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Public policy performance for social development: solar energy approach to assess technological outcome in Mexico City Metropolitan Area

Angel Raúl Arenas-Aquino[1] · **Y. Matsumoto-Kuwabara**[2] · **M. Kleiche-Dray**[3]

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Abstract Mexico City Metropolitan Area (MCMA) is the most populated urban area in the country. In 2010, MCMA required 14.8% of total energy domestic demand, but greenhouse gas emissions accounted for 7.7% of domestic emissions. Mexico has massive renewable energy potential that could be harnessed through solar photovoltaic (PV) technology. The problem to explore is the relationship between local and federal public strategies in MCMA and their stance on energy transition concern, social empowerment, new technology appropriation, and the will to boost social development and urban sustainability. A public policy typology was conducted through instruments of State intervention approach, based on political agenda articulation and environmental local interactions. Social equality is encouraged by means of forthright funding and in-kind support and energy policies focus on non-renewable energy subsidies and electric transmission infrastructure investment. There is a lack of vision for using PV technology as a guiding axis for marginalized population development. It is essential to promote economic and political rearrangement in order to level and structure environmental governance. It is essential to understand people's representation about their own needs along with renewable energy.

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✉ Angel Raúl Arenas-Aquino
rarenas@cinvestav.mx

[1] Department of Science Methodology, Centro de Investigación y de Estudios Avanzados, 2508 Instituto Politécnico Nacional, San Pedro Zacatenco, 07360 Distrito Federal, Mexico

[2] Department of Electrical Engineering, ibid, Mexico City, Mexico

[3] IRD-Ceped & IFRIS, 19 Rue Jacob, 75006 Paris, France

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Introduction

Mexico City Metropolitan Area (MCMA) is the largest and most populated urban area in the country. It is delimited by 16 federal district (FD) deputations with 8.851 million inhabitants and 59 municipalities in the State of Mexico (SM) with 11.168 million inhabitants (INEGI 2010). In 2010, MCMA required 14.8% of total energy domestic demand, but greenhouse gas emissions accounted for 7.7% of domestic emissions (SEMARNAT-INE 2010; SEDEMA 2014).

The National Population Council (CONAPO in Spanish) defines marginalization as "…set of problems and/or social disadvantages of a community where certain opportunities for development are not present. Communities living in this situation are exposed to certain risks and vulnerabilities that prevent them from achieving certain life conditions" (CONAPO 2012). CONAPO estimates that about 63% of MCMA's population is within a marginalization degree between medium and very high.

Given current environmental conditions and latent social crisis, it is necessary to promote policies that allow widespread use of alternative energy sources, thus, effects and processes of environmental degradation associated with urban growth and city's negative metabolism itself could be reduced (Lazcano Martínez 2005). A particular technology is required and certain characteristics are needed to allow its use without conventional electric network dependence, to satisfy a building electric needs, to be able to engage to urban compact dimensions, and to use a renewable and clean energy source (that source must be available with the least possible

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intermittence, that means, to be able to yield energy without several natural or technical interruptions). PV technology fulfills those requirements; nowadays, these systems' costs steady decline grants them a greater economic importance (PV Insights 2014).

The Mexican territory is entirely within the so-called sun belt, which is one of Earth's highest solar incidence areas over 5 kWh/m^2/day radiation (Alemán-Nava et al. 2014). This big renewable energy potential could be harnessed through solar photovoltaic (PV) technology. This technology is economically competitive to electrify vulnerable areas which generally do not require much power; often, this feature makes PV devices installation less expensive than extending traditional electric lines (Cassedy 2000). A standard silicon photovoltaic module consists of solar cells interconnected in series or parallel through a wire mesh. Each solar cell works similar to a diode operation, under light incidence an electric current is generated as a result of generation and separation of charge carriers at the interface of the p/n junction within the solar cell (Trujillo et al. 2013).

Besides, grid-connected PV systems allow generated surplus electricity to be returned without cost to the government network (Bakos 2009). The benefit of this system is that if there were insufficient generation with the PV system, public grid energy can be used.

Although techno-environmental implications affect all socioeconomic sectors, marginalized populations are severely affected because of their high dependence on resources around them and their limited ability to adapt to both present and future energy conditions (Juárez Neri 2003). In consequence, State intervention is essential, since it is the agency that should regulate production modes, promote economic activities, boost population welfare, and incorporate population sectors that, because of their conditions and needs, do not share the economic dynamics benefits (Ezcurra et al. 2006). Therefore, there are several government policies within MCMA that focus on energy issues and social exclusion; the most important policies belong to federal government.

A transition to newer and cleaner energy systems often require significant changes not only in technology but also in political regulations, tariffs, pricing schemes, and user behaviors (Sovacool 2016); this means talking about energy transition in a global sense.

There is no need to propose installation of photovoltaic devices for people without access to the electric grid, because despite his condition, almost all marginalized and not marginalized families in MCMA have access to this public service (SHCP 2013). However, electricity in this city relies on polluting non-renewable sources, so self-generation represents an energy paradigm shift. Energy transition based on PV systems emerges as a potential solution to socio-environmental degradation of cities. It is based on the need to maintain flow continuity of energy and materials and helping to renew nature cycles through benign urban and rural economic and social activities.

Hence, the problem to explore is the relationship between local and federal public strategies in MCMA and their stance on energy transition concern, social empowerment, and new technology appropriation. Moreover, public programs allegedly struggle to set strict rules in order to assist marginalized population. Thus, the research question for this paper is the following: are these strategies willing to boost social development and urban sustainability? Previous works regarding to these matters have not been made neither for MCMA nor for Mexico despite the transdisciplinary approach importance for governance problems regarding social inclusion and urban technological adaptation.

The objective of this research is to analyze the social and environmental political agenda articulation and to discover local interactions between social interests within MCMA, techno-environmental marginalization, and PV technology-based energy transition.

Methodology

An important aspect of the public policy study is to provide an understanding of general theory of politics, and consequently, the policy-making process. To accomplish this, these policies must be categorized or classified so that policy analysis and decision-making can be understood clearly.

Encyclopedia Britannica[1] defines typology as: "cluster system, of which members identify postulating specific attributes that are mutually exclusive and collectively exhaustive. These groups help researchers to establish a limited relationship between phenomena". Thus, a policy typology is their own classification in terms of important distinguishing features.

The policy typology is based on the idea that certain issues involve characteristics that make them objectively discernable. Such features relate not only to the descriptive characteristics of the issue but also to the nature of policies that tend to arise from the decision-making process.

The public policy typology was conducted through Theodore Lowi's instruments of State intervention approach, based on political agenda articulation and environmental local interactions. Public policies can be classified according to their effect on society and the relationships between those involved in their making (Lowi 1964): distributive: designed to distribute, set or assign privileges, powers or resources to citizens; regulatory: aimed at regulating and controlling agents' activities of certain sector; constitutive: modifies the

[1] This definition may differ from Encyclopedia Britannica's printed version since it was consulted from its webpage. Available online: https://global.britannica.com/science. Furthermore, the specific definition was taken from the encyclopedia's scientific approach as stated in the web link.

State organization and establishes rules of powers distribution in a social environment and creates decision-making procedures; and redistributive: policy that fundraises from some social groups or regions to give to others, particularly based on poverty or vulnerability.

When designing a public policy, the State decides on the use of one or other instrument for its implementation, these are known as "instruments of State intervention". Study based on legal and administrative instruments can give indications on how the State and institutions understand the problem to solve and reveals the conception of authority.

Policies and State instrument rating was defined around main ideas, some of these concepts may depend on the context and reality in which research takes place. The main ideas were energy transition and PV technology, environmental impact and mitigation, and marginalization and multidimensional effects in the social sector.

Also, policies had to meet certain criteria to be selected for the typology, but did not have to meet them all: to mention renewable energy and/or energy transition as a main development point, to locate their objectives within MCMA, to be supported by legislative framework, to be up to date in political agenda (regardless data is not updated, this depends on several factors), to consider (even in general terms) application of PV technology, and to aim some of its goals for marginalized population development.

The research was thoroughly made by searching information contained in sections of federal government FD and SM agencies. Strategies and policies were investigated to trace a chronological results history. Results were divided into two sectors according to policy approaches: energy-environmental sector and social sector. At the same time, for each of these sectors, results are described in two categories: federal and local policies.

For policies and State instruments research, information from federal, FD, and SM governments was used as well as some private consultancy firms and non-governmental organizations (NGO); this can be consulted below, in the references section. Search was made mainly within the Social Development, Public Works, Housing, Natural Resources, Communications, Environment, and Energy Ministries (also known as Secretariats) or administrative offices for each of the three governments. Internet search was the main tool to collect the information because almost all official data is available digitally. Furthermore, when asking for public information directly at the official bureaus, they mentioned that all that requested information was available in the government webpage. Every try to contact a public officer and request physical information at the government office buildings brought to the same answer: to look at the webpage.

Results and discussion

Typology results are arranged to show information of research-derived policies and their description and reach, followed by itemized extensive-analytic tables. First, energy-environmental policy sector is shown, then, social policy sector:

Energy-environmental sector

The problem of electricity subsidy is of great importance. Mexican government has invested much of its gross domestic product (GDP) to subsidize electricity cost, especially in the country's central area. In the 2013 Federation Expenditure Budget, electricity subsidy budget (85,770 million pesos) is considered over transportation (75,600 million pesos) or social security program (66,792 million pesos) budgets (Cámara de Diputados 2013); this will lead to subsidies reduction and therefore electricity tariffs increase.

The first main federal policy is the National Development Plan (PND in Spanish). Here, a transverse strategy is energy sustainability to increase energy efficiency and take advantage or renewable energy potential (MEXGOB 2013a). PND allegedly includes for first time renewable energy in Mexican policy. But in this sense, PND just focuses on energy deregulation and competition and mention renewable energy as an efficient use of energy promotion. In 1981, the Shared Risk Trust (FIRCO in Spanish) was created; a parastatal entity sectored in the Agriculture, Cattle, Rural Development, Fishing, and Nutrition Secretariat (SAGARPA in Spanish). Solar energy is considered in FIRCO's scopes, but solar technology is not prioritized as an energy transition source. Furthermore, it only covers Mexican agricultural sector and MCMA is left out. In 2000, the World Bank partially funded the Renewable Energy Project for Agriculture (PERA in Spanish) (FIRCO 2012).

In December 2013, a Congress-approved constitutional reform on energy was enacted. According to this federal government reform, geothermal and nuclear resources were classified as clean energy sources; from this conclusion, federal government plans to boost public and private investment in both fields (MEXGOB 2013a). Water pumping for agriculture is the most important topic in policies regarding PV technology and water solar heating is the main use for solar technology, but direct investment in PV is still far behind expectations within MCMA. As for energy reform, it presents a comprehensive change in the energy market, but it really favors fossil fuels and hydrocarbons sectors; renewable energy was relegated to background. Although one of the objectives is to generate 35% of energy through clean, renewable sources of energy for 2024, it is not specified how that commitment will be achieved. On the other hand, a study tries to justify reducing electricity subsidy with different proposals, targeting and mitigation through compensation to consumers (CIDAC

2015). However, the types of policies made do not show a scheme such as the one proposed. It seems that is intended to make a gradual but drastic subsidy reduction, but there is no way to mitigate the consequences for marginalized populations that are already hit by tax increases in other areas.

The second main policy is the Climate Change General Law (LGCC in Spanish). It includes ambitious goals like reducing national greenhouse gas emissions by 30% before 2020 and to increase renewable sources electric generation by 35% before 2024. LGCC and the Renewable Energy Use and Energy Transition Financing Law (LAERFTE in Spanish) are contained within the same legal frame as ENE (MEXGOB 2013a). An important federal strategy in Mexico is the Photovoltaic Systems Development Program (PROSOLAR in Spanish). Both FIRCO and PROSOLAR are included within the Mexican political agenda in two primary axes: the National Development Plan and the National Climate Change Strategy (ENCC in Spanish) (MEXGOB 2014a).

FIRCO authorized several projects: 95 water pumping PV systems, 21 solar refrigerators, 7 solar thermic systems, and 65 grid-connected PV systems. Between 2011 and 2012, 175 million pesos were allocated to ensure these projects. SM had support with 6 projects for 9.7 million pesos for only 22 recipients. FD had no financing within that period. Fund claims that 160,000 tons of greenhouse gases emissions were reduced (FIRCO 2012).

According to PROSOLAR, in 2009, it was a feasible potential of 700 MW (would belong to a sales potential of around 52,000 million pesos for solar industry). Based on this study, potential target groups were residences with an electric consumption volume within high consumption domestic range (average tariff of 3.2 pesos/kWh) (SENER-GIZ 2012); electric subsidies are the restriction for potential profitable exploitation in Mexican residential sector. In 2012, the Campo Solar Agua Prieta II 14-MW solar plant was built. This was done using World Bank funding by 462 million pesos. In 2013, according to federal government, budget investment for the electric industry was 32,452 million pesos, 4.9% lower than in 2012 (SHCP 2013). At the end of that year, it is stated that 49 projects were supported with a 375.6-million-peso budget and 3 innovation centers were created with a 4627-million-peso budget (MEXGOB 2014b). With the Special Climate Change Program (PECC in Spanish) at the end of 2012, it is claimed that greenhouse gas emissions were reduced by 49.88 million tons thanks to these programs; this is 98.4% of the goal set for 2012 (SEMARNAT 2014a). From January to September 2012, technical advice was given by the Environment and Natural Resources Secretariat (SEMARNAT in Spanish) through the Sustainable Rural Development Special Concurrent Program (PEC in Spanish) in management and operation of biodigester pilot projects in the State of Mexico and Michoacán, where 74 biodigesters were installed (SAGARPA 2014). In 2010, PEC's authorized budget was 268,406 million pesos. In 2011, it had a 7% reduction (SHCP 2012). The Renewable Energy Special Program specifies electricity generation potential from renewable sources in Mexico, as well as targets and estimated scenarios until 2018 (SENER 2014a). The Energy Sector Program has two important strategies: the Electric Energy Savings Fund (FIDE in Spanish) and FIDE seal. These strategies have allegedly been carried out since 1990; about 1.8 million energy diagnostics have been made and more than 2.6 million loans to the domestic sector have been awarded (MEXGOB 2007). During 2013, the Sustainable Production and Consumption Special Program created the Development of Renewable Energy Program Guide through more than 20 events between the State and municipal authorities, as well as agents of the private and academic sectors (SEMARNAT 2014b).

The Energy Sector Program (MEXGOB 2007) focuses on petrochemicals and energy such as natural gas. It is supposed to be a petrochemical modernization with the 2015 investment budget of 5500 million pesos (Cámara de Diputados 2014). In 2013, the National Program for Sustainable Energy Development coordinated energy efficiency programs; it states that 10.8 million tons of greenhouse gases emissions were avoided, 90.5% by standardizing energy efficiency, 0.12% for energy efficiency actions in federal and public administration buildings, and 9.4% by daylight saving time implementation (SENER 2014b).

During 2012, the National Housing Program (PNV in Spanish) gave 309,227 green mortgages, a 6.2% increase over the same period in 2011. From 2007 to August 2012, 978,185 green mortgages were given (SEDATU 2014).

The third federal policy is the National Energy Strategy (ENE in Spanish); it takes an energy sector role to support economic and social development in Mexico (SENER 2013). It looks to promote social inclusion through long-term sustainability and to reduce environmental- and health-negative impacts emerged from energy production (SENER 2013).

Until August 2013, the Federal Electricity Commission (CFE in Spanish) had 10 projects within the Clean Development Mechanism scheme, with an estimated reduction of 2.85 million tons of greenhouse gases (MEXGOB 2014b).

The Technologic Innovation Fund (FIT in Spanish) was created by the National Climate Change Strategy (SEMARNAT 2013) with the only purpose to support technologic innovation projects from Mexican enterprises. At the end of 2012, 175 million pesos were used to support a new productive structure for biofuel, biofertilizer, organic fertilizer, and renewable energy production (MEXGOB 2013b).

In 2013, SEMARNAT adjusted the Environmental Financing Strategy throughout an origin identification of multilateral organisms' resources received by the sector from

2006 to 2013; sum was 76,860 million dollars (MEXGOB 2013a).

Locally, on the other side, FD government has a specific program that brings together the best features targeted to the metropolis problems analyzed in this paper. The Mexico City Climate Action Program (PACCM in Spanish) is an articulated set of public policies that define the actions of the federal district and guide the social participation. It is also a planning instrument in which the actions related to climate change in Mexico City are integrated (SEDEMA 2008). This program covers all MCMA's territory despite being an initiative only of FD government and its development did not have SM Government cooperation.

Between 2008 and 2012, FD raised 26 actions aimed at mitigating 12% of annual greenhouse gas emissions in Mexico City throughout the Mexico City Green Plan (SEDEMA 2010). To carry out the implementation of all these actions, a budget of 56,152 million pesos was required (SEDEMA 2008). Until 2014, 4615 house solar collectors have been installed against 285 PV modules settled for street lighting (SEDEMA 2011).

SM government has the Climate Change Initiative (ICC EDOMEX in Spanish) (SMA EDOMEX 2009). Yet, it is not mentioned how it works and does not consider solar energy as an essential technology; this reflects a rather slight concern regarding PV systems and the marginalized population. ICC is SM government's only one main axis in energy policy. This initiative lists some actions to solve the State's energy problems; still, it does not mention how will the actions work and does not consider solar energy as an essential technology (EDOMEXGOB 2013). This reflects a stark consideration regarding the State's PV technology and marginalized population. For SM, in 2014, total public budget was 195,303 million pesos; 826 million pesos were for the State of Mexico Environment Secretariat, 104 million for housing, 234 million for energy, and 1127 million pesos for environmental protection (SII EDOMEXGOB 2013).

Finally, there is a coordinated system in the MCMA which involves both the FD and SM governments: the Environmental Sustainability Agenda for the Metropolitan Area (ASA ZMVM in Spanish), in 2010 (CAM 2010a). For ASA, no information regarding results or diagnostics was found. Moreover, in 2013, the Megalopolis Environment Commission was created in order to take another action course; new states were added and it seems that ASA was left behind (Roccatti 2007; CAM 2010b).

Derived of this information, for the energy-environmental sector, the following six policies were identified:

1. National Development Plan—federal government
2. Climate Change General Law—federal government
3. National Energy Strategy—federal government
4. Mexico City Climate Action Program—FD government
5. Climate Change Initiative—SM government
6. Environmental Sustainability Agenda for MCMA—FD and SM governments

Seventeen State instruments were identified. Typology of both policies and instruments is shown in tables (Tables 1 and 2). First, policy class is displayed, then the main instruments for that policy, and finally, the main agencies that created and/or operated the policy. Policy instruments are itemized including operation periods for each instrument, objectives, and financing origins.

Social sector

PND is the general policy that regulates all public federal administration's budget and programming. According to these claims, the current government office will emphasize three strategies: productivity democratization, modernization, and gender perspective (MEXGOB 2013a). Terms like "marginalization, poverty, vulnerability and exclusion" are used in PND, but none of them are established there; however, it is stated that these terms are explained by CONAPO. For each social program, a methodology to announce recipients is explained. In spite of this explanation, there are no programs that focus on social development through renewable energy, although there are four programs that imply housing and sustainability: the Priority Areas Development Program (PDZP in Spanish), Productive Options, Social Joint Investment, and National Social Development Program (SEDESOL 2014).

Poverty measurements in 2012 showed that lack of housing quality affected 15.9 million inhabitants in Mexico (SEDESOL 2014). From 2008 to 2011, the Social Development Policy Assessment National Council (CONEVAL in Spanish) stated that PDZP replaced 584,695 dirt floors with solid floors; it gave sanitary service to 28,875 residences, 142,473 ecologic stoves were installed, and new 29,710 houses were added to the public electric grid (CONEVAL 2012). However, for the same period, the Social Studies and Public Information Centre (CESOP in Spanish) reported different results. Their source, the Social Development Secretariat (SEDESOL in Spanish), claims that 1.5 million dirt floors were replaced, 45,123 sanitary services were built, 300,942 ecologic stoves were installed, and 30,268 houses were added to the public electric grid (CESOP 2011). There are broad discrepancies between agencies' figures.

Locally, the FD General Development Program establishes objectives and an action axis that will work as a public policy base in Mexico City until 2018 (SIDESO 2013). The amount of social development programs from 2010 to 2011 in FD went from 190 to 211 and in SM from 282 to 189 (CONEVAL 2011). From 1998 to 2012, a 218-million-peso budget was used (SDS DF 2013). However, in May 2014, 113 social projects were approved in FD, with a 15.6–million-peso

Table 1 Typological table of public policies in energy-environmental sector

Policy	Class	Main instruments	Main agency
National Development Plan	Distributive Regulatory Constitutive Redistributive	FIRCO	SAGARPA
		PROSOLAR	Energy Secretariat (SENER in Spanish)
		Special Climate Change Program	Federal government/SENER/SEMARNAT
		National Infrastructure Program	Federal government/SENER/Communications and Transport Secretariat (SCT in Spanish)
		Sustainable Rural Development Special Concurrent Program	Federal government/SAGARPA
		National Housing Program	Federal government/Agrarian, Land, and Urban Development Secretariat (SEDATU in Spanish)
		Sustainable Production and Consumption Special Program	Federal government/SENER/SEMARNAT
		Renewable Energy Special Program	Federal government/SENER
		Energy Sector Program	Federal government/SENER/National Commission for Efficient Use of Energy (CONUEE in Spanish)
		National Program for Sustainable Energy Development	Federal government/SENER/CONUEE
Climate Change General Law	Distributive Regulatory Constitutive Redistributive	National Climate Change Strategy	Federal government/SENER
		Special Climate Change Program	Federal government/SENER/SEMARNAT
National Energy Strategy	Distributive Regulatory Constitutive Redistributive	Economic growth Social inclusion Energy Sector Program	CONUEE/SENER/CFE/Energy Regulation Commission (CRE in Spanish)
Mexico City Climate Action Program	Distributive Regulatory Constitutive Redistributive	Mexico City Green Plan	FD Environment Secretariat (SEDEMA in Spanish)
		General Development Program	SEDEMA/FD Housing and Urban Development Secretariat (SEDUVI in Spanish) /FD Housing Institute (INVI in Spanish)
Climate Change Initiative	Regulatory	Climate Change Law	SM government/SM Environment Secretariat (SMA EDOMEX in Spanish)
Environmental Sustainability Agenda for MCMA	Distributive Regulatory Constitutive Redistributive	Metropolitan Environmental Commission	SEDEMA/SMA EDOMEX

Table 2 Typological table of public policies' instruments in energy-environmental sector

Instrument	Period	Objective	Financing origin
FIRCO	1984–to date	To contribute to biofuel, biofertilizer, and organic fertilizer production and to efficient and sustainable use of energy in production processes.	Federal—international
PROSOLAR	2012–2017	To boost PV technology in Mexico in short and medium term, to ensure growth of solar PV market, and to develop PV technology local and industry market.	Federal—international—non-governmental
Special Climate Change Program	2014–2018	To reduce greenhouse gas emissions in order to move to a competitive economy and to low emission development.	Federal
National Infrastructure Program	2014–2018	To optimize effort coordination for energy infrastructure generation in order to have energy at competitive prices.	Federal—international—non-governmental
Special Concurrent Program for Sustainable Rural Development	2014–2018	To boost field productivity to ensure food security through economic development, caring for sustainable management of natural resources.	Federal
National Housing Program	2014–2018	To promote housing access through well-placed, decent housing solutions and according to international quality standards.	Federal—non-governmental
Special Program for Sustainable Production and Consumption	2014–2018	To increase and ensure efficient use of natural resources as part of sustainable production and consumption.	Federal—non-governmental
Special Program for Renewable Energy Development	2014–2018	To expand power generation from renewable sources, to accelerate clean technologies investment, to develop business and technology in Mexico, and to democratize renewable energies use.	Federal—non-governmental
Energy Sector Program	2013–2018	To optimize energy production and processing capacity through infrastructure development and to expand renewable energy sources use.	Federal—non-governmental
National Program for Sustainable Use of Energy	2014–2018	To design and develop programs and actions that promotes optimal use of energy in national energy chain processes and activities.	Federal—non-governmental
Renewable Energy Use and Energy Transition Financing Law	2008–to date	To promote energy efficiency and sustainability as well as to reduce oil dependence as the primary energy source.	Federal
General Law on Climate Change	2012–to date	To guarantee the right to a healthy environment and to establish the power concurrence to climate change adaptation and greenhouse compound emission mitigation.	Federal
Economic growth (GDP)—social inclusion	2013–2027	To have a vast supply of energy to meet the existing requirements, enough to generate development poles, and to ensure public access to energy services.	Federal
Mexico City Green Plan	2007–to date	To integrate actions to improve citizens' interaction with their environment, favoring care and rational use of natural resources.	Local FD—NGO—non-governmental
General Development Program	2007–2018	To integrate sustainable development principles in policies and government programs and to reverse loss of environmental resources.	Local FD
Climate Change Law	2013–to date	To establish arrangements to achieve climate change adaptation and to mitigate greenhouse gas emissions.	Local SM
Environmental Sustainability Agenda for MCMA	2010–2020	To reach in MCMA sustainability conditions that allow guiding the trend of actions towards water, solid waste, air, soil, and climate change.	Local FD & SM

budget. In this year, FD government states that 8076 citizens were given resources like food provisions, blankest, mattresses, cleaning kits, and even cardboard plates (SDF 2014). Moreover, a 3-million-peso budget was authorized to support housing units and half million pesos to support precarious housing in two deputations (ALDF 2014). In 2010, there were 1349 territorial units in FD, 40.7% of them were placed in a high level of marginalization. FD government states that the Community Program for Neighborhood Improvement helped to develop all these territorial units (SDS DF 2014). For 2013, 95 million pesos of the program's budget was allocated.

The State of Mexico's Social Development Secretariat has only one social policy: poverty, marginalization, and vulnerability reduction. Nevertheless, there are only four social programs; just one of them addresses vulnerability as a critical social problem. It is called *Por mi Comunidad* (for my community). Its objective is to decrease poverty within homes but also to improve community areas by delivering goods and materials (SEDESEM 2014). Diagnostics for this program are in charge of the State of Mexico's Social Policy Investigation and Assessment Council (CIEPS in Spanish); nevertheless, there is no data available regarding this assessment. It is not even possible to know if this information exists.

Thus, from this information, for social sector, three policies were identified:

1. National Development Plan—federal government
2. FD General Development Program—FD government
3. Poverty, marginalization, and vulnerability reduction—SM government

Eight State instruments were identified. Like in energy-environmental sector, typology of both policies and instruments is shown in tables (Tables 3 and 4), with the same structure as the previous chapter's tables:

Recapitulating, according to overall results, energy policies focus on non-renewable energy subsidies and electric transmission infrastructure investment. A convergence point of these policies is that they do not promote a strict quality control system for PV technology, neither for purchasing it inside and outside the country nor for their manufacture; even if there are tools to perform these tasks (Cortez et al. 2014). On the other side, social equality is encouraged by means of forthright funding and in-kind support. However, typology points out a lack of vision for using both renewable and PV technology as a guiding axis for MCMA's marginalized population development and energy transition. Besides, local and federal governments have drawn up plans for urban growth regardless the inhabitants' perspective and FD and SM governments have made their development plans apart from each other. No public policy addresses the energy transition problem and social exclusion from a transdisciplinary point of view. Neither environmental impacts of PV systems (Beloin-Saint-Pierre et al. 2009; Fthenakis et al. 2005) are evaluated nor carbon footprint (Reich et al. 2007). SM government has not published enough solid results of their programs and policies since 2010. Furthermore, social programs concentrate to solve marginalized population problems through building missing infrastructure and making goods donations. But public agencies do not guide their budgets to solve MCMA's vulnerable population root issues by means of education, cultural understanding, and socioeconomic opportunities.

Despite some NGOs were consulted, the data source comes directly and exclusively from government measurements. Nevertheless, published results between different government's agencies did not match despite using the same data. The World Bank, German Society for International Cooperation (GIZ in German), and Global Environment Facility (GEF) are the most important NGOs funders for energy and social development. Citizen participation should emerge as a transformation axis of urban environment towards

Table 3 Typological table of public policies in social sector

Policy	Class	Main instruments	MAIN AGENCY
National Development Plan	Distributive Regulatory Constitutive Redistributive	Priority areas Productive options Social joint investment	SEDESOL
		National Social Development Program	SEDESOL/SAGARPA/SEDATU
FD General Development Program	Distributive Regulatory Constitutive Redistributive	Joint Investment Program Social services for families living in substandard housing and neighborhoods in Mexico City	FD Social Development Secretariat (SDS in Spanish)
		Preventive and emergent services for people affected by contingency or social vulnerability	
		Your city needs you	
		Neighborhood improvement community program	
Poverty, marginalization and vulnerability reduction	Distributive Redistributive	For my community	SM Social Development Secretariat (SEDESEM)

Table 4 Typological table of public policies' instruments in social sector

Instrument	Period	Objective	Financing origin
Priority Areas Development Program	2013–to date	To improve housing and benefit communities of poor municipalities.	Federal
Productive Options Program	2013–to date	To improve population income by developing sustainable productive projects.	Federal
Social Co-Investment Program	2013–to date	To strengthen social actors through joint investment projects promotion with government to support poor or social vulnerable population.	Federal—non-governmental
FD Co-Investment Program	2013–to date	To combine institutional resources for social development and to promote citizen participation for their environment transformation.	Local FD—non-governmental
Social services for families living in precarious housing in Mexico City	2013–to date	To improve living quality in housing environmental relations and social inclusion in vulnerable areas.	Local FD
Preventive and emergent care to people affected by contingency or social vulnerability	2013–to date	To provide ongoing care to people in vulnerable situations.	Local FD
Community program for neighborhood improvement	2013–to date	To develop a comprehensive process of public spaces and neighborhood improvement in vulnerable areas in Mexico City.	Local FD
For my community	2012–to date	To reduce multidimensional household poverty and to improve community spaces conditions.	Local SM

a qualitatively different one (Graizbord 2002). In this sense, social movements correspond to different perspectives of urban reality, but they can be considered as complementary in social technology reappropriation context (Torres-Carral 2009).

Ultimately, some results cast doubts on transparency and reliability of public information. Besides, government measurements, assessments, and analyses of their own programs have political trends to enhance public opinion.

Conclusions

Solution to public information reliability problem is not discussed from the majority perspective. Solving environmental degradation from an ecologic and social perspective is a condition without which urban sustainability is not possible; this means energy revolution and use of new technologies. Urban development and energy transition sustained by PV technology do not emerge as alternatives and solutions to MCMA's issues.

For public policies, economic and political rearrangement is not important, neither to level or structure environmental governance. Government's urban approach is unable to modify, design, and introduce public policies. Therefore, there is no consideration of a circumscribed way of social appropriation to MCMA's institutionally established geopolitical boundaries. Multi-sectorial approach brings the idea to integrate existing economic activities, inside and outside a specific territory.

Government intentions to reduce and remove electric subsidies depict an attempt to solve economic underdevelopment and to improve electric sector efficiency. But these attempts lack of a social and technical study frame. It is not possible to increase electric energy prices without mitigating negative consequences over population, and this mitigation results do not exist in any public policy researched here. Renewable energy and, particularly, PV technology do not seem to act as social and environmental problem solvers, although residences that incorporate this technology can take advantage of a solid fiscal-incentive system.

On the contrary, to solve analyzed problems, it is more important to expand social and environmental networks than government policies; in other words, to apply a participatory democracy. Moreover, it is clear that in Mexico, there are not connections between science, technology, and government fractions; public and private investments are not linked.

Energy transition diagnostic is not organized; it is important for decision-makers to be conscious about social and economic difficulties. Public diagnostics do not follow a population behavior assessment. MCMA's social- and technical-established structure is not environmentally friendly and government does not take population through an energy transition path.

Giving population free access to clean and efficient energy services, encourages basic services and economic opportunity democratization. But public policies have no understanding

about population's representation about renewable energy, new technologies, and their own needs. Priorities that marginalized communities assign to daily needs do not define public policies' decision balance.

This paper's consequences show the need to develop methodological tools to be used for energy poverty research studies. Federal and local governments would be able to supply funds for these tools as support related to energy transition and social development. In addition, a long-term study can be consolidated in order to understand social an environmental effects not only in MCMA but also in other cities around the world.

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