TRANSIT ORIENTED DEVELOPMENT **REGENERATE MEXICAN CITIES TO IMPROVE MOBILITY**





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ACRONYMS AND ABBREVIATIONS

ABBREVIATIONS

BRT. Bus Raid Transit
TOD. Transit-Oriented Development.
ISUD. Integrated Sustainable Urban Development.
GHG. Greenhouse Gases.
NAMA. Nationally Appropriate Mitigation Action.
UDP. Urban Development Plan.
GDP. Gross Domestic Product.
ISUMP Integrated Sustainable Urban Mobility Plans.
NUS. National Urban System.
GMA. Guadalajara Metropolitan Area.
MMA. Nonterrey Metropolitan Area.
VMMA. Valley of Mexico Metropolitan Area.
EIS. Environmental Impact Statement.

INSTITUTIONS AND LAWS

CONAPO. National Population Council. CONAVI. National Housing Commission. INFONAVIT. National Workers Housing Fund Institute. ITDP. Institute for Transportation and Development Policy. SEDATU. Agrarian, Land and Urban Development Ministry. SEDESOL. Social Development Ministry. SEMARNAT. Environment and Natural Resources Ministry. SHF. Federal Mortgage Society AA. Agrarian Act. GEBEPL. General Ecological Balance and Environmental Protection Law. GLHS. General Law of Human Settlements.

UNITS AND CHEMICAL COMPOUNDS

CO₂. Carbon dioxide. CO₂e. Carbon dioxide equivalent. Ha. Hectare Hab. Inhabitants . Km. Kilometer. MMTCO₂. Millions of Megatons of CO₂. MtCO₂e. Mega tons of CO₂ equivalent. NOx. Nitrogen oxides. PM. Suspended particles. SOx. Sulfur Óxides.

EXECUTIVE SUMMARY

The impact of the diverse growth of cities in Mexico has enabled the consolidation of 59 metropolitan areas and generated an unprecedented expansion of urban areas. The estimate of land area occupied by major cities with over 50,000 inhabitants has expanded 6 times between 1980 and 2010, while the population increased by only 1.9 times. The result has been a 67% decrease in population density, increased costs for public services (including, among others, transportation); and an excessive promotion of car use - all at the detriment of the nation's long-term sustainability.

This expansion and diversification process has been messy and chaotic, mostly realized outside urban development plans. This expansion has occurred spontaneously, the result of many institutional weaknesses and perverse economic incentives that are still in play today.

Among these incentives are:

- **a.** Dismissal of urban planning and mobility in national planning and federal public policy
- **b.** Lack of mechanisms and incentives for effective urban planning
- **c.** A regulatory framework that reduces the effectiveness or contradicts basic tenets of urban planning; e.g., faculties granted under the Agrarian Act (AA) and the General Ecological Balance and Environmental Protection Law (GEBEPL)
- **d.** A housing policy that incentivizes the expansion of cities
- **e.** A financial system that allows and stimulates the massive funding of housing construction but is blind to basic urban planning principles.

Territorial expansion has had benefits, such as housing construction, employment and short-term economic growth. This chaotic process, however, has not promoted sustainable economic development in these cities. On the contrary, if we are to continue this trend it would be unsustainable in the medium and long term. On the one hand, fiscal costs that arise from the supply of infrastructure and installations would be too much for the government, about 22 times higher (based on a conservative estimate) than if urban planning was realized.

Costs to citizens are equally high, especially for households that own automobiles; if transportation costs are added to housing and maintenance costs, the resulting average would be about 35% of disposable household income. Conventional thinking suggests that a family should not lend out more than 30% of this income to avoid falling into the risk of default or harming their economic well-being. Given the cost of transportation, the above suggests that housing policy and urban expansion results in additional financial stress for the average family, negatively affecting their economic well-being both in the short and long term. Under this scenario, it is not surprising that 5 million homes throughout the country have been either vacated or abandoned.

Urban expansion also causes negative externalities that harm the environment and biodiversity in urban areas, as well as causing waste generation and water pollution. As explained herein, urban expansion also generates negative externalities associated with transportation, especially car use.

Evidence exists to show that the expansion of cities generates significantly higher car use which results in increased social costs (emission of greenhouse gases and key pollutants, car accidents, congestion and noise) that represent up to 4% of the GDP of Mexican cities.

Given this situation, urban development needs to be re-thought with a focus on greater mobility, including more equitable and sustainable transportation for the inhabitants of Mexican cities. This means that urban development must be reoriented towards models and strategies in which walking, cycling and public transport form the key elements. This is known as **Transit-Oriented Development (TOD)**, an urban development model that has proven successful in diverse cities around the world including Copenhagen, Curitiba, Denver and Hong Kong, as described below.

In order to achieve this, the government can implement two types of policies. On the one hand, it is necessary to reduce incentives that stimulate urban expansion. This implies:

Modify urban planning to include mobility as a guiding principle. **Establish** Establish the need to update urban development plans that include benchmarks and monitoring by designated supervisors, as well as sanctions for non-compliance.

Modify Modify housing policies to include location criteria, which should be reflected in the securities market.

Manage land on city outskirts

Encourage housing rentals in cities.

Consider urban expansion and traffic in Environmental Impact Statements.

Modify divestiture mechanisms of ejido (Mexican communal) lands to require that they conform to urban development plans. **Redirect** public funding to public and non-motorized transportation, establishing a moratorium (including financing) on large road projects such as highways and distributor roads in metro areas, as these types of projects tend to increase car use and urban sprawl.

The second set of policies require:

Strengthen the Agrarian, Land and Urban Development Ministry **Establish** in the National Urban Development Program a land expansion containment policy that takes into account mobility as a structural basis of urban space and promotes TOD.

Develop a Special Program for Transit-Oriented Urban Development that establishes goals, objectives and technical guidelines to ensure that urban growth occurs near mass transit stations and, as a result, reduces car use.

Establish federal financing that requires local governments to establish institutions responsible for urban planning and mobility, as well as an update of their urban and metropolitan development programs.

Limit funding to only mass transit projects that meet international quality standards and / or operate on a Transit-Oriented Development strategy.

Promote an inter-urban ISUD program for Transit-Oriented Development.

Provide bridge loans for housing in TOD, as well as mortgages based on location and focused on TOD.

Continue to reduce gas subsidies in the short term; in the medium term, impose an environmental tax on gas consumption that can be used to fund residential housing, transit-oriented development, mass transit, cycling and quality pedestrian infrastructure, with benchmarks for car demand.

Conduct research and studies to analyze urban expansion trends with precision; quantify the negative externalities that this implies on a national level; and prepare an economic assessment of alternatives to current policies.

In this sense, the boost given to Transit-Oriented Development at a federal level becomes an essential tool to discourage urban sprawl and ensure sustainable development. The federal government can promote a national TOD program that improves urban mobility and provides significant benefits to city residents. Promoting TOD could be considered part of a mitigation Greenhouse Gases (GHG) strategy or a Nationally Appropriate Mitigation Action (NAMA).

INTRODUCTION

One of the biggest challenges facing Mexico (and one which has received relatively little attention) is the chaotic expansion of cities. This expansion has generated – and will increasingly generate – high fiscal and environmental costs, as well as diminished economic equality, mostly due to its negative impact on the mobility of city dwellers.

Recent data released by SEDESOL (2012a) indicate that the land area of major cities with over 50,000 residents has increased 6 times between 1980 and 2010, while the population has only increased 1.9 times. This has meant a 67% decrease in population density. Meanwhile, car usage tripled from 1990 to 2010, generating negative externalities (pollution, accidents, noise, congestion, etc.) estimated at a 4% cost of Gross Domestic Product (GDP) to all cities (Medina, 2012a).

This phenomenon is not accidental, as it has been encouraged by existing institutions and national land guidelines as well as by various government policies including housing. In sum, scant attention has been given to the significance of urban expansion or its resulting impact on individuals' mobility. The obsolescence of this model is reflected in the existence of 5 million vacated homes, many of which were financed by housing loans. 26% of homes financed by INFONAVIT between 2006 and 2009, for example, are still unoccupied (BBVA Research, 2012).

This is a good time to re-think many of these policies and move towards a low-carbon emission urban model in which sustainable mobility and socioeconomic inclusiveness serve as guiding principles. This can be done by encouraging urban development based upon mass transit. As this strategy has shown in cities where it has already been implemented, Transit-Oriented Development - with its significant potential to alter the current urban planning paradigm - can help increase business development, economic fairness and environmental sustainability.



1. MEXICO'S ACCELERATED URBANIZA-TION: EXPANSION AND LACK OF PLANNING Mexico has changed rapidly from a mainly rural to urban nation, especially between 1940 and 1980. At that time, 20% of the total population was concentrated in 55 cities; 40 years later, about 55% of the population lived in 227 cities. By 2010, 72.3% (77% according to INEGI) of the population lived in 384 cities; by 2030, the percentage of people living in cities is expected to grow to 81% (CONAPO, 2007).¹

This urbanization process has been uneven, going through three distinct stages (Sobrino, 2011) mostly as a result of economic factors. "The urbanization process is rooted in the conditions of the production process, hence the link with economic development, so it is an expression of a causal relationship in which changes in production conditions are reflected in the growth dynamic of cities "(CONAPO, 2012:11). During the period between 1900 and 1940, when there was a breakdown of the liberal economic model, political upheaval and the consolidation of the modern nation-state, the rate of urban population growth was 2.55% per year. Over the following 40 years, this process accelerated to an annual rate of 5.75%, but was highly concentrated in Mexico City and, to a lesser extent, in Guadalajara and Monterrey. This reflected a closed economic model of import substitution, centralization and a focus on internal market development. The concentration of population and economic activity in a single city was recognized as a problem in the first National Urban Development Plan of Mexico in 1978. Its aim was to decentralize industries located in Mexico City and promote economic growth in intermediate cities (Garza, 1989).

The situation changed after 1982 with the adoption of an economic model focused on promoting exports, attracting foreign investment (FI), privatization of public functions and deregulation (neoliberal model). This broke the economic concentration of the prior model and gave way to productive² chains linked to the external market. In this way, the new economic model led to a reconfiguration and diversification of the National Urban System (SUN)³ through the consolidation and creation of new cities, from 227 in 1980 to 384 in

 $\ensuremath{\mathbf{1}}$. The urban population percentages measured by CONAPO and INEGI differ as

a result of different definitions used by each agency. CONAPO considers urban populations to be municipalities with over 15,000 inhabitants, while INEGI considers urban populations to be those with over 2,500 inhabitants.

This refers to the value chain of products, from raw materials to the finished product. Under the import substitution model, efforts were made so that most of the value chain (raw materials, intermediate goods, production, etc..) took place within the country. In the export promotion model, however, this ceases to be a relevant factor, as all necessary elements are imported (raw materials, machinery, intermediate goods, etc.) for later use in domestic consumption or export.
 The National Urban System is the "aggregate of functionally-related cities of

2010, with population growth rates of about 2.68% per year. Areas that were especially targeted included the production of goods for foreign markets (in the nation's north and center); and international tourism, which received the largest flows of internal migration (UNCLEAR) (Sobrino, 2011 and UN-HABITAT, 2011). In this manner, cities have not only become key population centers but also significant generators of wealth, estimated at about 86.5% of the nation's GDP (CIDOC, 2012).

The concentration of city populations has led to the emergence of new metropolitan areas.⁴ At present there are 59 cities in the country (CONAPO, 2012), evidence of an expansion in which cities have grown significantly beyond their original political borders. The expansion integrates areas socioeconomically but not politically. As a result, coordination between local governments becomes difficult and the rendering of services, including quality public transportation, becomes onerous both for the government and for greater society. In this way, the horizontal and disperse growth of cities has stimulated excessive car use (Medina, 2012a) and the proliferation of low quality public transportation services (generally the old "hombrecamión" model) to satisfy the demand for mobility (ITDP, 2012a). This territorial expansion poses a significant threat to the sustainable development of the nation's cities, especially with respect to mobility and economic equality.

1.1 Urban expansion and the incentive to use cars

The growth of NUS and the metropolitan phenomenon clearly points to a territorial expansion of cities in Mexico. The area of cities with over 50 thousand inhabitants has grown 6 times between 1980 and 2010, while the population increased only 1.9 times, which has meant a 67% decrease in population density, according to data released by SEDESOL (2012).⁵

This territorial expansion phenomenon is no longer only a characteristic of the VMMA, as it generally occurs throughout the main NUS subsystem. Among all the cities analyzed by SEDESOL, excluding the VMMA, the average expansion growth rate is 10.15%, while the population increased at the much lower rate of 4.2% per year.

15,000 or more inhabitants in which any significant change in one produces, to a greater or lesser extent, changes in the others" (CONAPO, 2012:11).

4. CONAPO (2012) A metropolitan area is defined as a set of two or more municipalities in which a city of at least 50,000 inhabitants is located and whose urban area, functions and activities extend beyond the limit of the original municipality, incorporating predominantly urban neighboring municipalities as part of itself or its area of direct influence, and with which it has a high degree of economic integration.

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TABLE 1: THE URBANIZATION PROCESS IN MEXICO,1900-2010

Year	Total Population	Town Population	Degree of Urbanization	Citys
1900	13,607	1,435	10.5%	33
1910	15,160	1,783	11.7%	36
1921	14,335	2,100	14.7%	39
1930	16,553	2,892	17.5%	45

	Town Population	Citys

Rupture of liberal growth model economic, the revolutionary movement and the emergence of the new nation state.

Development model oriented to import substitution protection business and the home market.

Year	Total Population	Town Population	Degree of Urbanization	Citys
1980	66,847	36,739	55%	227
1990	81,250	51,491	63.4%	304
2000	97,483	66,649	68.4%	343
2010	112,323	81,231	72.3%	384

New economic model oriented towards trade liberalization and lower weight of the state in economic functions.

GRAPH 1: EVOLUTION AND URBANIZATION OF MEXICO'S POPU-LATION, 1900-2010

Note: Urban populations with over 15,000 inhabitants, differing from the INEGI definition of urban populations with over 2,500 inhabitants. Source: ONU-HABITAT, 2011.



Note: For the purpose of this document, urban populations will be considered those with over 15,000 inhabitants, which differs from the INEGI definition of 2,500 inhabitants. Source: CONAPO, 2012.

This has meant an average yearly reduction in population density of 6.7% in the remaining cities, a rate greater than the VMMA, whose density has decreased annually at a rate of 4.49%, an ongoing problem for this city (see Graph 2).

This expansion has made the provision of quality public transportation largely unfeasible and led to large and growing numbers of private vehicles that make getting around on foot or bicycle increasingly difficult in every city.⁶ The vehicle growth rate in cities with over 50,000 inhabitants is on average 8.5% per year, with the exception of VMMA which shows a lower motorization rate. In the last thirty years, car use has increased overall by about 300% (Medina, 2012a).

This is also reflected in the alarming pattern of density loss in various cities. In Illustration 1, one can observe that most big cities have already reached densities of less than 100 people per hectare, at which point the implementation of mass transit systems becomes unfeasible. These densities are fast approaching those in cardependent societies.

The expansion of cities is not a serious problem when growth is planned and oriented towards the use of public transport and active transport (walking and cycling). This said, most growth in Mexican cities⁶ has been without proper planning, resulting in excessive dependency on car use. This has impeded the transformation and development of cities with low carbon emissions, high air quality ⁷ and acceptable life quality for its inhabitants. The increased costs required to cover greater distances has caused difficulties for the provision of basic goods and services - as well as a major management problem for local governments.

1.2 Expansion of the cities fostered by public policy

The growing number of cities, the rise of the national metropolitan phenomenon and the expansion of cities land areas have neither been planned nor fortuitous, but the result of institutional and

5. The Study **The expansion of cities 1980-2010** realized by SEDESOL is the first to shed light on many changes that occurred in the urban areas of 135 cities at different points in time:1980, 2000, 2005 and 2010. This first official study fills many information gaps and shall be used in this document as an important reference. Note that information about temporary cuts in 2000 and 2005, though, shall not be used, as it likely contains errors. This is because the total land area grew 5 times between 1980 and 2000, whereas in the period from 2000 to 2010, it only grew 1.2 times. This would mean that the total density decline between 1980 and 2000 was -67% whereas between 2000 and 2010, it was only -0.05%. This is probably due to a methodological error. The graphic representations of city expansion suggest that their urban area was overestimated in 2000, since the data between 2005 and 2010 are often inserted within the surface mapped for that year. (UNCLEAR) This implies that land expansion between 2005 and 2010 was also underestimated. Given the fact that no notes exist regarding the study's methodology or significant variation

economic gaps that are still present today

1.2.1 Dismissal of urban planning and absence of urban mobility The issue of urban planning has been gradually relegated to second place in Mexico since the enactment of the General Law of Human Settlements (LGAH) in 1976. Despite the law's impact on Mexico's political institutions, its role in the affairs of current city dwellers has been removed from the national agenda. These tasks, once supervised by a secretary of state – first, the Secretary of Human Settlements and Public Works (1976-1982), then the Secretary of Urban Development and Ecology (1982-1992); is now managed at the undersecretary level in the Social Development Ministry (1992-2013). Given the major changes that have taken place in Mexican cities, reality has clearly exceeded the government's capabilities. All this demonstrates the lack of importance given to this issue by prior administrations despite the vast economic and social importance of cities.

The most emblematic example of the abandonment of national urban planning was the federal government's failure to publish the National Urban Development Program - for the first time since the adoption of the GLHS - during the six years between 2006 and 2012. This was a clear indication that planning guidelines were not being used for the development of the National Urban System.⁸

In addition, we should note that urban development planning does not normally take into account mobility-related issues, as urban structure and mobility are closely interrelated (see Text Box 1). On a national level, too few institutions and laws are in effect to regulate an issue so vital for the development of cities. Even though 70% of the nation's population is affected, mobility suffers even more than urban planning, as it has been reduced to a purely local problem.

On the other hand, housing - essential in any city development plan - has also been removed from urban planning. Until a few months

in intermediate data points, this information cannot be used with confidence. For this reason, only data from the initial and final periods shall be used under the assumption that they are correct.

6. In addition to land area expansion, other factors have also contributed to augment the growth of both vehicles and car use, including increased household income; the entry of cheap imported cars; credit plans (see CTS-INE, 2010); as well as various other incentives including gas subsidies, elimination of the "car tax" ("tenencia"); lack of compulsory insurance and public spending policy focused on car infrastructure (see Medina, 2012a and 2012b).

7. Air quality measures the degree to which the air is polluted as well as its fitness for human respiration .

ago, housing policy was relegated by various government agencies at diverse levels. While the Inter-Ministerial Commission was chaired by the Ministry of Finance and Public Credit (SHCP), there was no coordinating agency specializing in these matters. The result has been public agencies focused on housing production rather than a sustainable and integrated national urban development policy.

With the recent creation of the Ministry of Agrarian, Land and Urban Development (SEDATU), urban planning has begun to regain a role in the federal agenda – although urban mobility and its relation to urban development is still largely absent.

At the local level, however, the situation has remained relatively unchanged. The lack of competent local agencies specializing in urban development planning has often led to chaotic urban expansion. This has not only caused serious problems affecting the provision of goods and services but also endangers sustainable urban mobility. The INEGI (2009) data speaks eloquently in this respect; of the 2,440 municipalities in the country:

351

do not have an urban development program.

In fact, regulations or local institutions generally don't exist with regard to mobility planning; when there is some regulation, it is normally considered apart from urban development (ITDP, 2012a). To make matters worse, the short duration of municipalities' mandates (3 or 4 years) makes long-term urban planning and metropolitan coordination practically impossible. For this reason, many municipalities have established Municipal Planning Institutes (IMPLANS), decentralized public entities with autonomous management led by a city council to promote and coordinate integrated municipal development (Olvera and Quiñones, 2007). The IMPLANS permit the continuation of urban development plans beyond the administration's term. At present there are only 38 such institutions nationwide, although not all of them meet institutional requirements. In fact, many cannot yet participate in the planning of several metropolitan areas, much less one municipality within these.⁹

312

do not realize any planning.

1,062

do not have an operational Municipal Development Planning Committee (COPLADEMUN).

1,836

have no legal provisions in terms of planning.

1,889

have no legal provisions for zoning matters or land use.

1,594

have no legal provisions regarding matters related to transit, roads or transport.

1,786

have no legal provisions regarding building regulations.

8. Although this may seem trivial, urban development programs at the federal level may not officially use the term "plan" (they must be called "programs") as this term is used exclusively in the context of the National Development Plan. In symbolic terms, this points to the lack of status of city planning. Given its importance in the supply of goods and services and its impact on the economic life of urban dwellers, this policy makes little sense.

9. In some cities like Guadalajara and Queretaro, progress has been made on the development of multi-municipal metro institutes. Among other factors, they have not yet been formalized due to the high degree of coordination involved.

TEXT BOX 1: INTEGRATED SUSTAINABLE URBAN MOBILITY PLANS (ISUMP)

The federal government promotes urban mobility planning through the National Infrastructure Fund (FONADIN) and the Mass Transit Federal Support Program (PROTRAM). These require the preparation of Integrated Mobility Plans (ISUMP) to finance mass transit infrastructure. These plans have generally focused, however, on securing the financing necessary to develop a BRT corridor without taking into account the mobility of the entire city or its connection with urban development.

Of the 15 urban mobility plan documents reviewed by ITDP Mexico and Central Eure, 60% of them give merely lip service to integrated urban mobility; only 40% include feasible plans with respect to: Urban Development (growth, expansion, land use, etc..), public space, environment, public transport, non-motorized transport (bicycle and pedestrian), roads and automobiles, load transport, among other issues.

Moreover, the ISUMP do not form part of state or local planning, which means they may contradict or compete with other plans, especially those involving urban development. This evidence has so far reflected a separation between two closely related issues: urban development and mobility.

Source: ITDP Mexico - Center EURE, 2012a.

 TABLE 2: MAIN NUS SUBSYSTEM: URBAN POPULATION,
 Source: Based

 AREA AND DENSITY BY CITY TYPE, 1980-2010
 Source: Based

Population	Cities	Population (millions)		Land area (ha)		Density (hab/ha)	
Size		1980	2010	1980	2010	1980	2010
5 million or more	1	14.122	20.116	51,908	185,291	272	2010
1 million to 4,999 999	10	9.261	21.252	49,635	324,111	187	66
500 thousand to 999,999	22	6.747	16.462	39,495	275,743	171	60
100 thousand to 499,999	62	6.473	13.963	37,811	283,058	171	49
50 thousand to 99,999	40	1.317	2.810	10,493	66,902	126	42
Total	135	37.922	74.605	189,342	1,135,105	200	66

TABLE 3: NATIONAL PLANNING PROGRESS, 2012

10x - -

Updated in:	Metropolitan areas	% of metro- politan areas	All NUS cities	% of NUS
Without UDP	14	25.5	37	16.52
1980-1989	2	3.6	12	5.36
1990-1999	16	29.1	110	49.11
2000-2005	21	38.2	61	27.23
2005-2012	2	3.6	4	1.79
Total	55	100	224	100



TABLE 2: AVERAGE ANNUAL POPULATION GROWTH, SURFACE VEHICLE POPULATION DENSITY AND PARK MAJOR CITIES TO 50 THOUSAND PEOPLE, 1980-2010

Source: Based on SEDESOL (2012a).



TEXT BOX 2: INCENTIVES FOR METROPOLITAN COORDINATION THROUGH FINANCING

Federal funding for infrastructure projects may become a useful tool to generate incentives for coordination between diverse agencies and government levels in city planning.

An example is the Metropolitan Fund (MF), which subjects access to federal funding on coordination among distinct local governments in a given metropolitan area. The MF operating rules require that state governments involved in the same metropolitan area must make joint requests. Once funding is approved, these metropolitan areas must legally create a Metropolitan Development Council, a body responsible for deciding the allocation and application of resources. This Council facilitates dialogue between the supervising state agencies and the districts or municipalities that form part of the given metropolitan area. The Council also includes actors in the public, social and private sectors to provide decision-making input. Operating rules promote the use of funds allocated in the creation of a metropolitan development plan or to use these resources for existing state and municipal development plans.

Despite the existence of these incentives to coordinate, the Metropolitan Fund has failed to promote sustainable urban mobility. On the contrary, 81% of the resources of the MF destined for mobility planning have been used exclusively to finance infrastructure dedicated to the automobile. Only 18% has been used to improve public transport (Garduño, 2012).

TEXT BOX 3: LACK OF ANALYSIS OF CAUSES: URBAN EXPANSION AND PUBLIC POLICY

The main cause of the recent city and urban expansion is attributable to a housing policy focused on major housing developments, perfectly understandable given the significant financial incentives these generate (see Section 2.2.4). But this phenomenon also includes self-building, informal housing developments, federal and urban infrastructure and production facilities, and government services; all of which have their roots in other incentives, including laws or public policies that encourage activities such as road infrastructure construction.

The dearth of official up-to-date studies evaluating the causes underlying the expansion of the nation's cities is troubling, as it gives us an idea of the lack of technical information with which Mexican lawmakers develop public policy. Which will no doubt result in undesired effects in the medium term that will negatively impact the general population's well-being. A recent estimate by Softec Consultoría de Proyectos Inmobiliarios describes how to use the new land area resulting from territorial expansion. This shows that for every 100 hectares of urban growth, 15% goes to residential housing development, 25% to other types of housing (formal and informal), 20% to primary and secondary roads, 10% to greenbelts and 30% to productive property, either private or government services.

This information is a good starting point for a discussion, keeping in mind that there are also other factors involved in cities' expansion. In a sense, it is a call to further study why Mexican cities continue to expand in land area and lose population density.

1.2.2 Lack of mechanisms and incentives for effective urban planning.

The lack of mechanisms and incentives for urban planning and, in particular, metropolitan planning is another institutional weakness that encourages urban sprawl. Firstly, neither legal provisions nor clear criteria exist regarding how often urban development plans must be updated. This can generate chaotic and expansive urban growth in the absence of coordination by local authorities or obsolete projections.

In addition, metropolitan urban development plans are not binding, so a local agency in any given metropolitan area may take action that completely contradicts the objectives established in a comprehensive plan. As a result, the legal framework currently in place fails to address these issues (CDM & CDHyOT, 2011).

It should also be noted that Mexican regulations do not provide mechanisms to continuously monitor and follow up to determine whether their provisions are being met in full. Nor do mechanisms exist to punish the lack of action or follow-up.

The consequences of this absence are self-evident. According to SEDESOL (2012c), 25.5% of the country's metropolitan areas and 17%¹⁰ of cities in the National Urban System did not have an urban development program for 2012. Similarly, 71% of metropolitan plans and 59% of urban development plans are older than 7 years, which means that these plans are probably outdated given the rapid pace of urban expansion.¹¹

1.2.3 A system of laws that reduces the effectiveness of urban planning We can also add to the above the fact that the national legal framework generates dynamics that reduce or even contradict the spirit of proper urban planning. Specifically, the powers granted by the Agrarian Act (AA) and the General Ecological Balance and Environmental Protection Law (GEBEPL) have resulted in the unintentional expansion of cities.

The amendments to the Agrarian Act passed in 1992 allow ejidos to sell their land without government permission, creating a legal land market. This situation has been exploited in many outlying urban areas to develop large tracts of land outside the mechanisms anticipated for the planning of a city (Chip ax, 2010 and Olvera, 2001). According to Bazant (2010), up to half of these cities expansion has been due to irregular processes, especially prior to 1992.

10. Includes metropolitan areas.

11. In the absence of monitoring, it is impossible to know whether these plans are simply outdated or are being fully complied with, a situation that seems unlikely

Meanwhile, the GEBEPL (enacted in 1988) authorizes the construction of huge infrastructure projects that have a major impact on cities dynamics, usually driving their expansion, including roads, airports, tourist developments, etc. Such infrastructure projects have been promoted by government agencies that often lack a clear vision of urban planning and mobility, for example the Ministry of Communications and Transportation and the Tourism Ministry, through the National Fund for Tourism Development. Azuela (2012) notes that over 1,500 permits are granted per year for such projects, in complete disregard for the urban dynamics involved.

As Anzuela mentions (2010: 603), the resistance to the merger of land planning realized by the GLHS and the GEBEPL's ecological framework has given rise to "[...] one of the most remarkable monstrosities of our current land planning regime: the local ecological framework covers everything "outside" population centers. "Inside" these frameworks, urban development plans govern. The absurdity of this Solomonic division is that the line between urban and rural does not even exist; yet its scope is one of the most complex of all land management issues."

1.2.4 The city's expansive housing policy. Housing policy undertaken in the last two presidential administrations have neglected urban planning because it has mainly relied on the market to decide the location of residential housing development.

Housing policy conducted by government agencies has been based primarily on quantitative targets and not on the creation of sustainable cities, economic fairness or quality of life. During the 2000-2006 government, 750,000 in yearly funding was planned for a total of 4.5 million during the administration (SEDESOL, 2002); while for the period 2007-2012, an initial target of 6 million in funding was established (SEDESOL, 2008). These goals were widely exceeded; between 2000 and 2006, more than 4.6 million credits were granted; and between 2007 and 2012, more than 8.9 million. In all, 13 million credits were granted over the course of 12 years. This amount contrasts with the 7.3 million credits granted in the prior 28 years.

given circumstantial evidence.

In the last two presidential administrations there was a 186% increase in funding; nearly 93% of them were awarded by public entities.

The economic incentives generated by government subsidies and massive investment in housing (which have benefited 1 in 6 homes financed) have been enormous (BBVA Research, 2013). This has pushed housing developers to search for cheaper land, usually in areas further away from downtown, in order to reduce final costs and make sure the final price allows them to qualify for housing subsidies offered by government agencies (Eibenschutz and Goya, 2009).

The result of these incentives are housing developments built in increasingly remote areas - and urban sprawl. Eibenschutz and Goya (2009) have shown that the average distance of housing developments to the city's downtown went from 6.8 km in 2001 to 43 km in 2006.

The effect has not been the same in all cities. According to data from Eibenschutz and Goya (2009), the average distance of housing complexes from downtown in the "mega cities" (Mexico City, Guadalajara, Monterrey) in the period 2006-2010 was 21.5 kilometers; in the big cities 12.9 kilometers; 6.7 km in medium cities; and 5.2 km in the small cities.

While it appears that housing developments themselves contribute little to the expansion of cities (see Text Box 3), the incentives generated by this expansion are powerful. Much of this new housing is not connected directly to the urban area, which creates "empty spaces", undeveloped land stuck between housing developments and the city. The value of land in these gaps increases and encourages further development, which occurs in a scattered, disorganized and / or illegal manner.

In the mega cities, for example, the urbanization of these "empty spaces" would cause a 23% growth of the city's land area. In the big cities, growth would be about 18%; in the medium-sized cities about 27%; and in the small cities about 28%.

Such growth would result in a drastic reduction in the density of cities, with detrimental effects for both city residents and the sustainability of their local communities.

Attempts have been made to reverse this situation through two programs: a) the implementation of a scoring system to access the **12.** The term "mega city" is generally used for cities with over 10 million inhabitants. In this case, however, Eibenschutz and Goya (2009) use it to describe the metropolitan areas of the Valley of Mexico, Guadalajara and Monterrey. housing subsidy program Ésta es tu casa of the National Housing Commission (CONAVI); and b) Integrated Sustainable Developments (ISUD) of the Federal Mortgage Society. Neither of these programs, however, seems to have achieved the expected results.

First, the program Ésta es tu casa qualifies location, installations (schools, hospitals, etc), re-densification and competitiveness, with the goal of improving both the location and quality of housing.With respect to location, the program provides four levels of scoring:

Priority 1

Intra-urban location, high densification (vertical housing) and low installations.

Priority 2

First rate location on city outskirts, with medium / low densification (vertical housing, duplex and quadruplex), with average installations.

Priority 3

Second rate location on city outskirts, with high re-densification (vertical), greater installations and ecological technologies (systems to save water, gas, light, etc).

Unrated

Non-urban locativon, low densification, without installations or nearby transportation.

In spite of this effort, the effects of these subsidies have been minimal. As BBVA Research (2013a) shows, home builders own many lots in outlying areas, for which reason access to subsidies has been difficult. As a result, only 3.4% of households are in areas located within cities that qualify for this grant (see Graph 6).

On the other hand, the goal of the ISUD is to align housing construction with urban development, promoting a basket of incentives to help coordinate developments between private companies and local authorities (states and municipalities). One ISUD requirement is that they integrate into the city development plan, regardless of whether they are intra- or peri-urban developments. This program, however, does not seem to have yielded the expected results, as only 10 ISUD were approved and only 2 were intra-urban (SEDATU, 2013).

GRAPH 3: TOTAL FUNDING FOR HOUSING, 1973-2011

Note: The figure for 2012 was based on Progress Tracking monitoring indicators to PAFV from CONAVI. The data include financial institutions, national housing agencies, state agencies, other agencies and federal grants. Source: Historical Housing Statistics, CONAVI.



GRAPH 4: AVERAGE DISTANCE TO DOWNTOWN RESIDENTIAL AREAS, 1996-2006

Source: Eibenschutz and Goya, 2009. The effect has not been the same in all cities. According to data from Eibenschutz and Goya (2009), the average distance of housing complexes from downtown in the "mega cities" (Mexico City, Guadalajara, Monterrey) in the period 2006-2010 was 21.5 kilometers; in the big cities 12.9 kilometers; 6.7 km in medium cities; and 5.2 km in the small cities.



1.2.5 A financial system blind to urban planning. CIDOC-SHF (2007) notes that the financing of housing construction and mortgage lending cannot be sustained solely through bank loans or workers' contributions. For this reason, the corporate debt market depends upon strong growth in housing construction. The result, as shown above, has been a severe neglect of city planning.

Housing developers can buy cheap land in outlying areas of the city, fund construction by bridge loans (special construction financing) and other types of loans, then quickly sell the unfinished home through mortgage credits. Once all the homes have been sold, the developer can sell the mortgages in the securities exchange by issuing securities endorsed by the same (mortgage securitization). As such, developers raise short-term financing to reinvest in building more homes, without any need to complete prior developments or wait for payment on homes actually sold.

This dynamic is reflected in the growth of the total stock of mortgage-backed securities; worth 1.2 million pesos when first issued in 2003, they grew to 247 billion pesos in 2012. In effect, the market grew 194 times, permitting the financing of millions of credits over the last decade.

Without doubt, this financial model has notable long-term limitations. First, a housing bubble risk combined with a Ponzi type scheme, can quickly cause a financial crisis similar to what occurred in the US in 2008 . While subprime type mortgages and derivatives based on mortgage securitization do not exist in Mexico, the current scheme is highly dependent on continued economic growth, high employment and public subsidies. This situation is unlikely to remain intact for long; already it has begun to show signs of exhaustion.

Housing prices also rose steeply, rising 48% between 2005 and 2012; this accelerated growth hints at a financial bubble. Due to low economic growth in Mexico, this rise has been accompanied by an increase in default rates, which rose from 6% in 2010 to 16.2% in October 2012 (BBVA Research, 2013a). These increases. combined with poor

13. At 2010 prices.

14. Ponzi schemes are pyramid-like debt schemes in which one debt supports another, so that the default of a single debt can provoke financial collapse15. See Gorton (2008) for further explanation of how the U.S. financial crisis occurred as a result of the collapse of mortgage-backed assets.

16. A subprime mortgage has very special features that differentiate it from other types of mortgages. Its structure is based on the premise that both lender and borrower can benefit from short-term (1-2 years) increases in housing prices. These mortgages establish explicit short-term (1-2 years) conditions for refinancing based on the appreciation of the home's value. If the borrower refuses to refinance his mortgage, he will be forced to pay higher rates and probably lose his home. At that

housing location - caused largely by official housing policy - have resulted in 5 million vacant homes (BBVA Research, 2012). This did not go unnoticed by the financial markets; shares for the Habita index, a grouping of 6 major national home builders , plummeted by over 88% between May 2008 and May 2013.

In anticipation of the new National Housing Policy enacted in February 2013 - with its emphasis on institutional coordination, increased investment in existing homes and more inner-city building, the big housing constructors' shares' were punished by the stock market. Since most of their development and land reserves are located in outlying areas of the city and depend heavily on housing subsidies, GEO's shares fell 4%; URBI 5%; Homex 2.1%; and ARA 1.3% (BBVA Research, 2013B).

All this points to the huge financial and economic risk posed by this housing finance model, which fails to properly integrate urban development. City planning requires institutions capable of vigorously controlling urban development.

point, the lender takes possession and profits by selling the home at a higher price. This type of mortgage structure greatly exposes the lender to housing prices. For further explanation regarding how these mortgages work, see Gorton (2008). **17.** This increase was calculated based on the SHF housing price index in Mexico. In 2005-I, the index had a magnitude of 81.32; for 2012-IV, it was 120.46 **18.** Altar, Geo, Home, Homex, SARE and URBI.

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18. Allar, Geo, Home, Homex, SARE and ORBI.

19. In May 2008, the Habita index reached 800.77 points, while for May 13, 2013, its high was only 90.82 points. Source: Data obtained from the Mexican Stock Exchange.



Source: Based on urban records of Eibenschutz and Goya, 2009.



TABLE 4: URBAN EXPANSION JOINT BYHOUSING, 2001-2006

Type of city	Distance to the Urban Center (km)	Distance to the Urban Boundary (km)	Percentage of Urban Expansion
Mega*	21.44	4.06	23%
Big	12.94	1.99	18%
Medium	6.66	1.41	27%
Small	5.17	1.13	28%

*Metropolitan areas Mexico City, Guadalajara and Monterrey.

Source: Prepared with planning records of Eibenschutz and Goya, 2009.

GRAPH 6: LOCATION OF HOUSING BASED ON "ÉSTA ES TU CASA" PROGRAM CRITERIA, 2011-2012. AVERAGE OF 40 MUNICIPALITIES WITH GREATEST GRANT PARTICIPATION Source: BBVA Research, 2013a.

Source: Housing Market Advances, March 2013. CONAVI.



GRAPH 7: TOTAL STOCK OF MORTGAGE-BACKED SECURITIES, 2003-2012

(Million pesos at constant 2010 prices)



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TEXT BOX 4: NATIONAL HOUSING POLICY

In February 2013, the Federal Government announced the new National Housing Policy, which focuses on containing sprawl and promoting the densification of cities. Achieving sustainable urban development, however, requires that the credits and federal grants promote the construction and purchase of better-located homes.

In this regard, the National Housing Commission approved new operating rules for federal funding for housing in late June 2013. They specify how subsidies shall be modified to improve the housing location and reduce sprawl. The new rules include Points for Location and Environmental Sustainability. The new system awards points to households based on their location and proximity to facilities and services, including density and sustainability practices in both home construction and the housing development. The subsidy granted towards the purchase price depends on both the score and the home's value. This works in a way similar to the scoring used in the Ésta es tu Casa program.

The Points for Location and Environmental Sustainability is the first effort made to promote location criteria and services for federal housing subsidies. This mechanism has proved inadequate, however, as it continues to provide grants for the purchase of homes in outlying areas. Although most grants are awarded to people of lower income households, the least expensive housing requires less location points to qualify. In this way, many more subsidies are granted to housing located on the outskirts than those in the city. This pushes low-income families to settle in outlying areas, instead of providing affordable housing options within the city. On the other hand, although greater subsidies are granted to housing with higher Location and Sustainability points, the amounts of the subsidies do not vary significantly between these scores. This discourages the construction of better-located housing.

With respect to transportation, the Location and Sustainability Score rewards proximity to mass transport and the existence of bike lanes and sidewalks. Nevertheless, this only refers to the mere presence of infrastructure, not its quality. Thus, proximity to a minibus stop gets the same rating as proximity to a subway station or BRT. In this sense, it is necessary to promote housing location near high-quality public transportation systems more vigorously, in order to ensure that low-income dwellers have access to these systems and do not require cars to get around.

Case Study Mobility and connected urban development in Copenhagen

The city of Copenhagen, Denmark is widely-known for its promotion of urban cycling; 35% of its population uses this form of transportation. This would not be possible, however, if the city had not pursued growth policies that integrated urban development and transportation.

Historically, Copenhagen has been a leader in the concept of Transit-Oriented Development. In 1947, the city implemented a development plan called FingerPlanen (Finger Plan), that concentrates city growth around five suburban trains that leave downtown. The plan selected development areas and retained green areas where the city was not allowed to expand.

This planning principle remains in effect to this day, even as the urban plan has evolved to meet changes in the Copenhagen metropolitan area and the construction of new transmission lines. One of the most important changes to the FingerPlanen occurred in 1989 with the enactment of the "Station Proximity" policy, which requires all new construction to be located within a 600 m radius of a train station. This policy also regulates the size and location of businesses to promote small city-based companies and encourage mixed-use development.

This TOD policy has provided wide accessibility to quality public transport: 57% of the population lives within a mile of a transit station. Notably, 61% of jobs are located within this same span. This policy creates disincentives for car use through the implementation of parking meters and parking quotas (for residents) as well as fewer requirements for new construction and on-street parking supply.

Only 26% of trips in the city are made in this manner, while 32% are realized in public transport. Mixed-use development, a compact and dense by-product of TOD policy, promotes travel on foot and bicycle, which comprises about 42% of trips in the city.

The national government of Denmark is a strategic actor in both metropolitan development planning and investment in transport infrastructure . In 2007, the Environmental Ministry updated the FingerPlanen and made it binding on all city planning initiatives. The government has recently invested in the development of a new area in Copenhagen called Ørestad, through the public company Ørestad Development Corporation. The different TOD areas are connected with each other and the central city via a new subway line, also built by the national government and partly funded through value capture. Previously publicly-owned lands have been developed by the agency or sold to private developers. This TOD includes universities, offices, shops and public services such as hospitals.

Sources: Knowles, 2012; LSE Cities, 2012; City of Copenhagen, 2010.



Source: City of Copenhagen, 2010.

1.3 Costs of urban expansion

Urban expansion is part of a much larger process that involves the creation of benefits including new value-added development and short-term employment. This expansion, however, has generated three types of additional costs for society: (a) taxes caused by increased demand for government infrastructure and facilities; (b) taxes on individuals in the form of increased transportation costs; and (c) negative externalities manifest by their impact on health and the environment.

All this makes it fairly clear why cities must be planned in order to contain uncontrolled growth and promote healthy development. This section analyzes the economic valuation of these costs, emphasizing that government agencies need to realize their own broad valuations based on the best information and techniques available.

1.3.1 Fiscal costs. The social costs of urban expansion are reflected in government budgets, which must cover additional public services in ever-growing areas. It is far cheaper to provide services in denser locales than more extensive areas with widely-dispersed housing that require additional physical infrastructure.

For example, Bunchel et al. (2005) has estimated that the cost of urban expansion in the U.S. between 2000 and 2025 could reach 1.12 trillion dollars without development restrictions; and this only takes into account infrastructure construction.

In the case of Mexico, SEDESOL (2012b) conducted an analysis of two scenarios, one of urban expansion and another of controlled ²⁰ agrowth up to 2040 for the city of Los Cabos, Baja California. The analysis estimated that urban expansion increased the construction and maintenance costs for infrastructure and installations by 40%. It is important to note that 64% of these costs would cover road construction and maintenance, whereas in the planned development scenario, this percentage would be only 34%.

Using figures provided by SEDESOL (2012a), we can forecast the costs involved in providing infrastructure for Mexican cities with over 50,000 inhabitants up until 2030²¹. This could involve either of two scenarios:

21. The methodology used by SEDESOL (2012b) has not been updated since the change in road infrastructure and installations requirements from the original

• **Baseline:** This scenario implies an average yearly reduction of population density of 5.42% and an urban pattern focused mostly on car use (40% of land area intended for streets - 20% primary roads and 80% secondary roads).

• **Control Scenario:** Based on a conservative assumption of stable population density (2010-2030) and an urban development pattern focused on sustainable mobility (25% of land area intended for streets, of which only 8% are primary roads), and the inclusion of BRT systems and bike paths, depending on the type of city. (see Annex 1 for more details).

The results indicate that the costs of providing infrastructure and installations in Mexican cities given the current trend of urban expansion to 2030 would be approximately 51.5 billion pesos. They again emphasize the costs of new roads, both in terms of infrastructure and maintenance, which would amount to about 87% of the total in the expansion scenario.

If this expansion is controlled, however, through a better urban model and sustainable mobility, the investment required would be only about 2.3 billion pesos, even with massive investment in transport systems.

This analysis suggests that uncontrolled urban expansion is costly both for public finances and, as a result, for taxpayers. Given local governments' dependency on federal transfers and subsidies, this situation only increases the pressure on the nation's finances. If we wish to implement social policies that help reduce inequalities and increase sustainability and economic development, the cost of uncontrolled urban expansion is undesirable.

1.3.2 Impact on consumers. The uncontrolled expansion of cities has a direct impact on the welfare of Mexican families and individuals, as longer commutes to work increase transport costs and divert disposable income from other pressing needs.

Merino (2012) notes that during the period 2000-2010, only 30% of higher-income households decreased their spending on transportation, whereas spending in the remaining households increased. We must emphasize that in lower income households, spending on transportation increased by 78%, much of this for car purchases. In 2000,

development proposal.

22. It is estimated that families spend an average 15% of their income on transportation that, in most parts of the country, is considered low quality (ITDP, 2012a).

^{20.} The vision scenario involves the development of 45% less land area than the baseline scenario.

Source: SEDESOL, 2012b.

TABLE 5: CONSTRUCTION AND MAINTENANCE COSTS TO 2040 FOR DIFFERENT URBAN EXPANSION SCENARIOS FOR LOS CABOS, BAJA CALIFORNIA (millions of pesos)

	BASELINE SCENARIO		VISION	PERCENTAGE	
	CONSTRUCTION	MAINTENANCE	CONSTRUCTION	MAINTENANCE	DIFFERENCE
Roads	194,710	3	64,213	1	-67%
Public transportation	0	0	3,973	0	
Water	9,160	2,290	2,966	742	-85%
Drainage	15,363	3,841	4,975	1,244	-85%
Energy	200	0	91	0	-54%
Public lighting	3,544	416	1,562	173	-64%
Education	3,772	0	2,434	0	-35%
Urban services	7,025	0	4,626	0	-34%
Health	411	0	191	0	-54%
Recreation	72,300	1,196	103,849	969	+43%
Total	306,485	7,790	188,879	3,127	-40%

TABLE 6: ESTIMATE OF CONSTRUCTION AND MAINTENANCE COSTS TO 2030 FOR CITIES WITH OVER 50,000 INHABITANTS (millions of pesos)

Source: Authors

	BASELINE SCENARIO		CONTROL SCENARIO	
	CONSTRUCTION	MAINTENANCE	CONSTRUCTION	MAINTENANCE
VMMA	3,837.93	60.52	187.13	3.18
1 million to 4,999,999	11,904.45	187.71	501.75	8.27
500 thousand to 999,999	9,197.53	145.03	497.36	7.92
100 thousand to 499,999	21,044.33	331.83	762.54	12.71
50 thousand to 99,999	5,597.74	88.27	426.12	7.64
Total	51,581.98	813.35	2,374.91	39.72

only 4.5% of these households had a car; by 2010, this percentage had increased to 16.4%. At the same time, food poverty increased from 7.1% to 18.4%.

Evidence suggests that transport spending increases have been fueled by housing policies implemented by the last two administrations. Eibenschutz and Goya (2009) show that, among those who bought homes in housing developments, average car use increased by 8% relative to their previous residence. Some increases, however, range between 10% to 12%, depending on the trip-motive. There was an 11% increase in car trips needed to purchase food, necessities and medical appointments, as well as trips made to friends' homes and places of worship; and a 10% increase for administrative proceedings (see Graph 8).

Similarly, the National Survey of Household Income and Expenditure (ENIGH, 2012) indicates that residents of new housing developments require more than twice the amount of transit time to access health facilities than residents of properties older than 11 years (21 min vs. 9.6 min). All this suggests that residents of recently-built housing developments no longer have ready access to basic goods and services, facilities and social interactions without a car.

23. The gas subsidy is mainly concentrated in these deciles (see Medina 2012a and 2012b).

Similarly, Eibenschutz and Goya (2009) found that 43% of residents in these housing units had increased their transportation expenses. Analysis of data of the National Household Income and Expenditure Survey 2010 and 2012 show that the average household expenditure of individuals who had purchased housing after 2001 (year when the current housing policies were implemented) exceeded the disposable income expenditure of those already with homes by an extra 3%.

If we add finance changes and housing repair costs to transportation, this represents an average of 32% of disposable household income in 2012. In order to avoid falling into default or endangering their economic welfare, national standards suggest that families should not borrow more than 30% of their income (CONDUSEF, 2009). Given the cost of transportation, the above suggests that housing policy and urban expansion results in additional financial stress for the average family, negatively affecting their economic well-being both in the short and long terms.

9.6 min). All this suggests that residents of recently-built housing
developments no longer have ready access to basic goods and servi-
ces, facilities and social interactions without a car.For this reason, it is not surprising that 31% of homes funded by
INFONAVIT are unoccupied, mostly for reasons related to location
(INFONAVIT, 2011). In these cases, economics is not the only issue;

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GRAPH 8: PRIOR AND CURRENT CAR USE BY TRIP-MOTIVE FOR HOUSING DEVELOPMENT RESIDENTS, 1996-2006 (percentages)



Source: Eibenschutz and Goya, 2009.

buyers also take into account transportation, as time is a major factor in the well-being of their families..

1.3.3 Social costs: negative externalities. The social costs of urban expansion are difficult to quantify, as these include negative externalities such as the loss of ecosystem services and biodiversity in urbanized areas²⁴, waste generation, water pollution, etc. As this paper notes, urban expansion also generates negative externalities with respect to transportation, especially car use.

An evaluation of these costs surpasses the scope of this document. There is sufficient evidence, however, to suggest that urban expansion significantly increases car use, both in terms of kilometers traveled and percentage of total trips (see Graph 9 and 10). As cities become more dispersed, public transport is unable to reach many vital locations; accessibility to goods and services, work, family, etc. is inhibited, and the volume and frequency of car trips increase. This relation has been well-documented. The PNUMA (2011) reports that more highly compact city models have lower car use, while more extended and diffuse cities have higher per-person rates, as in the case of U.S. and Canadian cities.

The evidence for Mexico is also clear. Analysis of transit times shows that inhabitants of higher-density residential areas, i.e., subsidized housing developments, have higher transit times in cars than those living in smaller developments (e.g. apartment buildings) located in downtown areas.²⁵ This is mainly due to the fact that large housing developments are located in outlying areas of the city. **Figures 2**, **3** and **4** show transit times for the metropolitan areas of the Valley of Mexico, Guadalajara and Monterrey.

24. For more in-depth information regarding the effect of urbanization on biodiversity and environmental services, see the Ministry of the Convention of Biological Diversity (2012 and 2013).

25. See Annex 2 for calculation methodology.



TABLE 7: HOUSEHOLD SPENDING ON HOUSING ANDTRANSPORTATION, 2010-2012

Source: Authors' calculation based on data from the ENIGH

	OWN HOME, BUT ARE PAYING		OWN HOME	
	2010	2012	2010	2012
Average home cost (payment for house and maintenance)	6,462	7,309	386	317
Average amount spent on housing and transport	13,061	14,968	5,823	6,645
Percentage of income spent on housing and transport	34.8%	32.26%	16.10%	15.99%

GRAPH 9: URBAN DENSITY AND PERCENTAGE OF CAR USE AS TOTAL TRIPS IN DIFFERENT CITIES OF THE WORLD

Source: Medina, 2012a



GRAPH 10: URBAN DENSITY AND VEHICLE-KILOMETERS TRAVELED PER CAPITA IN DIFFERENT CITIES OF THE WORLD







Increased car use from dispersion also increases social costs resulting from additional car use (e.g., greenhouse gases, accidents, congestion, noise, emissions criteria, among others) that represents up to 4% of the GDP of Mexican cities (Medina, 2012a and 2012b). This is a conservative figure considering that other estimates calculate congestion costs alone as representing 3% of GDP for Latin American and Caribbean cities with over 100,000 inhabitants (Bull, 2003). Even the World Bank (2002) estimates that the negative externalities of car use as a whole exceed 5% of GDP.

In the case of worldwide greenhouse gases emissions²⁶ (GHG), for example, it is estimated that urban areas generate 40% to 70% of all emissions (UN-HABITAT, 2011). Much of these emissions are due to the 1.2 billion private cars located mainly in cities and which generate 13% of total GHG emissions (UN-HABITAT, 2011). Mexico is no exception; the nation's nearly 21 million private cars in circulation produce 18% of the country's GHG emissions (Galindo, 2009). This is reflected in higher energy consumption and higher GHG emissions, as seen in Graph 11.

Finally, it is clear that increased car use due to urban expansion can nullify benefits gained from energy efficiency measures implemented for vehicles, resulting in increased GHG emissions (Ewing et al. 2007); as well as the "rebound"²⁷ effect of energy efficiency measured for cars (Small & Van Dender, 2006). In this sense, the recent energy efficiency policy adopted in Mexico for new cars²⁸ will have limited effects; as a result, the country shall require urban development strategies and demand management to achieve consistent long-term reductions in GHG emissions.

26. These greenhouse gas emissions contribute to global warming, including carbon dioxide (CO_2) , methane (CH_4) , nitrous oxide (N_2O) and ozone (O_3) . **27.** The rebound effect refers to how the benefits of improved energy efficiency in motor vehicles can be offset by lower gas prices and, as a consequence, increased car use. See Greene (1992) for additional explanation and evidence. **28.** Mexican Official Standard NOM-163-SEMARNAT-ENER-SCFI-2013, Carbon dioxide (CO₂) emissions from the exhaust and its equivalent in terms of fuel efficiency, applicable to new motor vehicles with a gross vehicle weight up to 3,857 kilograms. ILLUSTRATION 2: TRAVEL TIMES BY CAR TO TWO DIFFERENT HOUSING DEVELOPMENTS BUILT IN THE

Source: Softec Consultoría de Proyectos Inmobiliarios.



ILLUSTRATION 3: TRAVEL TIMES BY CAR TO DIFFERENT HOUSING DEVELOPMENTS BUILT IN THE MTYMA AFTER 2005

Source: Softec Consultoría de Proyectos Inmobiliarios.

SYMBOLOGY







Economic

Social



Source: World Bank, 2010.



Case Study Curitiba, BRT and transit-oriented development

In 1966, the Institute for Research and Urban Planning of Curitiba, published the Master Plan for the city. The goal of city planning was to promote the gradual creation of activities and jobs in areas away from downtown and inner-city locations. Five structural corridors that leave downtown were created in order to achieve this. A high concentration of housing, shops and services are planned for these corridors. As a result, innovative mass transit lanes were placed along these corridors. This was realized as a way to reduce car use through road space restriction.

The density along these corridors is the highest in the city; new growth is already planned in these areas. These corridors will permit an occupation rate of 6 - without any building height limit.

These corridors shall also promote mixed commercial use, offices, businesses and housing. In fact, the city bought land and built affordable housing along these corridors and near industries to ensure that low-income people have access to public transport and jobs. These homes were subsidized by the government and designed to integrate low-income housing in areas with residential uses. In this way, the Curitiba government built housing for 17,000 families.

The integrated Curitiba bus network covers 90% of the city's area, ensuring that inhabitants do not walk more than 500 m to access public transport. Approximately 28% of homes in the city are located

along these hubs. Despite having one of the highest car ownership rates in Brazil (668 vehicles per 1,000 inhabitants), this model permits Curitiba to boast relatively low car use (only 22% of total trips).

In Curitiba, the active role assumed by the government was critical in establishing the direction of the TOD model through the Master Plan, which mapped the city's transport planning and growth to discourage car use. In addition to mass transit infrastructure, investment was also realized in consolidating and expanding the integrated transport network and building affordable housing. All this was accompanied by regulations in relation to land use, building density and height that promoted urban development along the transport corridors.

Sources: Rabinovitch, 1996; Smith and Raemaekers, 1998; IPPUC, 2011; Suzuki, et. al., 2010.



Source: Suzuki, et. al., 2010.



Three-way road system

2. TOWARDS URBAN DEVELOPMENT BASED ON SUSTAINABLE MOBILITY TOD

Up to now, national urban development policies have not yet taken into account mobility, which is why urban expansion has incurred significant social and environmental costs. Given this fact, it is necessary to rethink urban development so that it promotes inclusive, equitable and sustainable mobility for urban dwellers. This means that urban development must be reoriented towards models and strategies in which walking, cycling and public transport are key elements. This is known as Transit-Oriented Development.

Although TOD is an integral part of urban development planning, it is not the only tool available. Although cities may expand their land holdings, this must be done under proper planning principles to reduce the negative effects of urban sprawl. Ewing et al. (2007) shows how the U.S. can reduce GHG emissions to 2050 from 7% to 10% using intelligent growth planning strategies, which means concentrating and densifying cities. Based on a conservative expansion estimate, CTS-World Bank (2008) determined that a densification program in Mexico would reduce emissions by up to 117 MtCO2e, 11,800 tons of PM2.5 and 855,000 tons of NOx to 2030 just in the transport sector.

Similarly, it is important to clarify that pollution reduction is not the only benefit of the TOD, as other benefits accrue (e.g., economic development, accident reduction, etc.) if this strategy is properly applied.

2.1 Transit-Oriented Development (TOD)

Transit-Oriented Development (TOD) seeks to build urban neighborhoods around mass transit hubs. A TOD strategy takes into account certain elements of a neighborhood's infrastructure including bus stations, BRT's or subways surrounded by compact development, high-density populations and quality pedestrian and bicycle paths. Although this type of development is normally built around new transit stations, it also includes renovations made in areas with preexisting stations.

Hickey (2013) notes that a TOD requires high-density population, infrastructure investment, diverse-income level housing, employment opportunities and amenities within walking distance of public transit. Affordability is achieved when investment benefits all income levels equally. Proximity to mass transit is essential to the TOD; stations are normally located at a distance not exceeding 800 meters in order to promote walking and other non-motorized forms of transport. Access to public transport, however, does not guarantee a TOD's success. According to Chatman (2013), other essential features include the construction or presence of small housing units (rented or owned); a lower availability of parking (both on- and off-street) with plentiful bus service, jobs, housing and shops within walking distance; proximity to downtown areas; and high density of jobs in the region. Along with densification, mixed-use development and high pedestrian access to goods and services, a TOD also includes disincentives for car use.

In this way, the TOD can lessen the need to travel long distances to purchase goods and services as well as help reduce car use and road congestion. This strategy helps promote the use of sustainable transport modes and reduces the emission of pollutants that damage air quality and cause global warming. By promoting compact and dense development, the TOD increases land use efficiency. Other benefits include improved road safety, increased public space and enhanced livability, as well as the promotion of local business development and urban renewal.

2.2 TOD Benefits of Transit-Oriented Development

It's important to realize that there are several benefits of TOD that are closely interconnected, which means that in order for one to take place, another must first occur. In this sense, one must first understand the implications of these benefits and transmission mechanisms prior to realizing the TOD so that each element may be properly evaluated to achieve maximum social benefit.

Given Mexico's lack of TOD experience and the fact that no national studies are currently available, international references have been used as an illustration, principally the Transportation Research Board (TCRP, 2004) which provides a summary based on experience in the U.S. These have been classified into primary and secondary benefits, with the former determining the latter. Below are explanations of each benefit group, with some additional references added to complement the summary set forth in TRCP (2004).

There are 6 main in total:

1. in passenger transport systems. In cities where the TOD has been implemented, a significant percentage of the population lives and works near transit stations, which increases the chances that inhabitants use these systems. In Copenhagen, for example, 57% of





the population lives within 1 km or less of a station; while in Hong Kong, this percentage is 75%. This is the main benefit generated by the TOD, from which most other benefits arise and are reflected in higher per ticket revenue for public transport systems, thus ensuring their financial viability. In this respect, no adequate references currently exist for Mexico, given that this approach has not been applied to urban development in our country. Even so, references regarding the U.S. have shown the following benefits (TCRP, 2004):

- **a.** Doubling the population density around public transport hubs increases passenger number by 60%.
- **b.** There are between 5% to 10% more passengers in mixed-use areas with a diverse population.
- **c.** There are 20% more passengers in stations that have areas with a walkable urban grid.
- **d.** The probability of using public transport increases 5 times with shorter distances to transit stations.

2. Joint government-private sector developments. In this arrangement, private developers cover either wholly or in part the infrastructure and operations costs, allowing significant savings by the government. This increases the viability of value capture techniques, including new property taxes that allow the government to fund additional public works (TCRP, 2004). In this sense, Hong Kong is emblematic, as the public-private company MTRC has been able to finance the subway system's infrastructure solely by means of the value capture of properties developed near public transport hubs (see Hong Kong Case Study). ²⁹

3. Neighborhood revitalization. In any given area, the TOD projects can be catalysts for change if they are properly implemented and linked to other public policies with respect to employment, housing, security, etc.. It should be noted that the increased use of public transport does not by itself revitalize a city neighborhood or area. This requires an urban intervention plan and social policy designed to rejuvenate obsolescent or depressed areas. This is clear in the case of Medellin and its Metro-cable ³⁰, which involved the implementation of social policies such as micro-credits, housing and cultural programs aimed at reducing poverty in neighborhoods along public transport corridors (Davila, 2012).

4. Growth generation and economic development. Good TOD development can trigger economic growth and development ³¹, attract investment, create jobs and increase sales of businesses located in the TOD area (TRCP, 2004). It should also be noted that the TOD, depending on its focus, can generate better jobs and mobility options that enable a fairer distribution of wealth and increased economic development. On the contrary, economic growth will have only limited impact on the population. Boosting economic development occurs when the TOD is designed to provide affordable housing, public

29. Other references can be consulted in Medina (2013).

30. This is a mass transit system based on an aerial cable of a type of cable car.

space, cultural and commercial uses as well as specialized sectors (e.g., technology). .³²

5. Increased affordable housing. A TOD can help stimulate affordable and/or low-cost housing in three ways: First, vertical building and higher-density housing can help reduce housing costs. Second, a reduction in car dependency lessens the need for parking facilities, thereby increasing land area available for housing and lowering housing costs. In the U.S., this reduction has been estimated at 16% of the cost of housing (TCRP, 2004). Third, a reduction in transportation costs, especially by car, can free up resources for other needs, such as mortgage payments. This reduction will vary depending on the cost structure of each country and city. It is also possible to explicitly realize low-cost housing construction along transportation corridors. For example, the Curitiba government bought land along BRT corridors which it then earmarked solely for this purpose. In this way, additional housing was provided for 17,000 families (see Case Study of Curitiba, Brazil).

6. Increased land values, rents and investment returns on property. Location and accessibility are fundamental reasons for differences in land value between different areas. In the U.S., premiums ranging from 25% to 100% have been reported on properties located in TOD developments (TCRP, 2004). Plamucini Agostini (2008) estimate that properties located in the vicinity of the Santiago subway station are on average higher than the rest of the city. Using econometric meta-analysis, Debrezion et al. (2007) found that commercial properties near train and subway stations are on average 12.2% more costly than in residential areas.

There are 10 additional "secondary" benefits of Transit-Oriented Development that stem directly from the primary benefits.

I. Diminished car use leads to a reduction in negative externalities, including : environmental pollution, greenhouse gas emissions (GHG), road congestion, noise, accidents, breakdown of social ties, among others. This reduction is achieved by increased use of public and non-motorized transport.

a. Litman (2011) estimates a 4% reduction in car use in cities with good subway systems or passenger trains as a result of two factors: (a) increased motivation to switch to public



31. It is important to differentiate between economic growth and development. The former implies a rise in economic activity due to increased generation of value-added opportunities - not distribution. Economic development, on the other hand, occurs when new wealth generation creates a relatively more equitable distribution of wealth, leading to improved living standards for the entire population.

32. For more specific examples of projects aimed at generating international economic development, see Medina (2013).

transport; and (b) reduced car ownership among families living near the stations.

b. Bento et al. (2003) estimated that a 10% increase in the subway system network reduces car use by 4.2% in the U.S.
c. Ewing et al. (2008) notes that in neighborhoods with decent access to public transport, residents reduce their miles traveled by car from 20% to 40%.

d. In the case of Curitiba, Brazil, an urban leader in TOD implementation, people drive 50% less compared to Brasilia, known for its car-oriented road infrastructure (Santos, 2011). In general, this type of development generates 50% less CO2 emissions (Magalhães, 2009).

II. Reduced costs of roads and other infrastructure. Restricted city expansion can result in a short-term reduction of 25% in the costs of providing roads, water, drainage and other infrastructure (TCRP, 2004).

III. Increased retail sales. This benefit derives from an increase in commuter foot traffic, higher-density housing and the TOD itself (TRCP, 2004). This increase may vary and depends on the type of business established in the development.

IV. Reduction of urban expansion and space conservation. Urban expansion absorbs lands with ecological value, either for the environmental services they provide or food production. Building high-density housing near public transport corridors reduces this effect: as a result of their inner-city location, compact developments occupy 60% to 90% less space than their expanded counterparts (TCRP, 2004).

V.Crime reduction. This effect is produced by concentrating public safety services in a smaller area (TRCP, 2004). In addition, more street life and renovated public spaces increase the presence of "eyes" upon the streets, thereby increasing surveillance and reducing the probability of crime. Jacobs (1961:44) notes that "this is something that everyone knows: a well-used city street is apt to be a safe street. A deserted city street is apt to be unsafe".

VI. Increased capital stock and public participation. It has been estimated that for every 10% reduction in driving time, there is a 10% increase in civic participation (Putnam, 2000).

VII. Increased tax collection. With the TOD, a small area is capable of generating significant local taxes, including property taxes, resulting in an improvement in the city's public finances. This does not occur, however, when expansion involves several local municipalities, as additional revenues must then be divided among various

administrations, reducing the efficiency of both tax collection and public spending (TRCP, 2004).

VIII. Cost reduction in the construction of parking facilities. The TOD often reduces or renders unnecessary the need for parking, as people get around mainly by walking, cycling and public transport. Removing parking spaces can reduce construction costs by up to 16% (TCRP, 2004).

IX. Increased physical activity. Residents who live or work in a TOD generally increase their physical activity by walking or cycling to get to public transport in the same development. This has significant health benefits, as TOD residents are 10% less likely to be obese compared to people living in extended developments. This results in lower public health costs associated with obesity (TCRP, 2004).

X. Increased access to human resources. Companies benefit from being close to public transport, as their employees can get to their jobs more quickly, helping to reduce both stress and fatigue. In Hong Kong, for example, 84% of jobs are located 1 km or less from transit stations; while in Copenhagen, this figure is about 61% (see Case Studies of Hong Kong and Copenhagen). As a result, companies benefit from higher labor productivity; lower costs due to their proximity to other businesses; less traffic congestion; and less need for parking spaces (Sadler and Wampler, 2013).





revenue growth of public transport and non-motorized

1.Passenger and

2.Opportunities for joint developments

ILLUSTRATION 5: BENEFITS OF TRANSIT-ORIENTED DEVELOPMENT

Notes:

* Private benefits. The remaining benefits are public. The values in brackets indicate the source of primary or secondary benefits Source: Based on TCRP, 2004. 3.Neighborhood revitalization

4.Economic development

5.Increase affordable housing

6.Increase in land values, rentals and property performance



Case Study TOD Policy for Hong Kong

The TOD model for Hong Kong is internationally-recognized for its focus on the joint development of urban rail systems and real estate. Real estate development is realized whenever a transit station is built, so that development gains are used to fund infrastructure costs. In this way, public transport is provided in Hong Kong without the need for excess public expenditure. At the same time, this model creates highly accessible transport nodes with diverse uses and attractions, which encourages residents, employees and consumers to use public transport.

The Hong Kong subway system in administered by the Mass Transit Railway Corporation (MTRC), a joint venture in which the Hong Kong transportation department is the largest shareholder. The MTRC also engages in real estate development around transit stations, including design, construction and (sometimes) property management.

The MTRC is a for-profit corporation listed on the Hong Kong stock exchange; as a result, it receives no government subsidies. Instead, it uses value capture to finance investment in subway systems. The Hong Kong government grants land to MTRC at low prices and gives them exclusive development rights. MTRC then sells these rights to private developers at much higher prices (considering that land prices will rise significantly once a subway stop is built). The company also negotiates a share in future profits arising from real estate development.

MTRC has developed twenty-five stations located in long underground housing, shopping and entertainment complexes that include 70,000 residential units and 15 million cubic meters of retail space. MTR also owns 12 shopping centers, 5 office buildings and co-owns the 88-story International Financial Center skyscraper.

This TOD model has resulted in a high population density: 6,480 people per square kilometer. Most inhabitants live near public transport: 75% of the population, or about 5 million people, live within a

mile of a subway station, and 43% live even closer, within 500 m (or less) of a station. This density around transit stations ensures that the majority of Hong Kong residents regularly use public transport, representing 90% of all motorized travel. Taken together, proximity to transit stations and mixed land use encourage residents to walk and cycle, representing 38% of total trips.

The government plays a critical role in the Hong Kong TOD model. On the one hand, land holdings give the government direct control over how plans are developed. On the other hand, the city has a clear vision of how it wants to grow. The vision and planning strategy for Hong Kong up until 2030 includes strategy development around the subway system and a commitment to prioritize development in outlying areas which are already urbanized. In addition, the city owns 78% of MTRC stock, giving it the right not only to direct transportation policy and urban development, but directly participate in its implementation and construction.

The Hong Kong government has enacted regulations that encourage high density growth in areas surrounding subway stations, including a required occupancy rate of up to 9. At the same time, it applies restrictive car ownership measures such as a high registration tax and annual ownership fee. This has led to a car ownership rate of 63 cars per 1,000 inhabitants; the result of a truly integrated mobility policy that prioritizes public transport.

Source: LSE Cities, 2012; Cervero and Murakami, 2008; Medina, 2013; Hong Kong Transportation Department, 2013; Lerner, 2011.



Case Study TOD policy for Denver

In 2000, it was estimated that Denver would receive an additional one million inhabitants over the next 20 years, i.e, its population would grow by 33%. For this reason, the Metro Vision 2020 plan was established for the Denver metropolitan area, a proposal to limit urban growth and expand the transportation system through the construction of 220 new subway and BRT kilometers and 57 new stations. In addition, the city proposed the Blueprint Denver plan, which adopts the TOD as an organizing principle for growth around new subway lines, both within the city and its suburbs.

The Denver Regional Transportation District ("RTD") is the public agency responsible for the operation of existing public transport as well as new building under the Metropolitan Vision 2020 plan. The RTD also plays a key role within the TOD for policy coordination at the metropolitan level, as well as collaboration with other local governments for proper planning of areas adjacent to stations. RTD owns the stations and in some cases adjoining properties. It often works in partnership to develop land areas around stations; rent properties; and even sell land to developers.

Working jointly to develop a better transport system, the city government adopted major zoning changes by increasing densities allowed in the transport corridors. These Mixed Use and Transportation areas (MUT) include all properties within a 2.4 kilometer radius from a transit station. Construction in these areas will permit a height of 67 meters (42 meters were previously allowed) and occupation rates of 5. There will also be a 25% reduction in parking requirements - which may be increased to 50% depending on the area's characteristics. The plan also promotes the creation of public spaces around transit stations. Until now, under the efforts of TOD, the Denver government has built more than 24 thousand residential units near the stations, 464,000 square meters of retail space, 557,000 square meters of office space as well as areas for cultural, educational, medical and government activities. By 2020, officials expect that approximately 30% of the general population and 70% of jobs will be located within 1.6 km (one mile) of a transit station (representing, in aggregate, an area equivalent to 9% of the city). If this prediction comes true, the city's density will likely increase (currently it is only 1,581 inhabitants per km 2), as well as the percentage of people who walk, ride their bikes and travel in public transport. Only 13% of the population currently use these forms of transport.

The Denver Metropolitan Planning Council - along with local residents and the financial support of federal agencies - jointly built a vision for the city based upon the Metropolitan Vision 2020 and Blueprint Denver plans. The government's main role in Denver's TOD model has been to finance expansion of the transport system through a 0.4% tax on the sales of daily consumer products. Similarly, the government created the RTD as an institutional body in charge of coordinating TOD policy with local governments in order to facilitate its implementation.

Sources: Picard, 2010; RTD FasTracks, 2010, 2013; TCRP, 2004; U.S. Census Bureau, 2009.





3. HOW FEDERAL POLICY CAN PROMOTE TOD

Responsibility for TOD project development corresponds more to cities and metropolitan areas than the federal government. The latter, however, may also play a key role in promoting TOD through smart urban development policies and federal funding. This suggests two possible strategies: (a) restricting incentives for city expansion; and (b) promoting TODs.

3.1 Limiting incentives for urban expansion

Modify urban planning to include mobility as a guiding principle

In order to give city planning its rightful place in the context of Mexico's sustainable economic development, urban planning must be coordinated, not subordinated, to economic development planning. Similarly, mobility must be included in city planning and housing as the backbone of urban development. Cities that have successfully implemented TOD have done so thanks to integrated and long-term planning efforts based on urban development principles and mobility, both on the national and local level: Copenhagen has Fingerplanen; Curitiba, the Master Plan; Denver, the Metropolitan Vision and Blueprint Denver; and Hong Kong has Hong Kong 2030: Planning Vision and Strategy.

Update urban development plans at least every six years with performance benchmarks.

Every new urban planning system must include an obligation to update development plans at least every six years with performance benchmarks; appointment of supervisors; and sanctions for noncompliance, including limiting access to federal funds.

This may fit within the proposed reform to the General Law of Human Settlements and Land Management, to provide the foundations for reusing land in city downtown areas and encouraging coordination between various levels of government to facilitate urban planning in different metropolitan areas of the country. This would help in the management of urban sprawl and implementation of TOD strategies.

Modify national housing policy to include location criteria.

National housing policy must be changed to include incentives based on the following criteria:

•Mortgages granted by government agencies should take into account two factors: transportation costs and accessibility to housing developments. Households with increased accessibility by means of walking and public transport are less likely to default on mortgages (Rauterkus et al., 2010), while the probability of default increases with closer proximity to urban highways. ³³

•Bridge loans for the construction of housing developments should require location and accessibility criteria in order to prevent urban sprawl. Achieving this will require strengthening the "Financing and Federal Housing Grant Program Regulations" to provide greater incentives for housing developments built within the city. In this sense, it is necessary to more vigorously promote locations near quality public transport systems to ensure that low-income residents have access to these systems and do not require cars to get around.

•Encourage developments to include a mix of high and middle income housing, including rentals, and reward such a mix with federal grants. For example, in Massachusetts, U.S., a recently enacted law (Massachusetts Comprehensive Permit Law (Chapter 40B) encourages new housing developments to include low-income housing, either for rent or sale, with this often comprising up to 25% of homes built..

The above should be reflected in securitized mortgage loans with a risk premium based on their location and accessibility. The more remote and inaccessible, the lower the credit rating.

Encourage housing rentals in cities.

Fiscal policies that promote housing rentals in cities, as not everyone wants or can afford to buy a home. Governments must face the fact that millions of individuals and families will rent homes for their entire lives (UN-HABITAT 2003:3). This means that household income must be considered an important factor in housing policy and must be analyzed, studied and applied as such for a country with Mexico's poverty and needs. This may well include grants for the construction of rental units, maintenance or rent payments in order to achieve affordable housing (World Bank, 2013). Increased

33. Haas et al. (2013) notes that accessibility to housing and public transport are essential to reducing credit risk. Meanwhile, Pivo (2013) states that default risks vary with the characteristics of household sustainability. For example, in neighborhoods where 30% of the population use the subway, the probability of default is reduced by 6 4 4.1%; and for every 5% of people who walk to work, the probability decreases

15%. Similarly, each 10-minute increase in home-to-work travel time increases the mortgage default risk by 45%. In contrast, the presence of urban highways in the neighborhood increases default probability by 59%.

rental housing units can ensure that low-income residents live near employment centers.

Manage land on the city outskirts

A strong land management policy on the city's outskirts, ranging from incentives to avoid development in these areas, outright prohibitions and the creation of land reserves through purchase and land expropriation. Without this element, it will be simply unrealistic to contain urban sprawl. Since it owns the land, the Hong Kong government has managed to control urban expansion. In this way, the city's growth is bound to a larger vision that preserves green areas as national parks or simply prohibits development.

Include urban expansion and traffic congestion in the Environmental Impact Statement.

It is indispensable for all works that impact public areas to have an Environmental Impact Statement (EIS) and show that the project doesn't promote urban sprawl or traffic congestion. The notable difference here is that developers conform to an urban development plan that prioritizes public transport. This applies to all infrastructure, from roads and airports to tourist development. Similarly, EIS's must soon start applying environmental valuation criteria in relation to ecosystems and biodiversity. Although these measures may be beyond the scope of local governments, the federal government through SEMARNAT can prepare economic criteria that measure the costs of urban expansion.

Modify divestiture mechanisms of ejido land to require that they conform to urban development plans.

Article 87 of the Agrarian Law states that **ejidos** can benefit from land development in accordance with the growth of population centers. This provision should be reviewed and modified to help limit uncontrolled urban expansion, as local urban development plans are often either non-existent or out-of-date. At the same time, we must strengthen payment programs for environmental services in outlying urban areas, giving higher scores to places more likely to be developed in order to limit urban expansion and encourage conservation of natural areas on the city's outskirts.

Redirect public funding to public and non-motorized transport

A more integral financing policy for urban mobility requires that the SHCP change the Operating Regulations for federal funds that **34.** During the second half of the twentieth century In the U.S., there was a strong impulse to build urban highways and Interstates. The result was a dramatic increase in vehicle miles traveled from 570 billion miles in 1970 to 1.73 trillion miles in 2002, resulting in increased total car emissions (U.S. PIRG Education Fund, 2004) Road expansion also changed motorists' behavior, inducing more trips; land use also currently fund mobility projects to ensure consideration of sustainable urban mobility projects. On the other hand, SHCP must require the inclusion of negative externalities and co-benefits in the costbenefit analysis of investment projects in order to facilitate a comprehensive evaluation.

On the other hand, establish a moratorium (including financing) on large road projects such as highways and distributor roads in metro areas, as these types of projects tend to increase car use and urban sprawl. (Downs, 1992) . As the data clearly shows, more urban highways and roads do not diminish traffic congestion and pollution; on the contrary, they encourage urban sprawl. In many cities including San Francisco, New York, Boston, Berlin and Seoul, freeways are being demolished to build public spaces and streets are being converted to prioritize pedestrian traffic over cars (ITDP-EMBARQ, 2012).

3.2 How to promote Transit Oriented Development at the federal level?

Strengthen the Agrarian, Land and Urban Development Ministry

The newly created Agrarian, Land and Urban Development Ministry replaces the former Department of Agrarian Reform and absorbs the functions of the undersecretary of urban development and land use of SEDESOL. In addition, the Ministry takes the lead in housing policy, directing policies established by the National Housing Commission (CONAVI), the Commission for the Regularization of Land Tenure (CORETT) and INFONAVIT. In this way, SEDATU becomes a federal level institution with faculties to comprehensively plan land, urban development and housing policies. It will still be necessary to redefine the Ministry's internal rules to give it the powers and institutional framework it needs in regard to sustainable urban mobility. Given its role in the Habitat and Public Space Rescue programs, it has ample experience in public works and investment in pedestrian and bicycle mobility. It is also essential to give more funds to the SEDATU so it can better promote Transit-Oriented Development.

shifted, leading to greater city expansion. Studies show that a 99.9% correlation exists between cities with higher urban road capacity and excess pollution levels (U.S. PIRG Education Fund, 2004).

Case Study Attracting urban development: the case for high quality BRT

In a recent ITDP study, 13 American cities and 20 transport corridors with BRT (Bus Rapid Transit) and light rail were studied to understand the effect of these systems on the development of real estate near the transport corridors.

Investment in new urban transport systems, both BRT and light rail, can help facilitate Transit-Oriented Development (TOD) and urban renewal. Investment in transport systems, however, will not by itself attract urban development. The most important factor for a successful TOD are transport corridors located in areas with high development potential, particularly in urban centers. This is obvious, as private investment does not gravitate to areas with little or no economic activity. Although the government can intervene to promote development in these areas, it requires more significant intervention. Emerging areas have greater potential, but do not provide short-term returns. This said, limited government intervention has the potential of significantly promoting real estate development. In high-potential areas, the government can require developers to make environmental improvements such as pedestrian and bicycle infrastructure in exchange for zoning development tweaks. These high-potential areas are usually located in urban centers or places with historical attractions.

The construction of transport systems should be in areas where demand already exists or the city will develop in the coming years. Achieving this requires a strong link between transport planning and urban development. This is why integrated mobility planning is so important in both cities and metropolitan areas.

The study also found that local governments willing to change zoning, finance development or collaborate with developers to facilitate planning around stations managed to attract more investment to the TOD. The same occurred when governments established regional planning bodies. The lesson is that government intervention is necessary to achieve a successful Transit-Oriented Development, especially with respect to policy planning and attracting private investment.

We therefore recommend that in areas with limited or slow development potential, the government encourage the following actions:

Appoint an agency responsible for urban renewal. An authority whose sole responsibility is to attract investment for TOD corridors or urban development agencies, economic development or existing transport hubs. The authority must establish standards under which the TOD urban development will be realized. Its role should include ensuring land for development; leading and participating in building and commercial rehabilitation; and securing financing for this purpose. In addition, there must be coordination of the stakeholders involved in the DOT renewal areas.

Change zoning. Zoning regulations can help governments to guide development in areas near transport corridors. These changes are aimed at increasing population density through shifts in occupancy rates, increased building heights, and reduced parking requirements. Some cities may also wish to impose limits on urban growth in certain parts of the city.

Use financial incentives. Since mass transport improvements will attract private investment, the government can build and recover costs by capturing increases in property value. Value capture can also help fund future area improvements.

Another way to attract investment is through deferred or reduced taxation, as this can reduce developers' costs and encourage them to build in areas designated by the local government.

Generate area improvements. Improvements in services and public space in DOT areas help attract investment, increasing prices for homes, offices and shops. Aside from transportation, improvements can also be made to water, drainage and telecommunications services. Improvements can also be made in DOT areas with walking and biking paths, wooded areas and cultural attractions.

Secure land for development. The government can encourage investment by securing land for development by means of land reserves, acquisitions or expropriations. The government can develop the land itself or sell it to private developers under certain maintenance conditions.

Although no major difference was noted for DOT investment preferences between BRT or light rail projects, BRT turns out to be a better investment. Since the BRT is cheaper, private investment attracted to TOD represents 33.2 dollars for every dollar invested by the government in transport infrastructure. In contrast, light rail projects attract 5.55 investment dollars in TOD for every dollar invested in infrastructure.

Source: Hook, et. al. , 2013

Establish in the National Urban Development Program a land expansion containment policy that takes into account mobility as a structural basis of urban space and promotes TOD.

First, establish within the possible National Urban Development Program a land expansion containment policy that considers mobility as a structural axis of urban space; boosts Transit-Oriented Development; and promotes local government support for TOD strategies. The program requires the creation of guidelines, goals, objectives and performance benchmarks and assurance that housing developments built in the next few years be located near transportation hubs. It's important to note that support for TOD strategies will be focused primarily on cities with mass transit systems.

Develop a budget to promote sustainable mobility and Transit-Oriented Development

In order to promote sustainable urban mobility and TOD, the SEDATU must first create a program budget to ensure compatibility between urban development and mobility policies. This program will implement pedestrian and cyclist mobility projects, as well as car-use management in dense, mixed and compact urban areas near mass transit stations. The program also includes the implementation of sustainable mobility projects in any city that requires it.

This may be achieved by changing current operating regulations used for federal funding and designating SEDATU as the federallevel link for the delivery, control and monitoring of resources with the goal of promoting public investment in sustainable mobility for road works. (Garduño, 2013).

This can also be achieved through the implementation of a Sustainable Urban Mobility Program administered by the SEDATU in coordination with the SCT, SEMARNAT and SENER. The latter generates technical guidelines and funding mechanisms to ensure implementation of sustainable mobility in Mexican cities.

Subject federal funding to local governments' planning efforts and program updates

Federal funding for urban projects shall require at least:

•Creation of institutions responsible for urban planning and mobility that facilitate long-term and binding metropoliswide coordination. This can be achieved through the creation of autonomous Municipal or Metropolitan Planning Institutes. •Metropolitan and urban programs, updated as required. •**Urban development programs** that include mobility planning as a structural component of the city.³⁵

Similarly, federal funding can be used to enforce goals related to land improvement and property tax collection by local governments, resulting in better land management and increased local revenues. In this way, local governments will be encouraged to plan and prioritize denser growth, while generating revenues needed to build public transport infrastructure and develop quality TOD projects.

Fund only mass transit that meets international quality standards and / or operates on a Transit-Oriented Development strategy.

Federal financing of mass transit (BRT, metro, train) should be realized only if projects meet minimum demand and international quality standards (e.g., BRT Standard) or include TOD strategy implementation that guarantees medium-term success. Investment in public transport infrastructure is essential to ensure Transit-Oriented Development. All successful TOD projects around the world have depended on major government or public agency investment to attract private investment.

Promote an inter-urban CSUD program for Transit-Oriented Development.

Transform Integrated Sustainable Urban Development (ISUD) projects to encourage TOD projects. It may be possible to increase the basket of incentives by coordinating project construction with the disbursement of federal funds, especially those allocated for mass transit infrastructure. Modifying this program to encourage the TOD to include affordable housing has a high chance of success.

It should be noted that a rigorous evaluation process must be implemented to ensure that these TODs are well-designed and provide the maximum benefits possible. To this end, we recommend using the TOD Standard for rapid assessment and implementation (see Text Box 6).

35. A French law requires that all towns with over 100,000 inhabitants must draft an Urban Transport Plan (UTP). Federal funding for transportation projects requires compliance with this plan. Similarly, England requires the completion of Local Transport Plans for all local transport authorities (ITDP Mexico-Centro Eur, 2012).

Continue to reduce gas subsidies in the short/medium-term; establish an environmental tax on its use; and finance sustainable urban mobility

Remove car use incentives, especially gas subsidies, amounting to 222 billion pesos in 2012 (SHCP, 2012) that mostly benefit the nation's highest income deciles (Medina, 2012b). In contrast, low income housing grants (e.g., "Ésta es tu casa" program) amounted to only 7.3 billion pesos (CONAVI, 2012) - an inequitable and unsustainable situation for development of the nation's cities. In this sense, with-drawal of the gas subsidy may be accompanied by an environmental tax based on its negative externalities. In this way, part of the proceeds available from the subsidy withdrawal and "externalities tax" can be used to finance a national urban mobility program, i.e., investment in TOD projects, mass transit, quality bicycle and pedestrian infrastructure and car-use control measures. This would lay the financial groundwork to establish a national strategy for low-carbon, mobility-oriented urban development.

Do research into urban expansion and transport system externalities.

The federal government should continuously conduct all research necessary to: better understand future trends in urban expansion; assess negative externalities and social costs associated with urban expansion and excess car use; and conduct economic valuations of alternatives to current development policies. Without access to reliable data, it is difficult to make decisions to curb the high costs of city expansion.

Establish a Transit-Oriented Development NAMA.

Funding can be obtained from abroad for mobility and sustainable urban development through a National Appropriate Mitigation Action (NAMA) focused on Transit-Oriented Development. This would be realized jointly by SCT, SEDATU and SEMARNAT; the resulting policy would combine mass transit, non-motorized mobility, car-use management, urban development and housing to achieve a significant reduction in emissions and improved life quality in Mexican cities.

TEXT BOX 5: BRT STANDARD

The "BRT Standard" defines and describes bus rapid transit systems ("Bus Rapid Transit"). Similar to the LEED designation for green buildings, high-quality BRT transport corridors receive bronze, silver or gold qualifications, depending on their compliance with standard requirements. This tool is useful as both a rating system and planning/ development tool for cities looking to implement BRT systems. Upon presenting the essential elements of BRT, a guide will be published for systems designers, policy makers and community transport decision-makers to help them identify and implement quality systems recognized by international standards. The BRT Standard rates over 30 design elements for transport corridors with points awarded for elements that notably improve operations performance.

TEXT BOX 6: TOD STANDARD

This tool recognizes urban development projects that are located within walking distance of a mass transit station and have specific urban design and land use features. As such, this tool recognizes development that is proactively-oriented toward public transport, instead of being just peripheral. This tool is based on the 8 principles of sustainable mobility, developed by ITDP and Gehl Architects (ITDP, 2011). The Standard lists 24 indicators to assess real property development and features of areas adjoining transit stations that support, facilitate and prioritize public transport and travel by foot, bicycle and other non-motorized means. Its main objectives are:

Assess the public transport orientation of urban development projects;

Evaluate projects in the planning and design stages to identify gaps and areas of opportunity,

Guide policy and regulations in matters related to urban planning, transportation, land use, urban design and parking.

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CONCLUSIONS

Mexico is facing a wave of uncontrolled and anarchic urban expansion; a phenomenon never experienced before on this scale, with such far-ranging consequences that it will be a decisive factor in the nation's future development. Urban expansion not only requires higher public expenditures for infrastructure and equipment, it also affects the welfare of ordinary Mexican families by imposing additional expenses; and poses a clear sustainability threat by encouraging excess car use.

This phenomenon is not accidental; it has been driven by an institutional structure and public policies that have disregarded smart urban planning and sustainable mobility for decades. Modification of existing incentives and a new urban development model are the only realistic ways to prevent an increase in the enormous social costs of chaotic urban expansion.

In this way, support from the federal government for Transit-Oriented Development (TOD) is an essential tool, as shown by many success stories around the world: Copenhagen, Curitiba, Denver and Hong Kong. The federal government through SEDATU can encourage a national TOD program that improves urban mobility and provides significant benefits to city residents. The adoption of such a measure should not be words only but include a real system of benchmarks, monitoring and accountability.

It is important to note that a TOD national strategy would be in line with the following National Development Plan strategies:

Strategy 2.5.1: Moving toward a sustainable and smart urban development model that seeks to secure dignified housing for all Mexicans.

Strategy 2.5.2: Responsibly reduce the housing backlog through improvements and the expansion of existing housing stock as well as the promotion of new housing construction.

Strategy 4.9.1: Modernize, expand and maintain quality infrastructure for diverse transport modes and improve their connectivity by means of strategic and efficiency criteria.

The TOD strategy is also aligned with the 10-20-40 National Climate Change Strategy vision:

M3.1: Course of action: Increase controlled and efficient land use by ensuring access to land inside the city; promoting mixed-use building and vertical densification; prioritizing densification over new building

in outlying areas; integrating urban forests; and establishing limits for urban growth.

M3.3: Course of action: Promote progress towards the construction of safe, clean, low-emission, accessible and comfortable public transport systems to strengthen national and regional inter-connectivity through efficient multi-modal networks; all with the federal government's support as part of a comprehensive urban development and mobility program designed to reduce travel times and trip distances.

M3.7: Course of action: Provide incentives, infrastructure and programs that encourage non-motorized transportation within integrated transport systems, giving priority to pedestrians and cyclists to generate short-term environmental and health benefits.

Similarly, a Transit-Oriented Development strategy could be part of a broader strategy to mitigate greenhouse gases (GHG) if presented by the federal government as part of a National Appropriate Mitigation Action (NAMA). For example, Bogota, Colombia, is raising a TOD-based NAMA designed to reduce car use by up to 25% and, consequently, a yearly MMTCO reduction between 1.9 and 3.8. (Wilkelman 2013). Based on a conservative expansion estimate, CTS-World Bank (2008) determined that a densification program in Mexico would reduce emissions by up to 117 MtCO2e, 11,800 tons of PM_{2.5} and 855,000 tons of NOx to 2030.

Mexico could develop a NAMA with similar or even increased benefits, including many that would help create both more inclusive and equitable cities. The decision to change the urban development model toward one of compact, mixed and diverse cities with sustainable mobility is no longer an option. As a result of the significant equality and environmental challenges currently faced by our nation, it is an urgent necessity.

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ANNEX 1

The infrastructure costs estimate was based on the following methodology.

First, we used land surface estimates of cities with over 50,000 inhabitants and population estimates between 1980 and 2010 generated by SEDESOL (2012a). With these data, population densities and growth rates were calculated for each city.

Second, we prepared two possible growth scenarios based on the following assumptions:

Baseline scenario. This implies an average population density reduction based on historical rates recorded until 2030. Once population density is estimated for each of the cities to 2030, land surface area was extrapolated based on CONAPO population projections. This scenario clearly implies that the factors driving city expansion remain unchanged for 20 years, an unlikely situation.

Alternate scenario. Population density from 2010 to 2030 has remained stable in each city. Similarly, using the CONAPO population projections to 2030, the new land area for population growth was extrapolated This scenario also implies urban expansion, but while maintaining controlled population density. This scenario is undoubtedly idealistic.

Third, based on estimated urban land area data for each of the cities, two types of road and transport infrastructure patterns emerge.

For the baseline scenario, an urban pattern based on car use, resulting in 40% of land area destined for roads. Of this percentage, 20% will be dedicated to primary roads and 80% to secondary roads.

An urban development pattern focused on sustainable mobility, with an ideal of 25% for the area destined for roads. Of the total space destined roads, only 8% are primary, including BRT systems and bikeways - depending on the city type - and based on the following assumptions:

Fourth, estimates are given regarding necessary water infrastructure, drainage, electric transmission lines and lighting, based on SEDESOL assumptions (2012b). For water and sewage infrastructure, the primary and secondary water and sewer networks require the same length as the road network; in the case of electric transmission lines, we assume that this represents 91% of road infrastructure and requires 28 lighting units per kilometer.

Fifth, we use the following cost estimates for each infrastructure

component based on SEDESOL (2012b), with which the final values were calculated. Notably, no discount rate was used; it is assumed that all investment is made in the first year. Despite this restriction, the differences do not change because the ratio is a function of the new urban area. Another established assumption is that public transport maintenance costs are zero and covered entirely by user rates, so that subsidy policies - required by many systems - are not taken into account.

ANNEX 2

The methodology used to generate travel time maps for the metropolitan areas of the Valley of Mexico, Guadalajara and Monterrey:

1. The developments database of Softec Consultoría de Proyectos Inmobiliarios were screened to obtain developments that started in 2008 for the VMMA; 2004 for the Guadalajara metropolitan area; and 2005 for the Monterrey metropolitan area.

2. Based on the sample, developments were selected that contain the highest unit number of units in order to extract the core of the most relevant housing.

3. Depending its size, we realized a density map of the new developments and the area of influence that could cove r each. This was realized to obtain the most important nuclei and trace centroids to realize origin-destination lines toward the center of each city.

4. Origin-destination lines were drawn with distance and time attributes.

5. Transit time approximations were realized based on the Google Maps travel route tool. This tool provides ideal times. As a result, calculations are approximate, as the tool does not consider traffic delays.

TABLE A.1: PUBLIC TRANSPORT AND INFRASTRUCTUREASSUMPTIONS FOR DIFFERENT TYPES OF CITIES

CITIES	BRT LINES (12 km)	KM OF BIKEWAYS*
50 THOUSAND - 99,999	0	70% of primary roads
100 THOUSAND - 499,999	1	65% of primary roads
500 THOUSAND - 999,999	3	60% of primary roads
1 to 4.9 MILLION	5	55% of primary roads
ZMVM	10	50% of primary roads

TABLE A.2: CONSTRUCTION AND MAINTENANCE COSTS PER UNIT (PESOS)

Source: SEDESOL, 2012b.

	UNIT	CONSTRUCTION	MAINTENANCE
Primary roads	КМ	40,319,148	350
Secondary roads	КМ	20,161,851	350
Public transportation	КМ	70,000,000	
Confined Bikeways	КМ	1,000,000	
Water	КМ	1,021,680	255,420
Drainage	КМ	1,713,490	428,370
Electrical energy (line transmission)	KM	29,054	
Public lighting	28 lights per kilometer	14,000	2,122

