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"CURRENT SITUATION OF THE ENERGY MARKET IN MEXICO: THE CASE OF MIPYMES WITH THE SALES AND INSTALLATION OF SOLAR PANELS IN TEPIC"

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Abstract: The present investigation is exploratory and a mixed methodological approach (qualitative and quantitative data) was used to reach the desired objective, that is, to recognize the problem(s) of Tepicense MiPymes, from the current context of the retail renewable energy market, especially the use of photovoltaic solar energy. Specific data on the solar panel market in the municipality of Tepic, Nayarit, is presented to analyze the energy market supply and demand in small businesses. Finally, a proposal and conclusions are included, based on the results obtained through the methodology used, as well as the tools used to collect the information.

Keywords: Energy market, MiPymes, Solar panels, Photovoltaic Solar Energ.

INTRODUCTION

The topic of the renewable energy sector has come, and continues to acquire a central role in the world's public agendas, while recognizing its environmental, economic and social importance. The central axis that frames these public agendas refers to environmental problems, in this case, climate change of anthropic origin and that, due to the globalizing phenomenon, has been able to spread to many and diverse geographical spaces. The foregoing, through the global political discourse that requires the use of renewable sources or energies at all territorial levels, that is, going from the supranational to the place level, as one of the ways to mitigate said problem.

In this sense, the phenomenon of globalization, by encompassing all territorial levels, without distinguishing the specific particularities of each territory, such as climate, pollution levels, demographic profiles, uses and customs, economy and social processes mainly, discriminates, in a certain shape, the needs of each territory. Since, each of these particularities of the territories, define and

respond to the acceptance or rejection of the use of renewable energies, through increasingly sophisticated technological innovations. In this order of ideas, the importance that the territory represents in all its geographical levels is very significant. Hence, on many occasions it is difficult to adapt and adopt political discourses that contrast with what each territory actually needs or has.

From the energy reform implemented in 2013, it was projected to have a more efficient electricity sector to reduce costs and electricity rates, through an energy transition towards clean energy through efficient technologies. To guarantee universal access to electricity, in accordance with what was agreed in the Paris Agreement in which Mexico committed to moving towards renewable energies in 2016. In turn, through the Sustainable Development Goals (SDGs), Mexico committed to addressing energy poverty, having affordable and non-polluting energy for all.

The 2013 energy reform, in which the conditions were created to create the Wholesale Electricity Market (MEM), allows the participation of private companies to sell and buy electricity in Mexico. It is observed that, for the most part, they correspond to large corporations and industries, which are self-suppliers of the electrical energy they produce. Currently, despite the decision to modify said reform to benefit state power generation plants and restrict the sale of energy from private projects built by foreigners, there continues to be private investment through the MEM by these large companies. Los Angeles Times [Latimes] (2022).

In this understanding, the current situation of the renewable energy market in Mexico, leaves aside the regulation and support for MiPymes that offer the service of renewable energies, as is the case of photovoltaic solar energy, or what is the same, to MiPymes with the sale and installation of solar panels. In

other words, there are no public policies or economic development programs that direct the investment and optimization of resources for these MSMEs, both in the public and private spheres. According to the statutes signed by Mexico, the role of the State must appear as promoter of an efficient market, but in defense of public interests, ensuring universal access to electricity, in an affordable and non-polluting way.

Given these contradictions, the need arises to carry out an investigation that accounts for the problems that have been arising around the energy transition towards renewable energies, specifically, at the place level, which is where the globalizing phenomenon has severe repercussions and which will be detailed later. Our informants have been delimited to the owners and representatives of the businesses, specifically, to the MiPymes (micro, small and medium-sized companies) of the municipality of Tepic, which are dedicated to the business of renewable energies, that of solar energy through of solar panels, or what is the same, photovoltaic solar energy. It is considered that one of the main aspects of the energy transition towards renewable energies is the economic aspect, from the mercantile approach that has been given to renewable energies.

In the case of Mexico, it is necessary to contextualize the mercantile approach mentioned above, recognizing its opportunities and weaknesses, since from this context the problems that have been brewing around a political discourse that propagates the linear transition towards the use of renewable energies as a mechanism to mitigate climate change. The role played by the State as a mediator between the end user is recognized, that is, whoever acquires this renewable energy service (demandant), must comply with a contract with the Federal Electricity Commission (CFE), as well as whoever provides it, that is, the MiPymes that are dedicated to the rotation of photovoltaic solar energy (offer).

PROBLEM STATEMENT

At present, at least in the case of Mexico, there are various documents, reports and research studies that account for the economic advantages acquired by moving energetically towards renewable energies, this in terms of economic profitability, economic savings, Direct Foreign Investment (FDI), utility, etc., along with the environmental advantages. However, these studies, for the most part, are presented for analysis at the macroeconomic level, leaving out microeconomic items, such as the case of MiPymes that are dedicated to renewable energies, mainly solar energy, which is where this type of companies have more margin of amplitude of offer of services.

In addition to the above, and as pointed out by the Mario Molina Center (2014), for the SME sector, the nature and structure of a type of environmentally friendly company through investment in energy efficiency technologies is not considered, leaving limited this approach only to large companies.

On the other hand, in the case of Mexico, it is unreliable to have a figure that statistically represents the number of MiPymes that are dedicated to renewable energies. Analyzing, specifically, the case of MiPymes that are dedicated to installing and selling solar panels. The foregoing was confirmed by conducting an exhaustive search in research institutes, public and private organizations, research agencies, annual government reports, etc. finding information only in the National Institute of Statistics and Geography (INEGI), through the National Statistical Directory of Economic Units (DENUE), whose purpose is to:

… To provide both specialized and non-specialized users with the identification, location and contact data of the active economic units in the national territory for the development and evaluation of both public policies and economic development programs at the three levels of government; as well as support in the decision-making process to direct investment and optimize resources both in the public and private spheres. (INEGI, 2020)

When analyzing in the DENUE the MiPymes whose business is the installation and sale of solar panels, for the specific case of the municipality of Tepic, it was found that they were registered with the name of: other outdoor jobs. Likewise, the registered number of these MiPymes in the DENUE did not coincide with what was observed in said municipality. Therefore, it was concluded that this significant variation was due to the fact that the registration with the DENUE corresponded to data from 2020, and on the other hand, it was that not all MiPymes with this line of business had registered in this directory. Hence, the number of these economic units before the DENUE will be considered statistically unreliable, representing a problem for the present investigation.

Not having statistical information on the MiPymes mentioned above, gave rise to consider as another problematic node, the role of the Mexican State as a mediator in the renewable energy market, specifically, that of photovoltaic solar energy. Since, and according to the Organization of American States, [OAS] (2004), the general lack of adequate policies prevents the diffusion of renewable energy technologies in Latin America and the Caribbean, where renewable energy has a disadvantage inherent in the structure of the electricity market, where the State is almost absent and companies compete with each other.

THEORETICAL AND CONTEXTUAL FRAMEWORK

In terms of energy, Mexico has the legal instruments that guarantee an adequate public service of transmission and distribution of electricity in our country. The primary legal instrument that is the Political Constitution of the United Mexican States, in its article twenty-seven, states, among other points, that: "The planning and control of the national electricity system, as well as the public service of electricity, corresponds exclusively to the Nation. transmission and distribution of electrical energy…" (Chamber of Deputies of the H. Congress of the Union, 1917)

In such a way that, commercializing electrical energy through the energy transition towards renewable energies, requires, in the case of Mexico, the intervention of the State for its regulation and control, guaranteeing a fair and equitable distribution of electricity for the Mexican population. Considering this assertion and using the Constitution, the theoretical framework that supports this research is the so-called "social market economy".

According to Pfaller (1997), the concept of "social market economy" is applied to the model of economic order. Its theoretical configuration is related to the names of Walter Eucken and Alfred Müller-Armack, and its political implementation to that of Ludwig Erhard. For the political implementation of this approach, within the objectives that the State has are: to generate an efficient market, guarantee of the freedom of the market, guarantee of competition, guarantee of reliable information, as well as the restriction of the freedom of the market in defense of public interests, compensation for market failures, correction of market results in order to ensure social cohesion and generate a "good" society.

Therefore, in the case of the commercialization of electrical energy through renewable energies through the use of technological innovations for its use, at least in the case of Mexico, and in accordance with its legal framework, it coincides with the concept of the "social market economy". In the sense that it is explicitly recognized that not even a highly efficient market satisfies all the needs of a society. That is why it attributes to the State not only the right, but even the task of actively intervening wherever legitimate social interests are undermined. This obligation to intervene covers three aspects: restriction of the freedom of the market, compensation of market failures, correction of results generated by the market. (Pfaller, 1997).

However, it is recognized that the "social market economy" approach presents certain divergences between what is proposed in theory and what happens in reality. Since, as previously indicated, in the case of Mexico and a large part of the countries of the Latin American and Caribbean region, the market structure of renewable energies is deregulated by the State, mainly for those countries that have nationalized the national electricity system, as in the case of Mexico. In this sense, we find ourselves with distorted markets whose influence of private interests exceeds that of public interests with a social impact.

The foregoing is explained, from the Mexican context, from the electrical reform of 2013, in which the conditions were created to create the Wholesale Electricity Market (MEM), where access is given to the participation of private companies to sell and buy electricity in Mexico. Currently and according to Latimes (2022), despite the provision to change said reform to benefit state power generation plants and limit the sale of energy from private projects built by foreigners, there continues to be private investment through the MEM, mainly by large corporations and industries, which are self-sufficient in the electrical energy they produce.

Likewise, and according to what Guzmán (2020) said, this reform allowed development, in terms of electricity generation capacity with clean energy. At the time, this generated a downward trend in the cost of such energy technologies. Likewise, and according to ProMéxico (2015), during the period from 2010 to 2014, Mexico received around 44 FDI projects in the clean energy industry, all by large corporations.

In this regard, one of the challenges of the role of the Mexican State is to watch over the political interests with social incidence, over the private interests of the large foreign corporations. In this sense, globalization plays a determining role in the challenges of competitiveness, in this case, of the "retail" energy market in Mexico, specifically, that of photovoltaic solar energy. From this perspective, the State must generate economic policies capable of encouraging the country's internal companies, such as MiPymes. And, it does not necessarily have to close the doors to FDI, but it does have to regulate the market in a basic good such as electricity.

METHOD

Consistent with the objective of this research, it was considered that the most suitable methodology to develop it was the mixed type; qualitative and quantitative character, since it allowed to identify in a broader way the theme of renewable energies from the context of the current situation of the renewable energy market, retail, specifically, the case of MSMEs with the line of sale and installation of panels plots in the municipality of Tepic.

In this sense, it is important to point out the elements that made possible the

selection of the placeity or placeities in the municipality of Tepic. Therefore, it was necessary to establish a description of the analysis categories from the dynamics of the territory and its link with photovoltaic solar energy, delimited in the MiPymes with the line of sale and installation of solar panels. This way, it was necessary to identify within this delimitation, the key actors that had a direct relationship with said MiPymes; who, together, would make up the key actors and/or social strata of this research.

METHODOLOGICAL SCOPE

When analyzing the municipality of Tepic, Nayarit, Mexico, the research had the characteristics of a descriptive study. Likewise, given the nature of the proposed objective, it also has an exploratory scope, since no previous studies similar to this research were found in the indicated municipality. Regarding the design, this research was methodologically based on case studies.

Finally, regarding the tools used, these were the interview and log, as well as the Geographic Information Systems (GIS) software to interpret the sources of information described above. Next, the mapping of place actors identified to the object of study is presented:

Study object	Type of actor place	Activity you perform
MiPymes with the sale and installation of solar panels	MiPymes with solar panels	Commercial
	homes with solar panels	Domestic

Table 1. Mapping of place actors
in the town of Tepic.

Source: Own elaboration, adapted from Algranati, S., et. to the. (2012), based on: Mapping actors, relationships and territories. A tool for the analysis of the social scenario.

According to the previous table, these place actors were considered to respond to the objective set forth in this research, all with a direct relationship with photovoltaic solar energy and with MSMEs with the business of selling and installing solar panels, object of study of this research. In this case, households and MiPymes with solar panels were considered, since they are the end users who acquire the service that said MiPymes offer them. It must be noted that large companies, industries and the agricultural sector were ruled out for methodological reasons.

CATEGORIZATION OF THE ANALYSIS INDICATORS FOR THE DELIMITATION OF THE POPULATION SAMPLE

The categories of analysis that were taken as a basis for the territorial delimitation of the placeity or placeities of the municipality of Tepic, were influenced by four main indicators or categories of analysis: 1) Degree of marginalization by placeity, 2) Strategic geographic location by placeity, 3) MiPymes that sell and install solar panels, and 4) Commerce as the predominant activity in placeities. In this sense, the following table was prepared that summarizes it (Table 2).

As can be seen in the table below, all the indicators were selected to obtain information at the placeity level, which for their election decision corresponded to non-probabilistic samples. As noted, it does not depend on probability, but on grounds related to the specific characteristics of the investigation.

DESIGN OF THE INVESTIGATION

In order to delimit the population sample of Tepic, the "sample delimitation matrix" was elaborated, which allowed delimiting at the placeity level. This way, the method that allowed to give a degree of objectivity to the collection of the sample was the selection and

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Category	Optimal indicator	Justification	Information source
Grado de marginación	Very low	Those who have a very low degree of marginalization, it is because they have electricity. Since it is assumed that those households and MiPymes that are willing to invest in solar panels do so to pay less for electricity, as their consumption increases, compared to how they had been doing it through the CFE.	SEDESOL. Catálogo de placeidades.
Ubicación geográfica estratégica	Closest to Tepic	The research seeks to minimize costs and time, so one of the most important factors is the proximity to the Autonomous University of Nayarit, which is the point of reference for the field study.	Google maps.
MiPymes con el giro de "Otros trabajos en exteriores" (*)	A bigger quantity	Object of study, are the MiPymes providers of solar energy equipment, so detecting the vast majority concentrated in one or several places of Tepic, is of great relevance for field studies.	INEGI (2020). Directorio Estadístico Nacional de Unidades Económicas del Estado de Nayarit.
Comercio como actividad preponderante	Third sector	Locating the towns that concentrate this type of economic activity represents a closer approximation to the MSMEs that have installed solar panels.	INEGI (2017). Anuario estadístico y geográfico de Nayarit 2017

Nota: (*) Son las MiPymes con el giro de venta e instalación de paneles solares, que en el DENUE se identifican con este nombre.

Table 2. Categories of analysis for the selection of the population sample.

Indicator	Optimal category	Qualification	Preponderant premises				
			Bellavista	Camichín de Jauja	Mora	Tepic	Valle de Pantanal
Grado de marginacion	Very low	20	20		20	20	
Strategic geographic location	Near Tepic	30	30	30	30	30	30
Economic units with the turn of other works in exteriors	A bigger quantity	25				25	
Commerce as main activity	Third sector	25				25	
Total		**100**	**50**	**30**	**50**	**100**	**30**

Table 3. Delimitation matrix of the sample of the Municipality of Tepic.

Source: self made.

weighting of indicators, in which the weighting was set, from the subjective approach, based on the qualities of each indicator. In such a way that, it would allow to generate an approach to the place actors related to the MiPymes that would have the turn of other works in exteriors, that is to say, the sale and installation of solar panels.

In this sense, applying the concept of probability to the sample distribution, the value of 100 was assigned to the entire sample distribution, that is, to the sum of all the categories. For this, only those placeities that met one or several categories were taken. Whose results are in the table 3 above.

From table 3, it is observed that the town of Tepic meets 100% of the indicators, in second and third place the towns of Bellavista and Mora were located, both meeting 50% of the total rating. It must be said that the town of Tepic is the only one that concentrated the economic units with the turn of other outdoor works, according to the DENUE to 2020 figures.

SELECTION OF LOCATIONS AND APPROACH TO PARTICIPANTS

As shown in the previous section, the sample delimitation matrix made it possible to delimit the main placeity that, according to its specific characteristics, complied with the scope and limitations of this research. Resulting in the town of Tepic for the municipality of Tepic. Which, based on the sample delimitation matrix, it was obtained that said placeity complied with the indicators and the optimal categories with a higher score than any other placeity, in accordance with the established weighting based on the object of study to be analyzed.

This way, by having the main placeity of the sample, the place actors were selected, in this case, the inhabitants of homes and MSMEs with solar panel installation, and, on the other hand, the MSMEs with the turn of sale and installation of solar panels. However, the problem detected for MiPymes with the installation of solar panels was that no official records were found that statistically accounted for the number of these businesses that have solar panels. For its part, in the case of the domestic sector, it was observed that there is a statistical record of solar panels at the municipal level, where the source for obtaining the information is the 2020 Population and Housing Census, through the expanded questionnaire.

In the case of MiPymes with the line of sale and installation of solar panels, identified in the DENUE (2020) with the concept of other outdoor jobs, it was found that, if information is available at the place level, provided by this directory. However, the problem observed was that many MiPymes with this line of business were not registered with the DENUE. Hence, the size of the sample was considered unreliable, as it presented a significant variation of the figure that was actually in the placeities against what the DENUE showed for that year.

In this order of ideas, it was necessary to differentiate the information (probabilistic and non-probabilistic), as well as by social stratum (place actors), which would allow the best application method for the selection of participants to be determined. (table 4).

According to what is shown in the previous table, it is concluded that the key actors or social strata presented different quantitative measurement parameters, that is, no statistical homologation is observed between each of them. Likewise, it is generally considered that information segregation is lacking at the place level. For its part, the non-probabilistic information, the source of information was characterized in the observation. However, being a qualitative method, the information obtained was not exact, so the level of

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Social stratum	PROBABILISTIC INFORMATION			NON-PROBABILISTIC INFORMATION			Comments	Applied method
	Source	Level	Trustness level	Source	Level	Trustness level		
Hogares con paneles solares	Censo Población y Vivienda 2020	City level	Muy confiable	Note	Place	Unreliable	The probabilistic information is up to 2020, which generates an information bias.	**Approximation**
MiPymes con paneles solares	*ND	Not applicable	Not applicable	Note	Place	Unreliable	Currently there is no statistical record that accounts for businesses with solar panels.	**Note**
MiPymes con el giro de "Otros trabajos en exteriores"	DENUE 2020	Place	Unreliable	Note	Place	Unreliable	The data provided by the DENUE is unreliable since not all economic units are registered here.	**Addition**

Nota: *ND = No disponible.

Table 4. Method applied by type of information and social stratum.

Elaboración propia.

reliability was considered low. In this sense, the probabilistic and non-probabilistic sources were combined, resulting in the method applied by each of the social strata, as can be seen in the last column of the previous table.

FINAL SELECTION OF PARTICIPANTS

Regarding the determination of the sample size, being an exploratory type research and with scarce quantitative data, it was ideal to use conventional and snowball sampling. Therefore, the following social stratification is presented by the type of method applied (table 5).

THE TOOLS

The instruments used to obtain the information were in-depth interviews, as well as the Geographic Information Systems (GIS) software. The latter made it possible to geographically locate the networks of place actors described above. Regarding the interviews, they covered the following aspects by type of dimension and social stratum (table 6).

PROPOSAL

In agreement and based on the problems observed, there is currently no source of information that presents us, statistically, the number of MiPymes that have installed solar panels (demandants). Likewise, regarding the MiPymes that offer this solar panel service (offers), it is observed that, in their source of information, in this case the DENUE 2020, many of them are not registered or registered in this directory. Therefore, for both place actors, the sources of information or the lack thereof, represents a problem for the development and correct evaluation of public policies such as public programs of economic

Place actor number	Actors	Applied metohd	Non-probabilistic sampling type
1	MiPymes with the turn of "other jobs abroad"	Addition	Conventional Snowball
2	Homes with solar panel installation	Approximation	
3	MiPymes with installation of solar panels	Observation	

Table 5. Networks of place actors by type of method applied.

Source: self made.

	Social strata		
	Households	MiPymes	MiPymes with the turn of "other jobs abroad"
Economic dimension	Level of economic savings when using photovoltaic solar energy Monthly income of households and MiPymes. Conventional electric light rates VS electric light rates with photovoltaic solar energy. Level of investment in photovoltaic solar energy.		Positioning in the clean energy market (supply-demand) Future projections of the ESF Investment cost levels
Environmental dimension	Level of environmental awareness when using photovoltaic solar energy		Level of environmental awareness when selling photovoltaic solar energy.
Political dimension	Promotion of renewable energies by the Government		Convenio con CFE y apoyo de gobierno
Social dimension	Degree of acceptance of the ESF (Claimants). Public or private solidarity financing		Degree of acceptance of the ESF (Offers). Solidarity financing.
Multilevel dimension	Advantages and disadvantages of solar panels.		Solar panel lifespan. Motivation in business.

Note: a/ Refers to households and MiPymes that have installed solar panels.

Table 6. Orientation of the questions by place actor and dimension.

Source: Own elaboration.

● MiPymes that sell solar panels

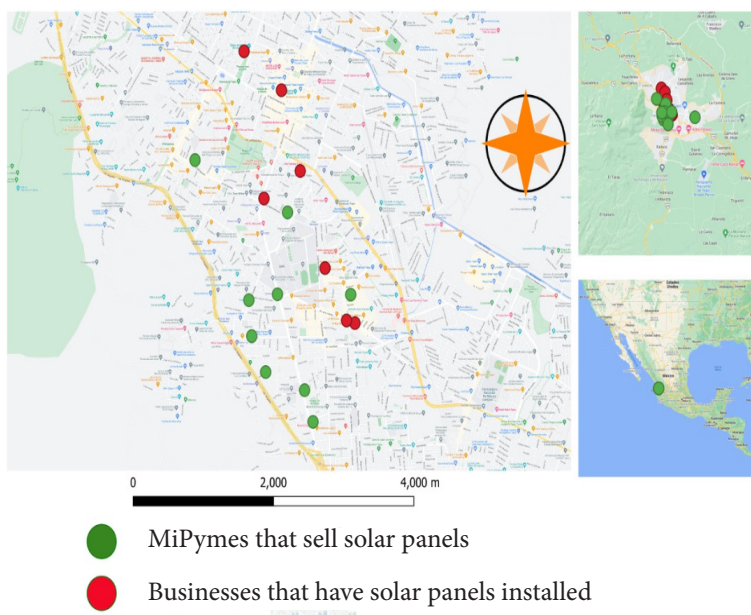● Businesses that have solar panels installed

Figure 1. Map of the MiPymes offering and demanding solar panels in Tepic.

Source: Own elaboration based on QGIS software.

development for these MSMEs at the three levels of government. In the same way, it represents a limitation for decision-making to direct investment and optimize resources both in the public and private spheres, regarding renewable energies in the retail market.

In this sense, based on the interviews carried out, a map with the location of the MSMEs in question was prepared, where it was possible to identify their geographical location thanks to the tools and methods applied. However, it is recognized that this identification only represents a small sample of what was observed. Figure 1 shows the results obtained.

Derived from the previous figure, where a small sample of the coverage of the supply and demand of solar panels in the town of Tepic is observed, in this regard, the importance of including, in the various surveys carried out by the INEGI referring to businesses, the data from the solar panels, to identify both national and place coverage of supply and demand for photovoltaic solar energy, with the intention of promoting a correct implementation of public policy aimed at favoring the MiPymes described in the figure above, without neglecting the social scope that this policy may entail.

CONCLUSIONS

There is no doubt that the electricity sector is essential for Mexico's economic growth and development, both for the improvement of people's quality of life and for the country's energy sovereignty. For these reasons, it is essential that its regulation guarantees a reliable supply of electrical energy with a sustainable planning approach. According to the results of the in-depth interviews carried out for the network of place actors analyzed, it can be deduced that, in the case of homes with the installation of solar panels, they showed high electricity consumption,

mainly due to the use of sophisticated air conditioners, and that in most households it was more than one. Regarding the infrastructure and basic services of these homes, it was observed that all of them had the necessary basic services, that is, water and electricity supplied by the municipality. Mostly built with brick or block, with tiled roofs and cement floors. As for the average monthly income of these households, it was above $19,000.00 pesos. Indicating that they were motivated more by economic savings than ecological savings when purchasing solar panels. Finally, they indicated that they did not have any government support or subsidy to acquire them.

In the case of MiPymes with the installation of solar panels, a great diversification of lines of business was observed, from restaurants, grocery stores, stationery stores, as well as rotisseries mainly. Pointing out that its greatest electrical consumption was generated by industrial refrigerators. Regarding the average monthly income, they also varied, staying in a range of $20,000.00 to 45,000.00 pesos. In the same way, motivated by economic savings rather than ecological savings to acquire solar panels, since they commented that they paid a lot for electricity, as they did not have a subsidy from the government. Finally, they indicated, for the most part, that they had paid for the solar panels in cash, without any government support or program.

Regarding the object of study, that is, the MiPymes with the line of sale and installation of solar panels, it stands out that they considered this line of business very promising in the long term. Although they have currently been affected by the COVID-19 pandemic, they consider more stable future sales projections. In general, for these MiPymes the business is profitable, although they say they buy supplies abroad.

Given this scenario, they point out that they necessarily have to buy some supplies abroad because they are not currently manufactured in Mexico. The demand for this service, they point out, is from both households and MiPymes, as well as large industries, and housing and commercial projects. As for the link they have with the government, it is through the CFE, only to generate an interconnected service with the end user, that is, maintaining the CFE meters. Pointing out that they do not have the support of the government through any public program. Finally, they pointed out that one of the disadvantages of solar panels is their environmental pollution when their useful life ends.

Derived from the above, it is important to generate public-private associations to strengthen MiPymes dedicated to the sale and installation of solar panels in the retail market, where the participation of the State has the possibility of generating competitiveness at this level of the market, motivated by an ecological awareness and electricity saving, generating a fair and democratic energy transition towards renewable energies. Considering, in turn, the advantages and disadvantages of moving, in this case, towards photovoltaic solar energy, to generate consistent and efficient policies for each of the place actors involved in said transition.

On the other hand, the possibility of manufacturing the inputs for solar panels within the Mexican national territory must be explored, favoring the internal market without compromising the degradation of the country's natural resources. On the one hand, to favor the internal retail economy, and on the other hand, to favor the energy sovereignty of the country.

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