3. The economy and competitiveness of cities

Introduction

This chapter explores the relationship between competitiveness and sustainability in the case of Mexico's main cities. In one first section, we have included a bibliographic review about *urban competitiveness* and its relationship with *sustainable urban development*. In the second section, we review the results of an empirical exercise to measure the competitive position of the main cities in Mexico during the 1998-2008 period. In the third section, we relate the competitive performance of cities to their energy use to illustrate the relationship between competitiveness and sustainability. Finally, we suggest a series of policy guidelines to promote competitiveness in cities in a context of sustainability.

1. Competitiveness and sustainable urban development

Cities are concentrated spaces of population and economic activities. In 2010, Mexico had a total of 384 cities, of which Mexico City, with 20 million inhabitants, was the most important. These urban areas concentrated 72% of the country's total population and generated 85% of the gross domestic product. Cities require energy resources for their habitat and functioning. In the case of Mexico, hydrocarbons constitute the main source of energy, contributing with almost 90% of the total offer.

There are five factors that can help understand the structure and dynamics of the economic growth of cities (Bluestone *et al.*, 2008):

i. Costs of trade and transportation;

ii. Internal economies of scale;

iii. Agglomeration economies;

iv. Size of consumption markets; and

v. Technological development.

The origins of the city date back to the development of its *commercial function*. The specialization and division of labor are the economic foundations of trade and explain the role of the city as a market place, that is, the place where the population gathers to exchange goods and services. In order to purchase these goods and attract the population, the city must reduce its transportation costs. It is for this reason that those cities that specialize in trade are the ones with a sufficient size and appropriate accessibility for the exchange of goods.

As is known, industrial production consists of the processing and transformation of raw materials for the production of tangible goods that meet the needs of the population. The cities that specialize in industrial activities take advantage of internal economies of scale (*v.g.* reduction of the average cost per product unit as the volume of production increases), as well as transportation costs for the purchase of supplies and the distribution of products. However, the spatial concentration of the industry and the specialization of cities in this sector mainly occur as a result of agglomeration or external production economies, either in the form of urbanization economies (*v.g.* reduction of the average cost per unit produced as the population size increases) or localization economies (*v.g.* reduction of the average cost per unit produced as the size of the economic activity in question increases).

Technological development and globalization have promoted a decentralization of manufacturing production and a centralization of the coordination and provision of services of a *higher order*. Cities that specialize in services for producers utilize agglomeration economies generated by the market size and the availability of infrastructure for the generation and transmission of ideas and knowledge. Other cities that specialize in services evolve thanks to the growth of specific activities and functions, such as tourism (*e.g.* Cancun, Los Cabos), government (e.g. Ciudad Victoria, Chilpancingo) or a higher education offer (*e.g.* San Luis Potosí or Xalapa).

Oil-based energy provision faces two important challenges from a sustainable development point of view. The first is of an environmental nature and is related to global warming: the production and use of energy is characterized by the burning of charcoal and oil, where greenhouse gases are emitted in the atmosphere, one of the main causes of global warming, a topic of global debate and the reason for international meetings where, to date, the only advances have come from individual efforts in each nation, given the impossibility to reach international binding agreements.

The second is of an economic nature and is related to the finite nature of hydrocarbons as a social good for a particular use with an unlimited use. This *tragedy of the commons* is expressed both in the increasing tendency of international prices of oil and the increasing vulnerability of those nations highly dependent on this hydrocarbon, which adds to the insufficiency in the domestic production of this type of energy. In these circumstances, private markets cannot achieve socially efficient production levels, which justifies the formulation and implementation of public policies that help redirect the course of the economy under a sustainability approach.

Sustainable development is a concept of common used in the social consciousness and political discourse, but its theoretical development has not been really consistent (see Chapters 1 and 2). By sustainable development we understand the possibility of indefinitely maintaining a process, both in terms of its factors and resources used, and the quantity and quality of tangible and intangible goods produced (Forsse, 2006). The concept of sustainability involves the economic, social, environmental, political, demographic, institutional and mobility dimensions, and assigns a distinctive trait to the concepts of growth and development. Sustainability, sustainable development and sustainable urban development are concepts still subject to debate, both in the academic world and within the government and the private sector. There is consensus in the sense that a sustainable society is one whose economic and social development is linked to the utilization of natural resources and the environment in such a manner that the present use of these resources does not compromise their availability for future generations.

In Mexico, the public management of the environment has been characterized by the creation of an administrative structure divided into sectors, with a hierarchical organization that is disaggregated when it comes to dealing with problems. This structure has neither favored the *integration of society* into decision-making processes, nor had the sufficient force, within the spheres of power, to implement consistent and long-term programs to achieve sustainable development.

The management of sustainable urban development must contain at least five major elements:

i. Identify the intervening agents;

ii. Recognize the controversies generated between the agents in its actions;

iii. Determine the spheres of power and government spatial structures to deal with environmental matters;

iv. Establish general and specific guidelines for the search of sustainable development, as well as the role to be played by each social agent; and

v. Promote and encourage the attraction and localization of economic activities that contribute to environmental achievements.

Policies regarding territorial development have recently introduced the *relationship* between society and nature, in a way that the organization of the territory is no longer about the definition and regulation of land use, but also about the land attributed to carry out diverse human activities. In the case of cities, territorial planning has adopted a *strategic approach* where the organization of land use is combined with the promotion of economic activities and the search of other key objectives such as social cohesion, governance and environmental protection (see Chapters 2 and 4).

In the *economic* sphere, strategic planning of urban centers has general recourse to the concept of *competitiveness* for local economic promotion. Urban competitiveness is the degree to which a city, in comparison to other competing cities, is able to attract productive investments that translate into the generation of jobs and an increase in income, while increasing and consolidating the quality of life and social cohesion of its residents, institutional governance and an appropriate environment (Global Urban Competitiveness Project, 2005). Cities compete for the attraction of public or private investments, as well as national or international capital (*first moment of competitiveness*). These investments contribute to the accumulation of the fixed capital of the city and can be oriented to build infrastructure and equipment (social fixed capital), or the production of goods and services (private fixed capital).

The success in the attraction of investments is based on a series of factors, or competitive advantages (*second moment of competitiveness*), which can be divided into:

i. Size-related, and

ii. Quality-based (Sobrino, 2006; Turok, 2005).

The size-related competitive advantages (territorial and distributive) operate under the concept of agglomeration economies generated by the scale, the scope and the complexity of the urban area. Cities do not require a particular organization to offer these advantages, nor the cooperation among economic units or social agents. On the other hand, *quality-based* competitive advantages (entrepreneurial and institutional) have to do with the *collaboration* among firms, the participation of local governments in the economic promotion of the city, and the coalitions among social agents. These advantages are not defined by the population size or economic importance of the city, but the exercise of planning strategies, formal arrangements and informal proposals. Their creation, maintenance and improvement depend on the necessary cooperation between persons, levels of government and territories (see Chapter 2), the so-called *competitive cooperation* (Leydesdorff and Eztkowitz, 2003).

The effects of competence among cities (*third moment of competitiveness*) are expressed through three main variables:

i. Increase in local productivity;

ii. Change in the labor urban market; and

iii. Improvement in the life conditions of the resident population.

A fundamental element that determines productivity growth is technological progress, which generates an increased efficiency in the use of productive factors. On the other hand, the urban labor market is the most important of all the urban markets because it will determine if people have employment or not and at which salary. The improvement in the life conditions is expressed in:

i. A larger quantity and quality of satisfactors of collective needs;

ii. An increase in physical accessibility and integral mobility;

iii. Increased participation in decision-making processes, and

iv. Increased conscience of environmental affairs and the protection of the environment.

The production and use of energy are present in the two determinants or factors of competitiveness among countries and cities, as follows:

i. A sufficient energy supply is a scale-related territorial competitive advantage;

ii. The use of that energy is an indicator of the grade of efficiency of the productive process and, therefore, operates as a quality-related advantage; and

iii. The search of alternative energy sources and their use is one of the objectives that have encouraged the creation of public-private coalitions.

Energy flows through different dimensions of human activity. The economic, social and environmental implications of the production and use of energy lead to the establishment of a link between energy and sustainability, as well as an analytical perspective between energy and competitiveness. It is necessary to understand the particular context of each country, region and city in the *energy-competitiveness-sustainability triangle*, which reflects the absence of a single sustainability criterion, as well as the lack of a concept of competitiveness that only relates to elements of economic growth.

2. Competitive performance in Mexico's urban system

As already mentioned, in 2010, the Mexican urban system consisted of 384 cities, 11 of which had a population of less than one million inhabitants, 84 were middle-sized cities, with a population volume between 100 and 999,000 inhabitants, and the remaining 289 were small, with between 15 and 99,000 inhabitants. 81.2 million people lived in these 384 cities, which indicates a level or urbanization of 72% (SEDESOL and CONAPO, 2012: 21-22). Mexico City concentrated 18% of the population in the country, the 10 millionaire cities 19%, the 84 middle sized cities 27%, and the 289 small cities 8%.

In 59 cities, urban expansion had surpassed the municipal limits of the central city, thus creating metropolitan fabrics. These 59 metropolitan areas consisted of 367 municipalities, where 63.8 million people, that is, 57% of the total population, lived (SEDESOL, CONAPO and INEGI, 2012: 15). With this level of concentration, Mexico had reaffirmed its position as a *predominantly metropolitan* nation. The last two decades of the 20th century were characterized by a significant decline in the pace of demographic expansion. In 1980, the annual average population growth rate was 3.2%, which then dropped to 2% in 1990, 1.9% in 2000 and 1.4% in 2010. This decline in the growth rate is attributed to the demographic transition and, in particular, to a strong contraction of the fertility rate, from a value of 4.8 live births per woman in 1980 to 2.4 in 2010 (Ordorica, 2006; Partida, 2006).

In recent years, the population growth rate of the 95 most populated cities in the country, those with 100,000 or more inhabitants in 2010, surpassed the national total, which translates into an increase in their demographic share: in 1980, they concentrated 58% of the national population, a percentage that increased to 62% in 2000 and 64% in 2010. This increase can be attributed to the migratory flow that originates from rural communities and small cities and ends up in these urban areas (Aguado, 2006; Sobrino, 2010a).

However, not all the cities experienced population dynamism between 2000 and 2010, considering that 20 of them had a growth rate below the national total, an annual average of 1.4%, with the most relevant cases being those of the metropolitan areas of Mexico City and Ciudad Juárez, both millionaire metropolises. In contrast, the cities with the fastest demographic growth pace were Playa del Carmen, Cancun, Puerto Vallarta, San Cristóbal de las Casas, San Juan del Río, Reynosa, Manzanillo and Pachuca: all of them had an annual average population growth rate of more than 3%.

In 2010, the 95 cities with 100,000 or more inhabitants formed the vertebral column of the national urban system, both due to their role in terms of population concentration and the fact of being the recipients of the bulk of the country's economic activity. Between 2000 and 2010, the population share of these cities in the national total increased from 62 to 64%, while, in the economic perspective, in 1998 they generated 90% of the national GDP of the industrial, trade and services sectors, a share that dropped to 88% in 2008. These percentages allow us to conclude that their economic concentration is higher than their demographic concentration thanks to the use of agglomeration economies and other advantages for the localization of economic activities (Beeson, 1992; Feser, 2002) and, also, that there is a certain tendency toward the decentralization of the economic activity, in favor of small cities and even rural communities.

As already mentioned in the first part of this document, urban competitiveness relates to the capacity of cities to receive productive investments that have an impact on the labor urban market and the local economic structure, while producing potential effects in other social, political and

environmental activities in the city. The promotion of these investments relies on a series of factors known as *competitive advantages*.

The notion of competitiveness does not imply the recognition of the situation of an urban area at a given point in time, but rather of its evolution over a given period. In other words, it has more to do with the *dynamic* of the city, rather than its *structure*. Therefore, an approach to measure it is through the construction and use of a measurement of economic performance that has the capacity to compare the economic growth of a city against that observed in other cities.

The term competitiveness has been used to quantify and qualify the degree of integration of territories into the globalization stage, considering that this stage creates the need for comparative analysis on different geographical scales. The competitiveness of a country has been conceived as the capacity of a nation to generate economic growth and increase its participation in international trade (Bannock *et al.*, 1998). This capacity depends on three key elements:

a. Microeconomic performance of businesses;

b. Formulation and implementation of clear and explicit public policies for the promotion of commercial trade; and

c. Existence of an urban system that supports the localization of productive investments and as a network for the transmission of information and innovations.

There are two main alternatives for the empirical study of territorial competitiveness (Kresl 2012). The first consists of using a *benchmarking* or comparative assessment method, through the quantitative collection and statistical processing of variables associated with the attraction of productive investments, the potential accumulation of competitive advantages and the life conditions of the population. This method quantifies the accumulation and potential use of competitive advantages for long-term economic performance. Its main strength lies in a certain level of stability of results over time, but also the evidence of specific changes in the competitive performance of some territories. Its main weakness is the lack of an objective form to determine which variables are statistically significant as competitiveness indicators. Comparative analysis through the use of this method depends on the use over time of the variables and the statistical instrument, typically factorial analysis. This method has been used to measure competitiveness among countries (IMD, 2012), among cities in different countries (Ni and Kresl, 2010), or among the main cities of the urban system in Mexico (Cabrero and Orihuela, 2012; Sobrino, 2010).

The second alternative consists of quantifying mid-term economic growth and, then, exploring its causality through the use variables associated with competitive advantages. This methodology is based on the assumption that territorial competitiveness is related to three elements:

i) Local economic growth;

ii) Growth characteristics; and

iii) Benefit of that growth for the local economy and the resident population.

The advantage of this methodology is that it requires less information and provides a statistical significance of the variables that explain local economic growth, through the ordinary least squares method. Its main weakness lies in the measurement of growth adopted, absolute or relative, and the selection of the variables for analysis. This alternative has been used for the study of competitiveness among countries (ECLAC, 1995), cities in the United States (Kresl and Singh, 2012) and cities in Mexico (Sobrino, 2003).

In order to illustrate the differences between both methods, we will now describe the results of their application for the 1998-2008 period in the 35 most populated cities in the country in 2010. The *benchmarking* exercise was conducted with the use of five variables:

i. Logarithm of the local GDP in 2008;

ii. Logarithm of the GDP per capita (GDPPC) in 2008;

iii. Growth rate of the local GDP between 1998 and 2008;

iv. 2010 Quality of life index; and

v. Employment gross rate in 2008.

The local GDP variable assesses the size of the local economy and the potential use of agglomeration economies. The GDP per capita variable estimates the level of economic efficiency of the city. The GDP growth rate is an indicator of macroeconomic dynamism. The quality of life index estimates the living conditions of the resident population. Finally, the employment gross rate shows the behavior of the labor urban market.

The Kaiser-Meyer-Olkin (KMO) and Bartlett tests of sampling adequacy concluded that the variables used in the factorial analysis were appropriate for an exercise of the main components. The former showed a value of 0.660, and the latter showed a significance level of 0.000. The exercise led to a component with a self-value higher than 1 and an explained variance of 54%. The explanatory variables of competitiveness in the benchmarking exercise were the GDPPC and the Quality of life index. This means that the long-term competitive advantages of the main cities in the country are related to *economies of scale and social equipment*.

On the other hand, in the mid-term dynamics exercise, four variables were used to quantify local dynamism:

i. Growth in the number of workers employed in the manufacturing industry between 1998 and 2008;

ii. Growth in the number of workers employed in retail trade, 1998-2008;

iii. Growth in the number of workers employed in services to producers, 1998-2008; and

iv. Change in partial labor productivity, 1998-2008.

The growth in the number of workers employed in each city and sector was compared against the population growth for the same city.

The period of analysis, 1998-2008, was characterized by the stabilizing stagnation of the domestic economy. The country's total GDP went from 7.4 to 10 trillion pesos, at 2005 constant prices, which meant an annual average growth rate of 3%. The participation of the 35 cities of study in the total national GDP declined from 75% to 72%. The number of workers employed by the manufacturing industry of the country grew from 4.2 to 4.7 million workers employed between 1998 and 2008, while the number of workers employed in retail trade grew from 2.9 to 5 million, and those employed in services for producers went from 1.4 to 2 million. As can be observed, retail trade experienced the largest absolute and relative growth in terms of occupational demand. The stabilizing stagnation of the economy in Mexico is also reflected in the partial labor productivity indicator, considering it declined from 550,000 pesos in 1998 to 500,000 in 2008, both at 2005 constant prices.

The competitive performance of the cities was different in the long-term perspective compared to the mid-term one. The long-term competitiveness, which resulted from the *benchmarking* exercise, was based on the historical accumulation of competitive advantages, while the mid-term one was linked to public intervention, but especially to the performance of the domestic economy. For purposes of this chapter, we are not that interested in studying the economic performance of cities in particular or their specific position in the *ranking of cities*, but rather in identifying general trends that contribute to policy guideline proposals for territorial development, from the perspective of local economic behavior and sustainable development. The conclusions reached based on the results of measuring local economic performance are the following (see Table 3.1):

First, there was no correspondence between the competitive position of the city in the *benchmarking* exercise and the *mid-term* analysis. The correlation between both lists was -0.076, with a level of statistical significance of 0.666. This means that the historical potential accumulation of competitive advantages was related to the evolution of the labor urban market that occurred during the 1998-2008 period. Second, the city size did not point to any association with competitive performance. In the *benchmarking* exercise, with the 10% population size increase, the competitive position increased by 0.73 units, with the variations in the population logarithm explaining 29% of the variations in competitive performance. In the mid-term exercise, on the other hand, variations in population size only explained 2% of the variations in competitive performance and, with the 10% increase in population size, the competitive position declined by 0.11 units.

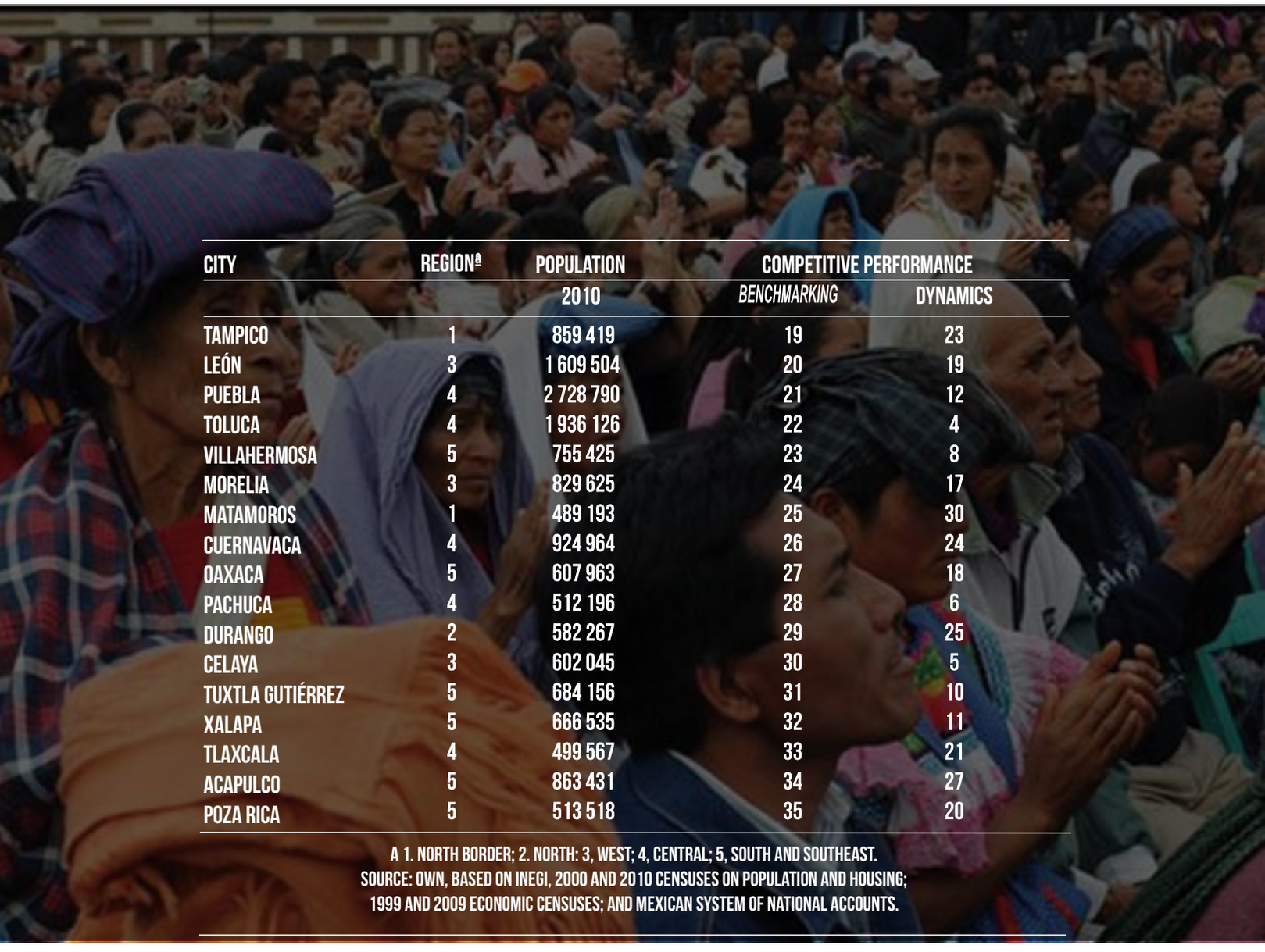
Finally, third, the competitive performance of the city had some relationship with its geographical location. In general terms, the cities in the North Border region had a high competitive performance in the benchmarking exercise, but a low performance in the mid-term exercise, while the Central region specialized in high competitive performance cities in the mid-term exercise, the South and Southeast region in low performance cities in the benchmarking exercise, and the West region urban subsystem in mid competitive performance cities in both exercises.[1]

Table 3.1

MEXICO: COMPETITIVE PERFORMANCE OF MAIN CITIES, 1998-2008

CITY	REGION[a]	POPULATION	COMPETITIVE PERFORMANCE	
		2010	*BENCHMARKING*	DYNAMICS
MONTERREY	1	4 106 054	1	14
CHIHUAHUA	1	852 533	2	16
MEXICO CITY	4	20 116 842	3	29
GUADALAJARA	3	4 434 878	4	13
HERMOSILLO	1	784 342	5	32
SALTILLO	1	823 128	6	26
REYNOSA	1	727 150	7	1
SAN LUIS POTOSÍ	2	1 040 443	8	9
QUERÉTARO	4	1 097 025	9	2
JUÁREZ	1	1 332 131	10	35
MÉRIDA	5	973 046	11	3
CANCÚN	5	677 379	12	31
TORREÓN	1	1 215 817	13	28
VERACRUZ	5	811 671	14	22
TIJUANA	1	1 751 430	15	33
AGUASCALIENTES	3	932 369	16	34
MEXICALI	1	936 826	17	15
CULIACÁN	2	858 638	18	7

1 The different regions were defined by grouping adjacent states:
i. North Border: Baja California, Coahuila, Chihuahua, Nuevo León, Sonora and Tamaulipas;
ii. North: Baja California Sur, Durango, Nayarit, San Luis Potosí, Sinaloa and Zacatecas;
iii. West: Aguascalientes, Colima, Guanajuato, Jalisco and Michoacán;
iv. Central: Federal District, Hidalgo, State of Mexico, Morelos, Puebla, Querétaro and Tlaxcala; and
v. South and Southeast: Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz and Yucatan.



CITY	REGIONª	POPULATION	COMPETITIVE PERFORMANCE	
		2010	*BENCHMARKING*	DYNAMICS
TAMPICO	1	859 419	19	23
LEÓN	3	1 609 504	20	19
PUEBLA	4	2 728 790	21	12
TOLUCA	4	1 936 126	22	4
VILLAHERMOSA	5	755 425	23	8
MORELIA	3	829 625	24	17
MATAMOROS	1	489 193	25	30
CUERNAVACA	4	924 964	26	24
OAXACA	5	607 963	27	18
PACHUCA	4	512 196	28	6
DURANGO	2	582 267	29	25
CELAYA	3	602 045	30	5
TUXTLA GUTIÉRREZ	5	684 156	31	10
XALAPA	5	666 535	32	11
TLAXCALA	4	499 567	33	21
ACAPULCO	5	863 431	34	27
POZA RICA	5	513 518	35	20

A 1. NORTH BORDER; 2. NORTH: 3, WEST; 4, CENTRAL; 5, SOUTH AND SOUTHEAST.
SOURCE: OWN, BASED ON INEGI, 2000 AND 2010 CENSUSES ON POPULATION AND HOUSING;
1999 AND 2009 ECONOMIC CENSUSES; AND MEXICAN SYSTEM OF NATIONAL ACCOUNTS.

The local economic performance in three out of five cities was significantly higher in specific economic sectors (industry, trade or services), while the other two showed a very similar dynamism in two or the three sectors. Among those cities with a heterogeneous intersectoral performance, one of the aspects that stood out was their better position in the tertiary sector, while in those cities with a homogeneous behavior the predominant dynamism mainly corresponded to the trade sector. It is worth mentioning that those cities with a heterogeneous behavior showed a better global economic performance compared to those with a homogeneous performance, which, in principle, would indicate the existence and utilization of localization economies.

The above-mentioned evidence on the use of localization economies is reinforced when position and specialization are related. Those cities that specialize in industry had a more positive performance compared to those that are not specialized in manufacturing production. This also occurred in the areas of trade and services, but it is worth mentioning that the biggest difference between the average position of specialized cities compared to non-specialized cities was found in the industrial sector, a situation that would indicate that it is in this sector where localization economies are used more intensely.

The association between local economic development and their population volume provides elements to identify the use of size-related competitive advantages (territorial and distributive). The results allow us to establish population ranges where we can find a broader use of these type of advantages for each socioeconomic sector: in the case of the industry, the most successful cities had, in general, a population size between 500,000 and 1.5 million inhabitants, while, in the case of trade, the lower value was also 500,000, but the highest was 1 million inhabitants. Finally, in the case of services, the minimum size was 2 million inhabitants.

The above means that the economic performance of cities with a population between 100,000 and 500,000 inhabitants is rather *stochastic* (*v.g.* determined both by predictable factors and random elements) and, therefore, the success in attracting investments mainly lies in the use of localization economies but also, in some cases, on the creation of quality-based competitive advantages.

Thus, the competitive position of urban areas during the 1998-2008 period led to a *higher territorial inequality* in their levels of development: the most successful urban areas were those with a population size of 500,000 or more inhabitants and/or located in the North Border and Central regions. They took advantage of their size-related competitive advantages, but also of the trickledown effects generated by the vicinity and proximity to the United States, or by the relationship with Mexico City, the main city in the country.

On the other hand, the cities with less than 500,000 inhabitants and/or located in the North and South and Southeast regions showed the most negative figures in the game of investment attraction. Their economic foundations have strong ties to the trade sector, nut no significant dynamism was achieved in it; they also failed to implement an economic restructuring of other sectors of activity.

3. Urban competitiveness, energy use and sustainability

Energy balance is an information system to determine the energy supply and demand in a territory in a specific time period. This quantification must be related to a measurement unit. The gross domestic primary energy supply in Mexico, in 2008, was 7,367 petajoules, and its share of the world's supply was 1.5%. Of this amount, 44% was generated from oil, 39% from natural gas, 5% from hydroelectric power and the remaining 12% from other sources (see Table 3.2).

The world's average oil production in 2008 was 81.8 million barrels per day, with Saudi Arabia as the main producer, with a share of 13%, followed by Russia, the United States, Iran, China and Canada. Mexico ranked number seven, concentrating 4% of the world production. The world`s proven oil reserves were 1.3 trillion barrels, 1% of which were located in Mexico. In recent years, the country experienced a decline in its production, as well as a decline in its proven reserves, a situation that has raised yellow flags in connection with the availability of this fuel in the mid-term.

In late 2008, the world's proven natural gas reserves were 185 trillion cubic meters, with a total production of 3 trillion cubic meters. The main producers were Russia, the United States, Canada, Iran, Norway, Algeria and Saudi Arabia. Mexico ranked number 17, with 1.8% of the total production, while its concentration of reserves was 0.3%. The imbalance between the country's production and reserves, once again, shows a landscape full of challenges in the mid-term.

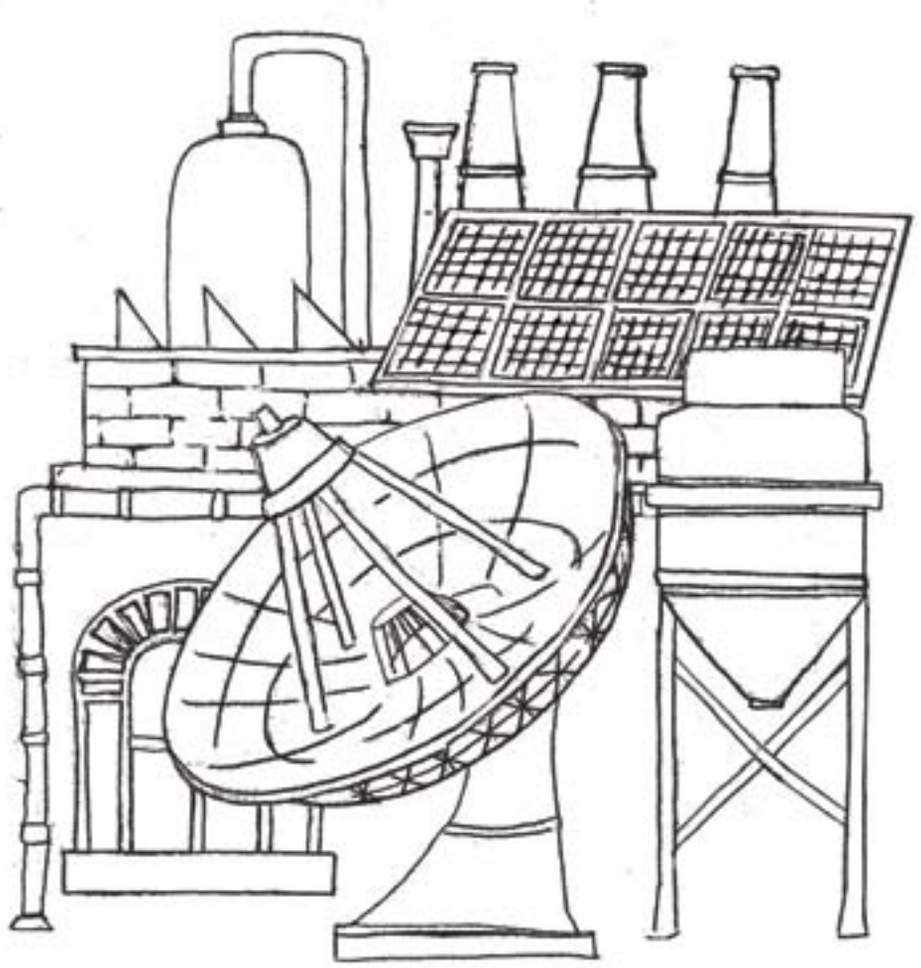


Table 3.2

MEXICO: GROSS DOMESTIC PRIMARY ENERGY SUPPLY BY SOURCE, 1998-2008 (petajoules)

SOURCE	2000	2008	2000	2008
			PERCENTAGES	
TOTAL	5 991	7 367	100.0	100.0
COAL	246	301	4.1	4.1
HYDROCARBONS				
OIL	2 856	3 212	47.7	43.6
CONDENSATES	142	91	2.4	1.2
NATURAL GAS	1 988	2 851	33.2	38.7
ELECTRICITY				
NUCLEAR	100	107	1.7	1.5
HYDROELECTRIC	253	388	4.2	5.3
GEOTHERMAL	58	70	1.0	1.0
WIND	1	3	0.0	0.0
BIOMASS				
SUGAR CROP	98	98	1.6	1.3
FIREWOOD	249	246	4.2	3.3

SOURCE: SENER, 2009: 97

In 2008, the world's primary and secondary generation of electric power was 20,201 terawatt-hours, and Mexico produced 1.3% of the total, a volume similar to Australia or Taiwan. Nations show variety in relation to the source used to generate electricity, considering that, for example, Italy and Mexico obtain more than three quarters from hydrocarbons (secondary energy), while Brazil, Canada and Venezuela obtain more than 60% through hydroelectric plants (primary electricity).

The gross domestic primary energy supply (GDPES) is obtained by summing up the primary production and the commercial energy balance. In 2008, Mexico imported 1,804 petajoules of energy, but its exports reached 3,759 petajoules, mainly oil-related. Oil revenues represented about 13% of the total amount of exported goods and services for the country.

Mexico's GDPES in 2008 was 7,367 petajoules, and it is a measurement of the energy domestic consumption. That amount represented 1.5% of the world's total supply, and the country was in the 14th position, below the United States, China, Russia, India, Japan, Germany, France, Canada, the United Kingdom, South Korea, Brazil, Italy and Indonesia. The primary energy

supply in the country constituted mainly of raw oil and natural gas, which accounted for 83%.

The GDPES, or national consumption, has two primary destinations:

i. Energy sent to transformation or intermediate consumption centers; and

ii. Energy used for final consumption, either in the form of fuel or raw material. Of the 7,367 petajoules, 81% was destined for recirculation and transformation centers (intermediate consumption), and the remaining 19% for final consumption. Primary energy transformation centers include refineries, gas plants and power plants. They are known as transformation centers because they use primary energy to convert it into secondary energy (gasolines or electricity).

Mexico's total energy consumption was 4,815 petajoules in 2008 (see Figure 3.1). Transportation consumed 50% of this amount, a situation that reflects the need to analyze different alternatives toward sustainable use in this sector in the urban areas of the country. These alternatives must include aspects related to the volumes and typologies of mobility, as well as cultural displacement patterns.

For example, in Mexico City, in 2007 an average of 22 million daily journeys were made, not considering the people walking; 68% of those were made by public transportation and 32% by private transportation. In the case of the latter, there were 4.7 million journeys by car, which means an occupation average of 1.4 travelers per car. From the total number of journeys, only 16% were made in public transportation that does not damage the environment (subway, electric bus, electric train and bicycle). Mobility patterns must have efficient and effective units of public transportation, with good accessibility to the desired lines and origin-destination routes, and with the environmental requirements necessary to provide less atmospheric pollution.

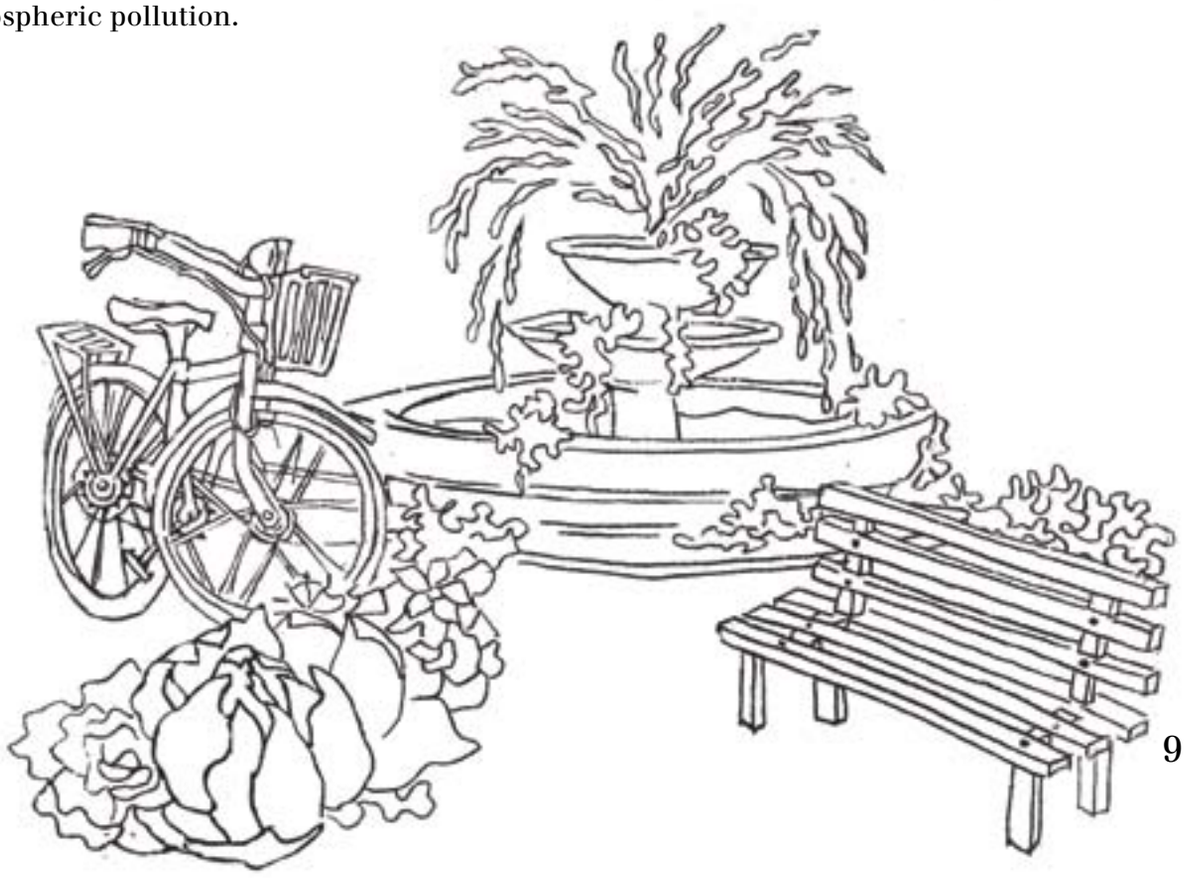
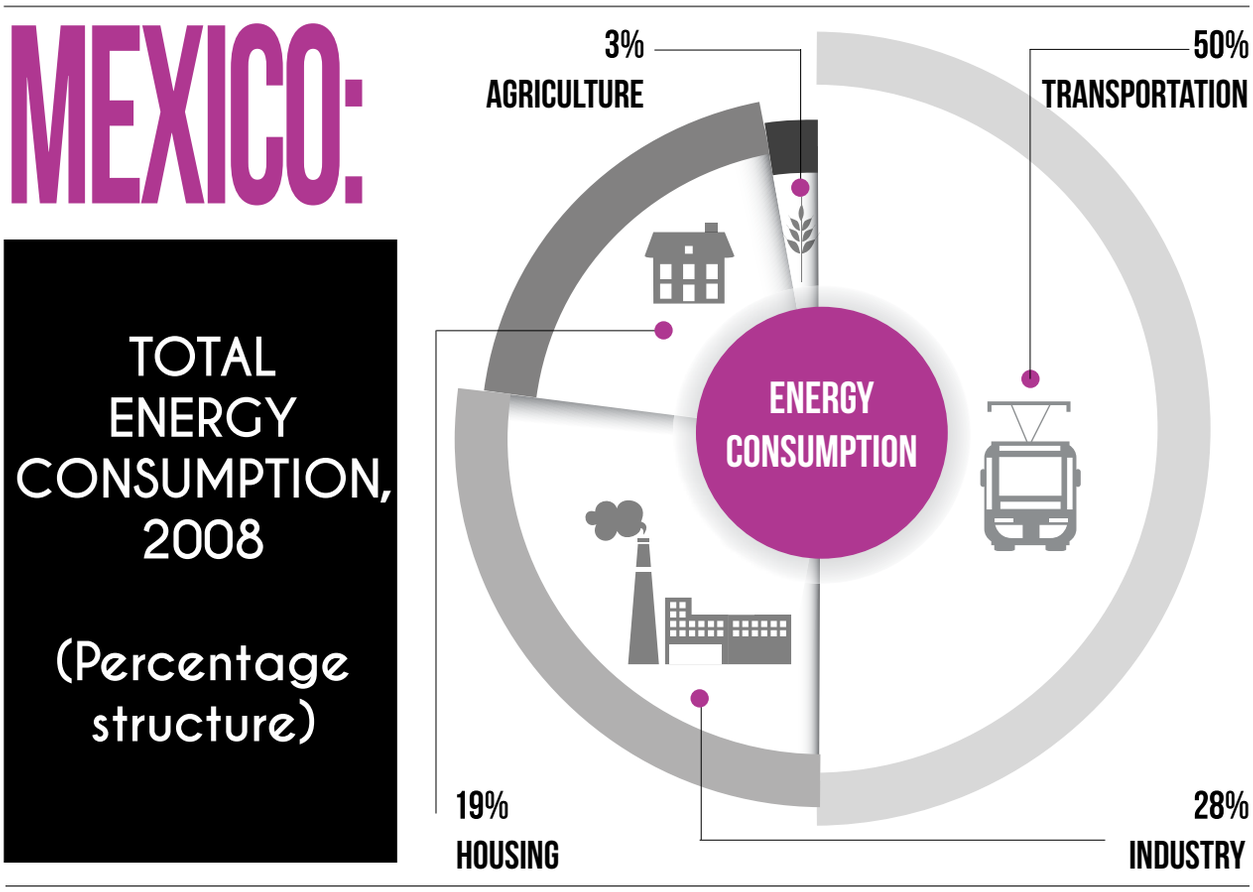


Figure 3.1



SOURCE: MINISTRY OF ENERGY, 2009; P. 101.

The industrial sector is the second main consumer of energy in Mexico, with a share of 28%. The most utilized energies in the country's industrial production are dry gas, electricity and fuel oil, which provide three quarters of the total requirement. The industrial areas that have more absolute consumption of energy are the iron and steel industry, and cement, which used 32% of the industrial energy consumption in the country in 2008.

There is no relationship between energy consumption and contribution to the GDP; on one hand, the industries of sugar, cement, iron and steel and petrochemical consumed 41% of the energy demanded by the industry as a whole, but only generated 5% of the industrial GDP of the country in 2008. On the other hand, the industries of construction, automobile, tobacco and aluminum generated 30% of the industrial GDP, but they only demanded 2% of the energy. The threat of global warming has turned energy savings and energy efficiency in the productive process into the main options for an industrially competitive and environmentally sustainable production

Housing constitutes the third main consumer of energy in Mexico. In 2008, housing accounted for 19% of total consumption, with an annual average consumption of 35,326 gigajoules per each of the 25.5 million dwellings in the country. The main forms of energy consumptions in dwellings are cooking, hot water, lighting, heating, cleaning an entertainment. The main sources of energy are electricity and gas, but firewood consumption is the main input for the resident population in rural communities. The consumption of conventional energy, gas vs. firewood, needs to be over-

taken to contribute to the reduction of energy inequality among dwellings in the country, specifically in the dichotomy of the urban-rural population.

The agricultural sector absorbed 3% of the final consumption of energy in the country. This sector is characterized by a high internal heterogeneity, having, on one hand, a modern technological production dedicated to the production of goods for export and, on the other, a traditional self-subsistence sector, with production concentrated on corn. This heterogeneity is also related, in a complementary way, to the negative effects that the North American Free Trade Agreement with Canada and the United States has had for the Mexican countryside, where one of them is the increase in internal and international migration from the states that were once important producers of agricultural goods.

Energy intensity is an indicator that has been used to measure the availability and use of energy in a territory. This index measures the quantity of energy to produce one GDP monetary unit. If territories are compared, then the energy intensity will show which of them is more efficient in the use of energy. If a territory is compared over time, then the energy intensity will show if that territory is moving toward efficacy in a more sustainable development. In operational terms, this indicator is obtained from dividing the GDPES by the GDP.

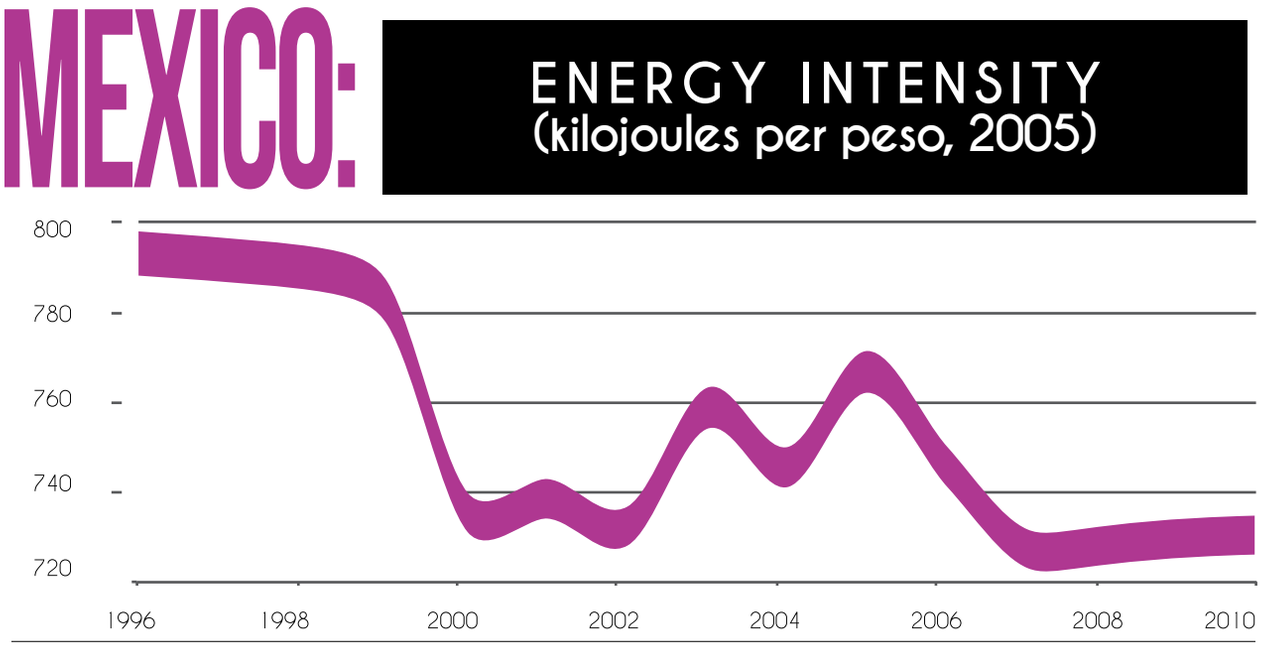
With the GDPES of 7,367 petajoules generated by Mexico in 2008 and its GDP of 10.1 trillion pesos at 2005 constant prices, its energy intensity was 727 kilojoules per peso produced. That energy intensity had an erratic behavior, although with a declining tendency in terms of use of energy per GDP unit generated (see Figure 3.2).

Between 1998 and 2002, there was a considerable reduction in the energy intensity of the country as a response to programs of energy saving and the effects of the economic contraction in the United States, which occurred in 2001. Between 2002 and 2006, there was an increase in energy use by GDP unit generated, which resulted from the null pursuit of the governmental policy for energy saving. Finally, the country's energy intensity declined again between 2006 and 2008. In 2008, 8% less energy was consumed to produce a GDP unit compared to 1998.

A second index is that of energy consumption per inhabitant. This index can evaluate the efficiency and efficacy in the generation and use of energy in a territory, but here it compares the demographic volume (while the energy intensity index considered economic importance). The calculation is obtained by dividing the GDPES by the total population. The consumption of energy per inhabitant in 2008 was 79.5 gigajoules, with a behavior over time similar to that of energy intensity (see Figure 3.3).

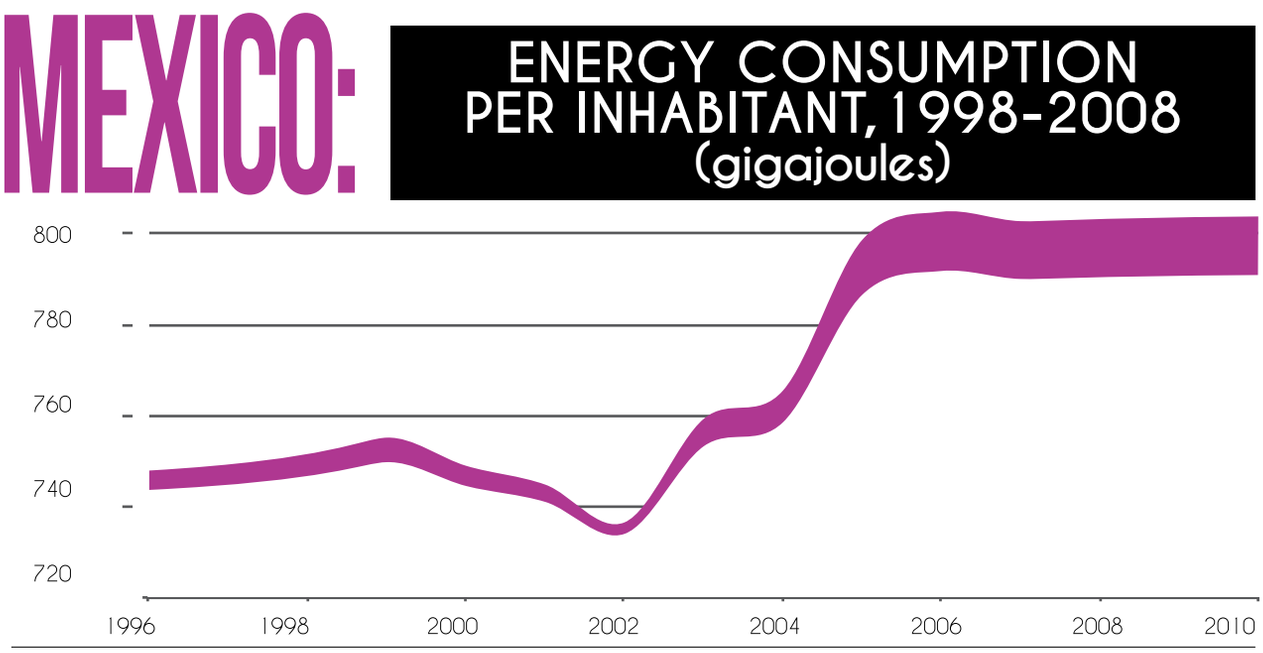
The consumption of energy per inhabitant index clearly raises concerns due to the lack of a public policy for the production, saving and management of energy in Mexico. It is worth remembering that the bulk of the country's primary and secondary production of energy is obtained from hydrocarbon combustion, with the consequent emission of greenhouse gases. These data indicate that the federal government and the Mexican society are not moving forward on the actions suggested in the Kyoto Protocol.

Figure 3.2



SOURCE: OWN, BASED ON SENER, 2009: 97; AND INEGI, 2012.

Figure 3.3



SOURCE: OWN, BASED ON SENER, 2009: 97.

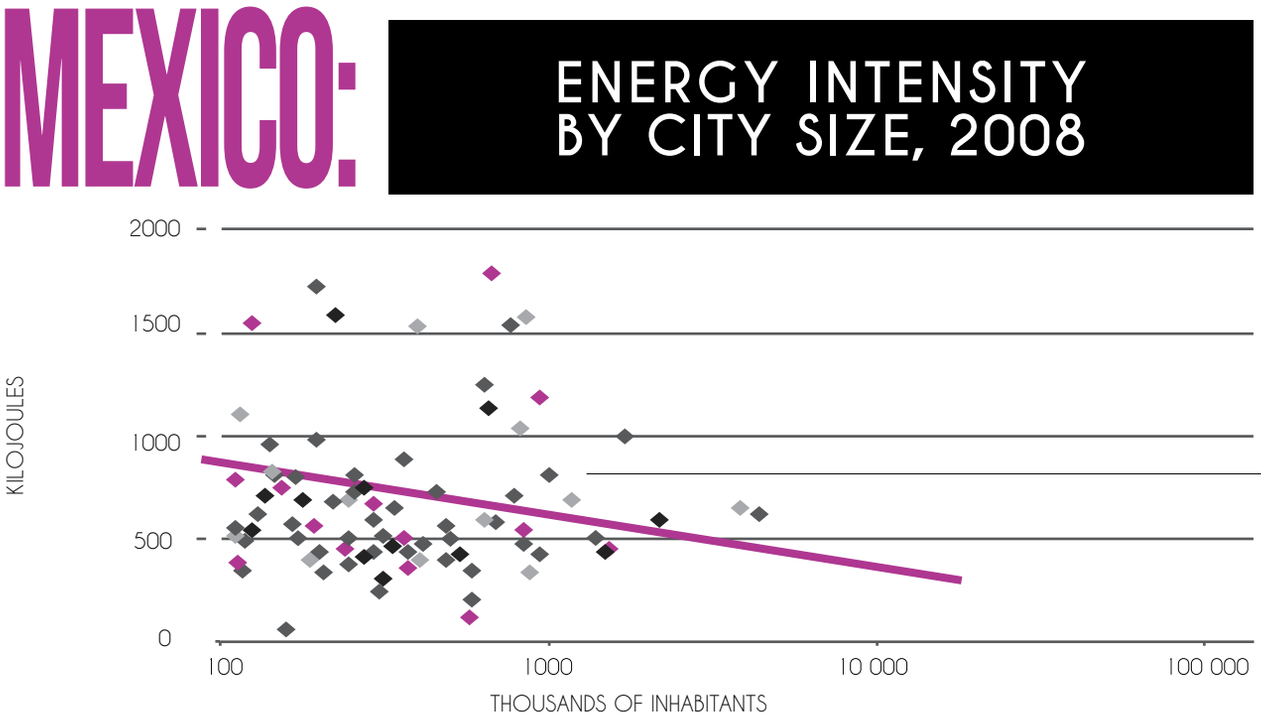
Oil production in the country is highly concentrated in the maritime platforms of the Gulf of Mexico, an area known as the "Campeche Lead". Ciudad del Carmen, one of the 95 main cities in the national urban system, operates as the center for the management and administration of production, and also as an area of temporary residence for the workers of those platforms. This city is the main administrative center for 60% of primary energy production of Mexico. Together with Ciudad de Carmen, there are other five cities, located in the area of the Gulf of Mexico, where another 7% of primary energy is produced. The remaining 33% is generated in municipalities that do not have a city of 100,000 or more inhabitants.

On the other hand, 40 of the largest cities in the country contain plants to transform primary into secondary energy, where the most important are refinery plants and thermoelectric centers. 84% of energy transformation is carried out in these 40 cities, which includes seven of the nine millionaire cities (in 2008). In Mexico City, there is about one fifth of the national transformation of primary energy.

In the 95 cities, the total consumption was 5,839 petajoules, or 79% of the total Their combined energy intensity was 672 kilojoules, 8% less than in the national context, which represents a *more efficient use of energy in the economic activity of urban areas*. On the other hand, the energy consumption by inhabitant was 87 gigajoules, 31% more than in the national context, which indicates a significant difference in the way of life and energy consumption conditions between the people living in cities and in rural areas.

The 95 largest cities of the country have a wide variation in their energy intensity, from 61 to 7,703 kilojoules. The cities with more intensity are those with a productive structure highly specialized in the transformation of energy (refineries and thermoelectrics) or in the manufacturing industry, while those with the lowest values are specialized mainly in the tertiary sector. Due to the tendency of urban areas to the tertiarization of their economy as the city size increases, a lesser energy intensity is expected. This relationship is statistically significant for the largest cities in the country (see Figure 3.4).

Figure 3.4



SOURCE: OWN, BASED ON SENER, 2009: 97; AND INEGI, 2009 ECONOMIC CENSUSES.

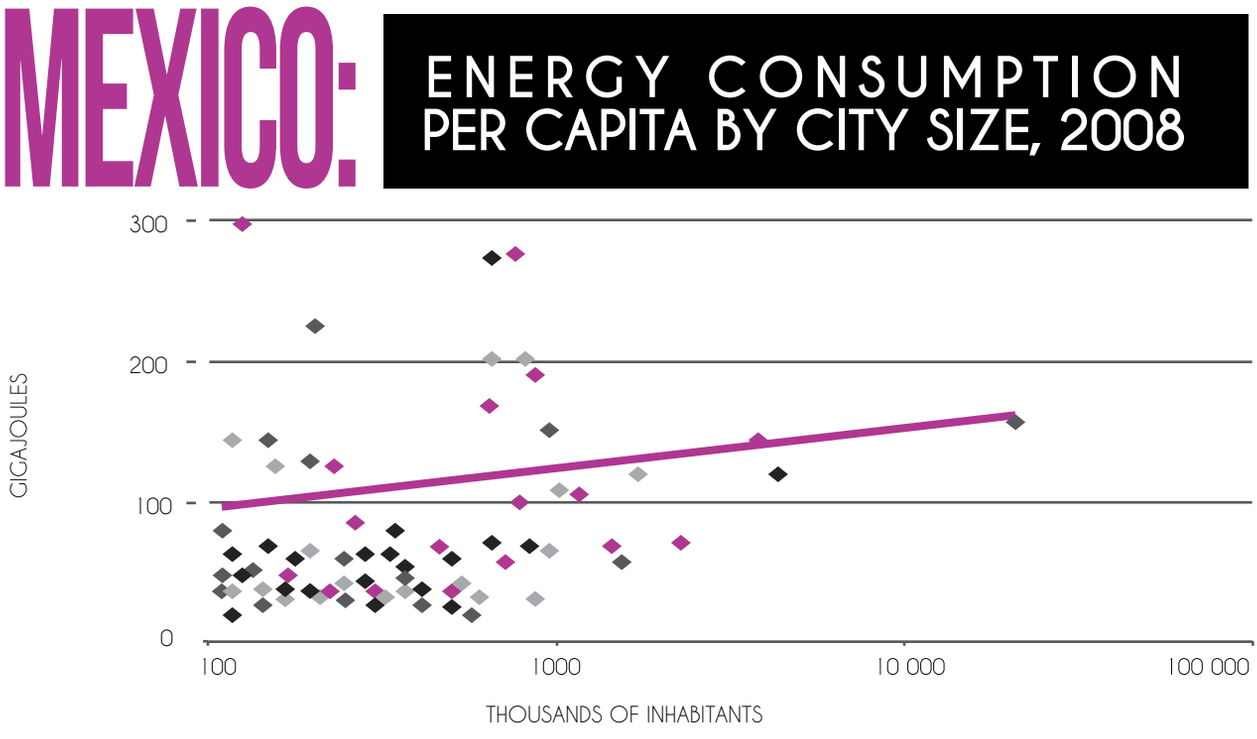
While it is true that there is less energy intensity as urban size increases, the relationship between city size and energy consumption per inhabitant is also statistically significant; the more people in the city the more consumption per inhabitant. In other words, the larger the city the more complex the economic, social and cultural pattern related to the use of energy by the resident population (see Figure 3.5). The variation range in the consumption of energy per inhabitant goes from 19 to 1,042 gigajoules; in millionaire cities, those values range between 57 and 156 gigajoules.

These results show a paradox and different challenges to urban sustainability depending on the population size:

i. The smaller the city size the more the energy demanded by its economic structure, but as the city size increases, economies of scale are achieved in the productive use of energy; and

ii. In contrast, the residents of small cities consume, on average, less energy than those of large cities, who experience a higher average use of energy in transportation as a result of the increase in travel distances and traffic jams, but also due to consumption patterns in households.

Figure 3.5



SOURCE: OWN, BASED ON SENER, 2009; AND INEGI, 2009 ECONOMIC CENSUSES.

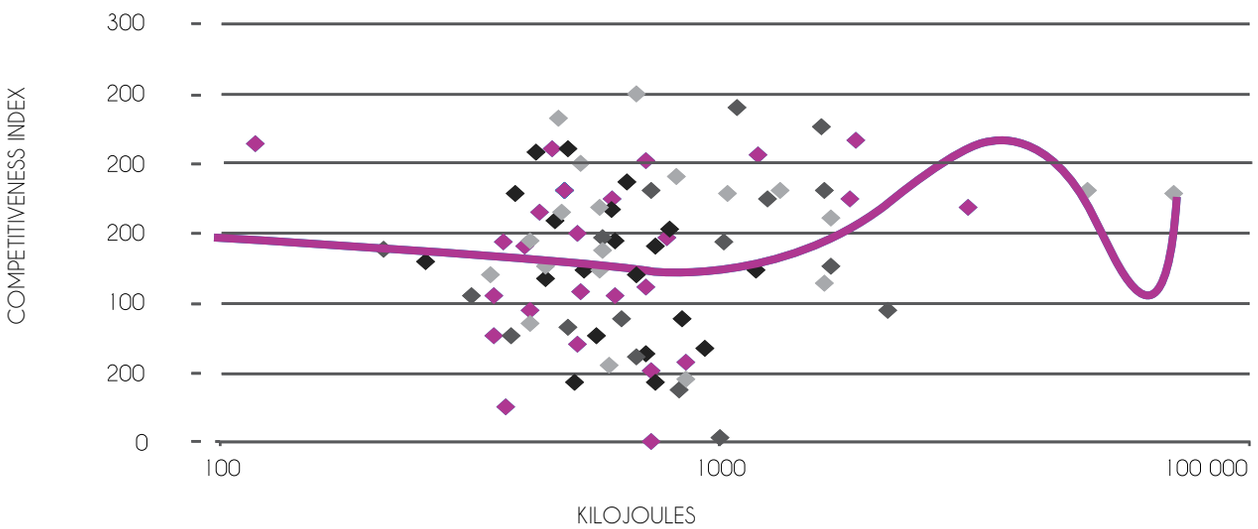
As already explained, urban competitiveness relates to the degree in which a city, compared to other competing cities, can attract productive investments that translate into the creation of jobs and an increase in income, while improving and consolidating its cultural and recreational appeal, social cohesion, governance and an environment appropriate for its resident population. Based on this concept, we infer that competitiveness is a relative term, inasmuch as it compares the performance or actions of a territory based on what other territories do or don't do. It also quantifies and qualifies the potential of that territory not only to attract productive investments, which may be public or private, but also to retain its resident population by providing them with employment opportunities and quality of life, and even to serve as a destination for domestic and international migratory flows.

The competitiveness index for each city, taken from the benchmarking exercise shown in Table 3.1, was related to their energy intensity and their energy consumption per inhabitant, with the purpose of identifying the degree of association between energy and competitiveness. The first relationship was not statistically significant (see Figure 3.6). There were cities with high competitive performance and high energy intensity, which were related to a productive structure mainly specialized in the industrial sector, but also cities with a low competitiveness index and high energy intensity, which indicates low-efficiency production processes from the standpoint of energy consumption.

Thus, the competitive performance of Mexican cities is not related to the energy intensity in their productive processes. The "U" shape in the relationship shows the *differential challenges* for cities in the country in relation to competitiveness and sustainable economic processes: the competitive performance can be improved with the use of technologies that generate less energy consumption. However, technologies should be introduced to maintain a favorable competitive position by reducing the energy consumption per dollar of production.

Figure 3.6

MEXICO: ENERGY INTENSITY-COMPETITIVENESS RATIO OF CITIES, 2008

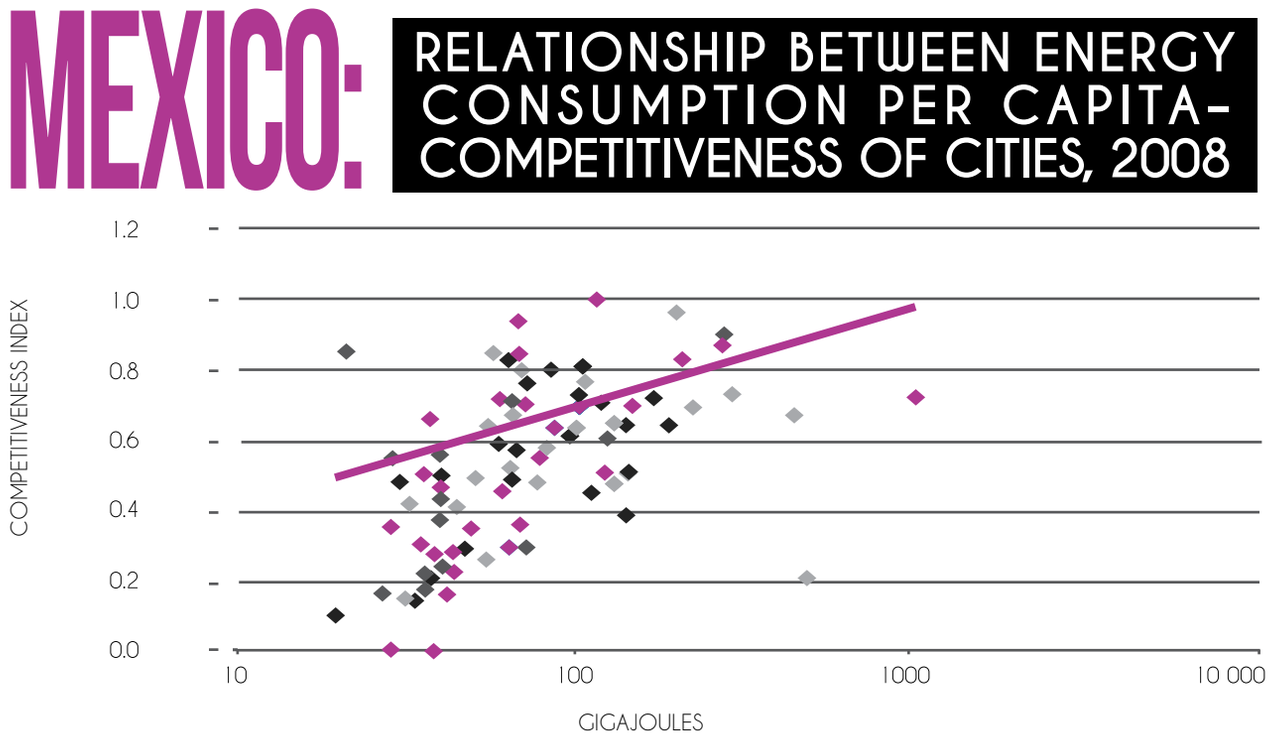


SOURCE: OWN, BASED ON SENER, 2009; AND INEGI, 2009 ECONOMIC CENSUSES.

In contrast, the association between *competitiveness and energy consumption per inhabitant* was statistically significant and with a positive sign, which indicates that the bigger the competitive performance the bigger the energy consumption per inhabitant. In other words, the most successful cities in the game of productive investment attraction, generation of employment and living conditions for their resident population also have a bigger consumption of energy consumption per inhabitant (see Figure 3.7).

These results show that Mexican cities have not introduced yet a sustainable, more efficient and effective consumption of energy. This brings us back to the lack of a national policy in this context and, therefore, the few achievements made in isolated cities would be the result of local actions with the involvement of key local actors.

Figure 3.7



SOURCE: OWN, BASED ON SENER, 2009; AND INEGI, 2009 ECONOMIC CENSUSES.

4. Policy guidelines to improve the relationship between competitiveness and sustainable urban development

Energy flows through different dimensions of human activity. The economic, social and environmental implications of energy production and use lead to the establishment of a link between energy and sustainability, as well as an analytical perspective between energy and competitiveness. It is necessary to understand the particular context of each country, region and city in the energy-competitiveness-sustainability triangle, which reflects the absence of a single criterion of sustainability, as well as the lack of a concept of competitiveness that only refers to elements of the economic growth of the territory.

Mexico is an example of a nation with important paradoxes in the area of energy. It is a net energy export country, but lacks an integral and long-term policy in this aspect. The country's energy supply is based on oil, but its production and proven reserves have diminished year after year. The primary energy sources have mainly been localized in the region with the lowest level of development in the country, where there is an important net regional exchange with no benefits for the producing territory. The consumption of energy per inhabitant increases as the city size increases, but there has been no promotion of a national urban transportation policy. People living in rural areas maintain firewood as their main source of energy. In cities, there are two contrasting forces: the bigger the size the more efficiency in the use of energy in economic activities, but also the more consumption of energy per inhabitant. Competitiveness is not related to a more efficient use of energy, but to other competitive advantages related to the scale of the city.

Sustainable development has been a concern for scholars and academics, but until now it has not been a concern for large corporations, and much less for the federal government. The discourse of the public sector is full of *slogans* about sustainability, but actions are minimal, with low social impact.

Because of this situation, government and civil society in some cities have initiated actions toward environmental protection and more effective and efficient use of energy. Mexico City is one of them, where some green actions have been implemented to provide better conditions of mobility for the population, and transforming their use of public transportation. The success of these programs depends, on one hand, on the change of attitudes and cultural patterns of the population. There have been attempts to introduce an environmental conscience, where the formulation and implementation of effective public policies should be at the forefront. There is no doubt that the most important and most simple way to reduce global warming is through the efficiency and efficacy in the use and consumption of energy (Krupp and Horn, 2008: 190-231). The triangle energy-competitiveness-sustainability should be seen as an opportunity for local economic promotion that identifies chances for innovation and use of technologies that contribute to energy saving. The unlimited private use of a *finite social good* can no longer be thought possible.

Economic promotion consists of the group of actions and strategies undertaken by local governments to attract productive investments, mainly in innovative sectors, where those investments mean the generation of well-paid jobs (Moretti, 2012). Local economic promotion has been emerging as another substantive function of local governments in the 21st century (Malecki, 1997; Otgaar et al., 2012). The success in the economic promotion of the city has been linked to the concept of competitiveness.

If local governments fail to look after the economic growth of their cities, then there is a risk of having stagnant and non-competitive productive structures that do not generate sufficient quality jobs, and fail to take advantage of the physical and human capital in which investments have been made and that have accumulated. Detroit may be the clearest example of the failure of several local administrations and key agents to inhibit the consequences of the closing of the large automotive companies that made up the economic foundations of the city, as well as the private sector and the government's inability to promote the necessary restructuring necessary for the sustainability of that metropolis.

In contrast, the cities of Santiago de Chile, Mexico, Lima, Sao Paulo, Buenos Aires and Panama have laid the foundations for the successful promotion of their metropolitan economies, and have emerged as the best and most competitive cities to do business in Latin America (América Economía, 2014; Ni et al., 2014). The key has been a combination of assertive government actions and the active participation of private agents, coupled with the correct recognition of the sectors and economic activities where *comparative advantages* are maximized and *competitive advantages* are generated.

Technological development and globalization have promoted the decentralization of manufacturing production and the centralization of the coordination and provision of services of a higher order. For example, those cities that specialize in services to producers take advantage of the agglomeration economies generated by the market size and the availability of infrastructure for the generation and transmission of ideas and knowledge. Other cities that specialize in services evolve thanks to the growth of specific activities and functions such as tourism, government or a higher education offer.

Both within Mexico's urban system and the network of metropolises in Latin America, it is possible to find the combination of cities with a neo-industrial development that are mainly dedicated to the export of goods, cities with an economic structure that mainly relies on the provision of services of a higher order, especially of those with the largest population sizes, or cities that utilize environmental capital and historic landmarks for the development of tourist activities.

The challenge for the economic future of cities will lie in the promotion of *low-carbon economic growth*. Also, changes in the population structure due to the existence of large age groups poses different challenges to urban sustainability. Their child population will continue to represent a constant share of the population, and will need to have access to education opportunities that allow children to obtain both training for their adult and labor life, and learning and experiences for the adoption of attitudes and practices linked to sustainability (see Chapter 2). The population ages 15 to 64 will experience a significant absolute growth, and their contribution to sustainable urban development will depend on the capacity of the city and the country to generate quality jobs that are linked to the low-carbon production of goods and services.

Finally, the elderly population will experience a really significant absolute growth, and this population cohort will only be able to support, and benefit from, sustainability to the extent they have access to the inclusive and sufficient public services and support required to meet their needs, in particular those related to health services, social welfare, financial security and enabling socio-spatial environments. We should not lose sight of the place of residence in the city of the elderly, for whom physical accessibility is even more important for the full exercise of their rights.

4.1. Key actions

The following are some of the main government actions for the promotion of the economy of the city:

- Build productive infrastructure, especially for the distribution of the different forms of energy and the transmission of information.

- Consolidate the economic sectors where the city has a proven economic vocation, that is, promoting productive specialization, but without neglecting the opportunities represented by the promotion of new economic activities, especially in innovative sectors. That consolidation and promotion can be done through strategic planning exercises with the participation of the public and private sectors.

- Create and strengthen the *city brand,* which should highlight the best things the city can do to improve its position in the national and global network of metropolises. This city brand requires the design of investment portfolios, conducting economic feasibility studies and promoting the city at the regional, national and international levels.

The attraction of productive investments and the creation of employment are undisputable indicators of the competitiveness of the city, but the rational use and utilization of the physical, human and environmental capital in the production of goods and services is an essential requirement to advance toward sustainable urban development.

The Latin American network of metropolises faces a big challenge in the near future, which requires the promotion of local economic growth driven by investments, but with actions aimed at environmental protection. This duality must be present both in the territorial policies of central governments and the plans and programs of local governments to promote the economy of the future. In some countries like Mexico, efforts made so far have had some success from a sectoral standpoint, considering that the country has managed to reduce the participation of the environmental cost with respect to its GDP (INEGI, 2012). The challenge lies in advancing toward more sustainable urban development, that is, toward a better local economic performance without more environmental pressure.