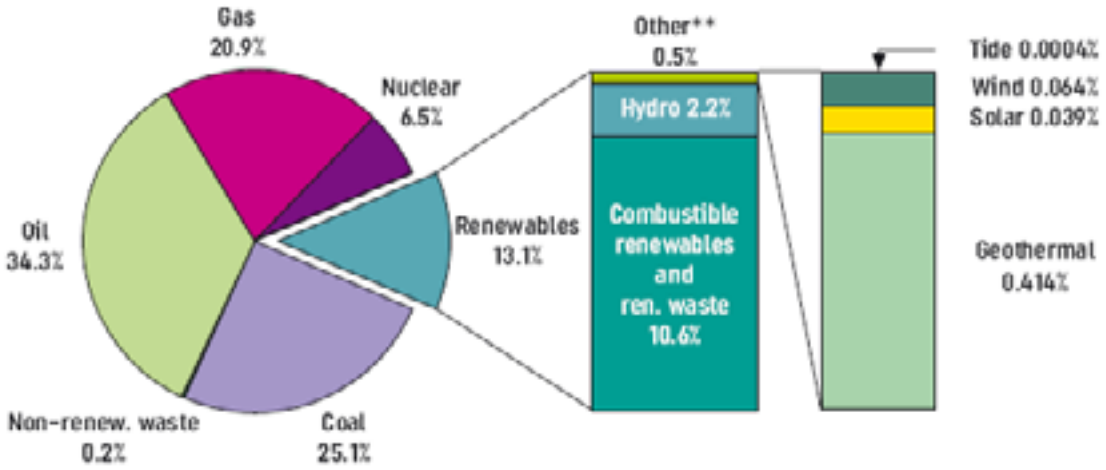

Fig. 1: 2004 Fuel Shares of World Total Primary Energy Supply

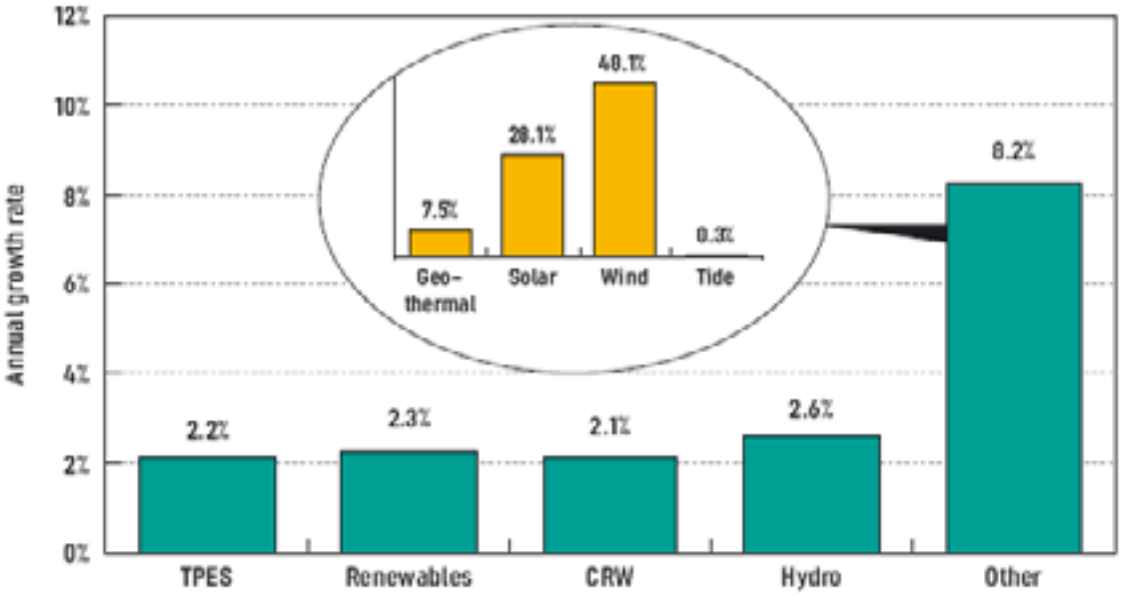

Fig. 2: Annual growth of renewable supply from 1971 to 2004

In the world production of electricity, renewable contribute 16.1% of the total, and most of it (almost 90%) is due to large hydraulic plants (Fig. 5). Geothermal, solar and wind have now reached 4.5% of renewable generation.

The distribution of the installed capacity for the generation of electricity in Mexico is shown in table 1, where 89% corresponds to hydraulic energy, 7.9% to geothermal energy and the 3% remaining corresponds to biomass, solar photovoltaic, wind and biogas.

According to the reference scenario, in which the IEA assumes that government policies remain without changes, and abrupt technological changes do not happen, renewable energies grow at a 1.3% annual average until 2030, while the global energy growth will be 1.7% annually.

A second scenario assumes a wide range of new energy and environmental policies enforced. In this case, different renewable energies will grow 4% between the year 2000 and 2030.

3. Renewable energy resources in Mexico

For Mexico, the prospective for the use of renewable energies foresees as base scenario that the total primary energy offer will duplicate between 2002 and 2030 (SENER 2005). Natural gas will have an annual growth rate of 3.5% and the demand for oil for the year 2030 is estimated at 3.4 million barrels daily; hydro will grow 2.3% annually, and biomass 3.7% and other renewable 4.1%. Renewable energies not used in the generation of electricity will contribute to 5% of the total, reducing the use of biomass from 8% in 2002 to 4% in 2030, due to the fact that today the main use of biomass is for residential purposes.

Municipal waste has grown at an annual rate of 4.7% from 1991 to 2001. In 2001, 31.9 million tons of waste were generated, 50% of which was organic material. There exists one plant in Monterrey that processes the biogas generated by municipal waste, and it has a capacity of 7.4 MW. The cost of energy of this biomass is in the range of 750 to 1 300 USD/KW.

Geothermal energy has High Enthalpy reserves estimated at: 1 340 MW proved reserves, 4 600 MW of probable reserves and 6 000 MW possible reserves for a total of 12 000 MW. There is a current installed capacity of 953 MW in four sites. The depth of the site wells vary from 600 to 4 400m. The investment costs vary in the range of 1 200 to 5 000 USD/KW, and the generation costs vary between 0.02 and 0.05 USD/KWh. There are Low Enthalpy reserves (< 150ºC useful as process heat) in 276 sites across the country and estimated resources on 300-350EJ.

The availability of solar energy is distributed as follows: 57% of the surface receives an average in the range of 1.6 to 2KJ/cm^2 per day, 38% receives more than 2KJ/cm^2 per day and 3% receives 1.6KJ/cm^2 or less per day on average. Low temperature solar panels are made by some 50 manufacturers scattered around the national territory. As of 2004, 573 919m^2 were installed on rooftops around the country. The national market has grown at an annual rate of 15% in the last ten years. Solar photovoltaic cells generate 14.17 MW in residential market and 4.01 MW in other sectors. 49% of the photovoltaic cells are imported from Japan, and 51% from the US and the European Union. The typical efficiency of the installed technology varies from 6 to 15%, and its useful life is from 20 to 30 years.

In relation to wind energy, some geographical regions in the southeastern shore facing south to the Pacific Ocean have shown a capacity of up to 2 000 MW in recent studies (Fig 6).

The biomass energy offer per year is about 2 056 PJ. 62% of it comes from firewood, 35% from plantations and the remaining 13% from natural waste. The biomass resources available to produce biodiesel and ethanol is equivalent to about 2 000 PJ per year.

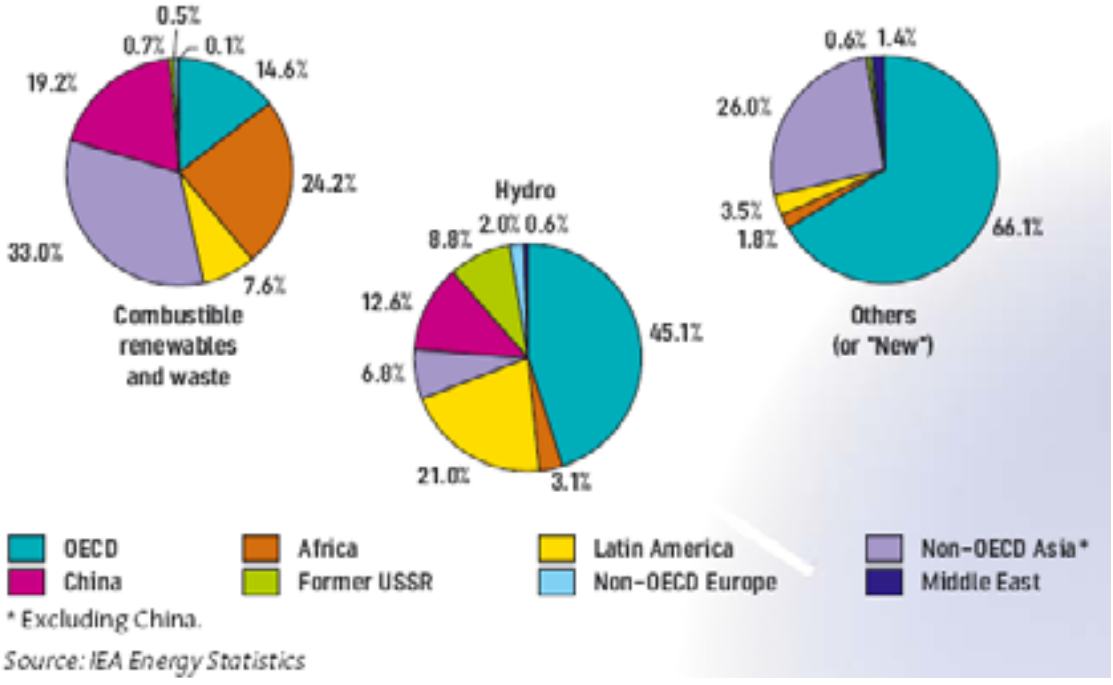

Fig. 3: 2004 Regional shares in renewable supply

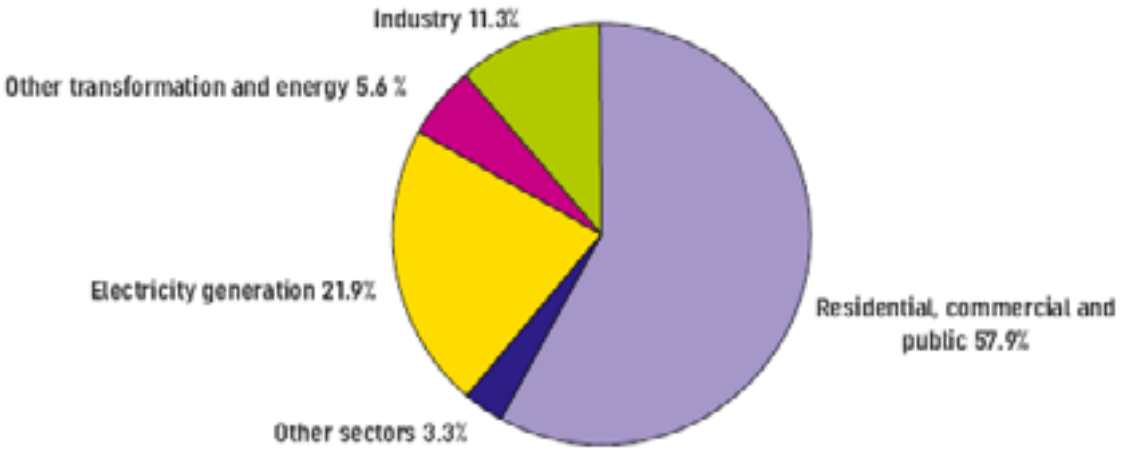

Fig. 4: 2004 Global sectoral consumption of renewable

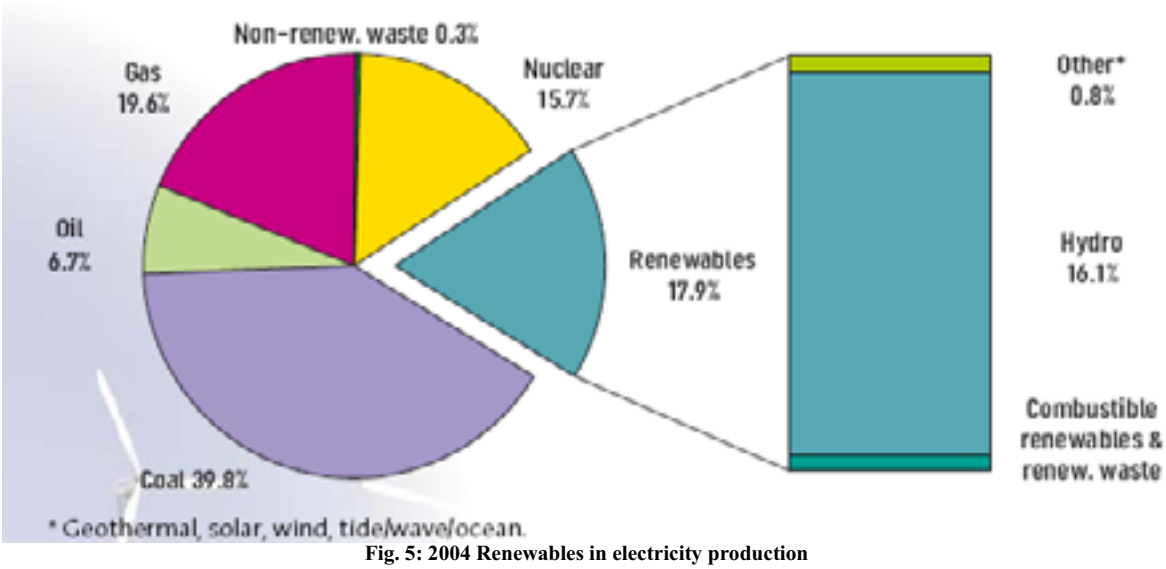

Fig. 5: 2004 Renewables in electricity production

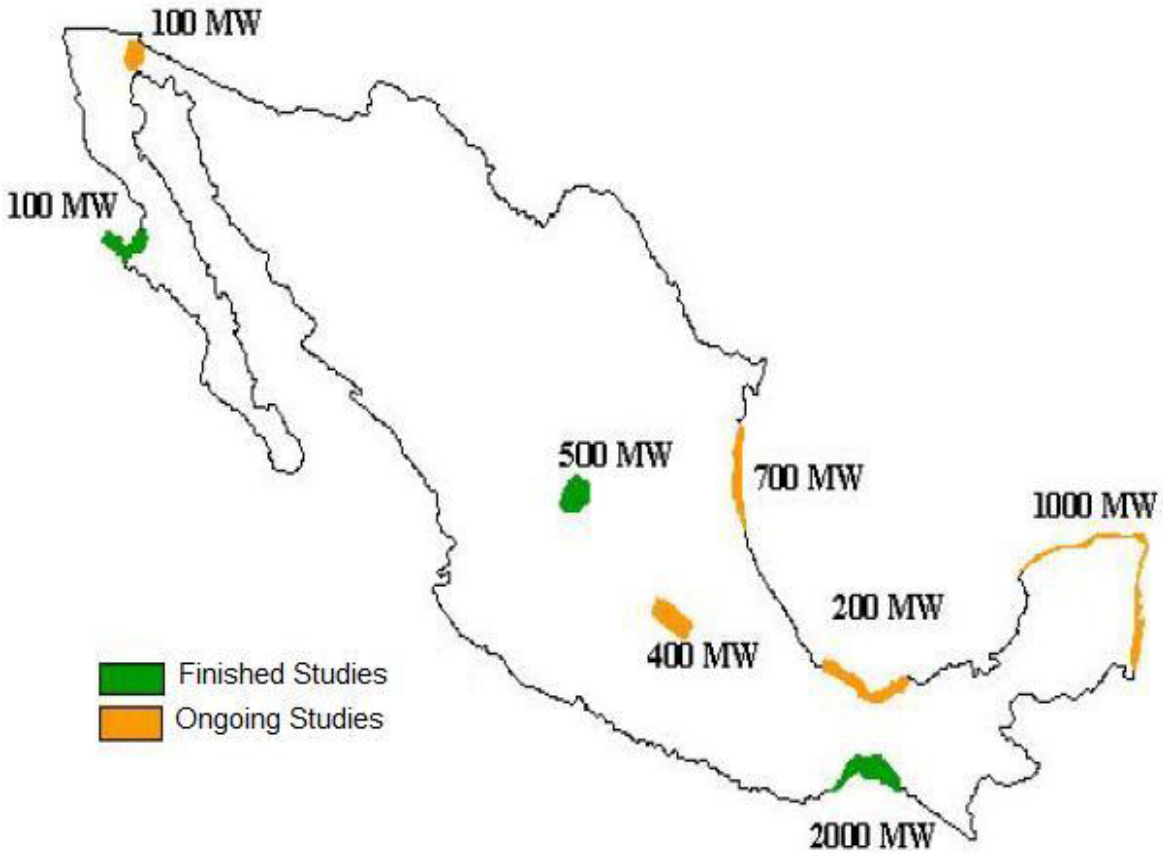

Fig. 6: Wind Energy Studies

4. Diagnostics on Renewable Sources of Energy in Mexico

According to the Secretary of Energy and the German Cooperation organism GTZ, there are several obstacles in the way of developing and implementing Renewable Sources of Energy in Mexico. These may be classified as institutional, legal and regulatory, economic, financial and technical. Among the institutional we find that the national energy plan is based on methodologies that evaluate only the short-term economic cost of the generation of energy, and not on the stability of prices of energy and the long-term consequences of this fact. Among the legal and regulatory, there are legal and constitutional limitations to the private participation in the energy sector. Some aspects on the evaluation of renewable energy resources are mentioned as technical barriers, but there is no mention to the domestic development of new technologies and the role that may be played by several national research institutes, some of which are currently working specifically on the subject of renewable energies.

The Law on the Use of Renewable Sources of Energy (Ley para el Aprovechamiento de las Fuentes Renovables de Energía), approved by the House of Representatives in December 2005, the creation for a Program on the Use of Renewable Sources of Energy is established. Its goal is that by the year 2012, at least 8% of the primary energy used must come from renewable sources (without including large hydro). It is necessary to utilize 600 million pesos (about 50 million US dollars) per year to the development of both public and private investment that install and operate electricity for public utilities, using competitive technologies. An additional investment of 400 million pesos (34 million US dollars) per year are necessary for less mature technologies that are considered as strategic for Mexico.

In spite of all the efforts made, the technology on renewable energy in Mexico is still little known by potential users, both as how it works, and the benefits that may be derived from its use. This is particularly relevant among key decision makers in the energy or productive sector. It has also proven very difficult to evaluate the environmental and social benefits from the use of renewable sources of energy.

Another important aspect is that the internal market is less than favorable to the applications of renewable energies because of subsidies that are applied to conventional energy sources. Most of the applications are not

economically competitive, and they hardly will be without modifying the structure of costs of conventional energy sources.

It cannot be ignored that the process of development of technologies that use renewable energy sources has been developed disengaged from the national productive process. As a consequence, many research institutions have only experimental prototypes, or worse, they simply import foreign technologies.

The economic resources destined to research and development of technologies based on renewable energy have been traditionally very scarce and discontinuous. As a consequence of this, most of the projects undertaken have been small, and in many cases have been abandoned before conclusion due to lack of resources. Thus, only on very few occasions the technological developments reach its final stage. Some projects were motivated by purely academic objectives.

The technological development is the next step after research, and in the case of renewable energies, there is a lack of cooperation between research institutions and the productive sector. The process has centered fundamentally on equipment, and very little on methods for the design and analysis of the systems, so the technology transfer has been extremely slow.

Also, scarcity of training programs for engineers and technicians is now evident. Yet, few efforts have been made to provide training and education despite it plays a key role in leveraging industry development. Some universities and research centers are creating programs on renewable energy systems and a particular interest on energy management is noticeable.

From the industrial sector perspective, one of the limitations has been the lack of industrial prototypes, i.e. prototypes conceived for serial production.

5. Conclusions

The known reserves of petroleum, natural gas, and other non-renewable energy sources in Mexico are not as large as they were thought to be; besides, its use implies environmental consequences that are ever harsher, that is why it is necessary to accelerate the energy transition towards more sustainable energy schemes. In this context, all renewable energies play an important role, since Mexico represents a great reservoir of such resources.

When discussing about renewable energy sources in general, it is a common mistake to include them all in the same category, as if they all had the same degree of technological and commercial development. A serious discussion must take into account the particular characteristics of each technology and each use.

Creation of a critical mass of both technology and human resources are crucial for the renewable energy industry to grow. Some efforts have been made to train engineers and technicians but specialized academic programs are still scarce. Creating a skilled and trained workforce is decisive to leverage development in the country.

Subsidies in the electricity tariff and fuel play an key role in the development of renewable energy. Some incentives for installing renewable energy systems have emerged and now net metering is possible. Yet, a profitable scheme for renewable energy systems is still far in the horizon.

Even though there have been efforts to include these sources of energy in national energy policy, the plans include errors, and a better strategy would include all the actors involved.

The problems for the development of renewable energy sources are not primarily scientific of technological, but rather institutional, programmatic, operational, legal and financial. It is fundamental to state a national objective about which topics are a priority for the research and development system. It is also important to define policy that include the industrial development as well as the commercialization of renewable energy sources.

6. References

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