GREEN BUILDING IN NORTH AMERICA

Paper 4a: Green Residential Building in North America:

Working Toward Affordable, Sustainable Housing in Mexico

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Introduction

The primary objective of this paper is to contribute to a shared North American (Canada, Mexico and the United States) vision of green building in the residential sector, as a response to the challenge represented by climatic change and its consequences.

In particular, this paper is intended to offer a current and future diagnostic assessment of green building in Mexico and to identify the obstacles and driving factors that in the future will hinder or permit the creation of a green building market that enjoys acceptance by final users as well as financial and governmental sectors.

Defining green building is somewhat complex, however for the purposes of this paper, the following two basic concepts may be useful:

a) Green housing is that which satisfies current needs without compromising the resources that will allow future generations to satisfy their needs.

b) Green building is that which seeks economic, social and environmental equilibrium by offering high-performance buildings, reducing negative impacts on the environment and improving human health, with a comprehensive focus that encompasses design, construction, use and maintenance, and even re-use and demolition.

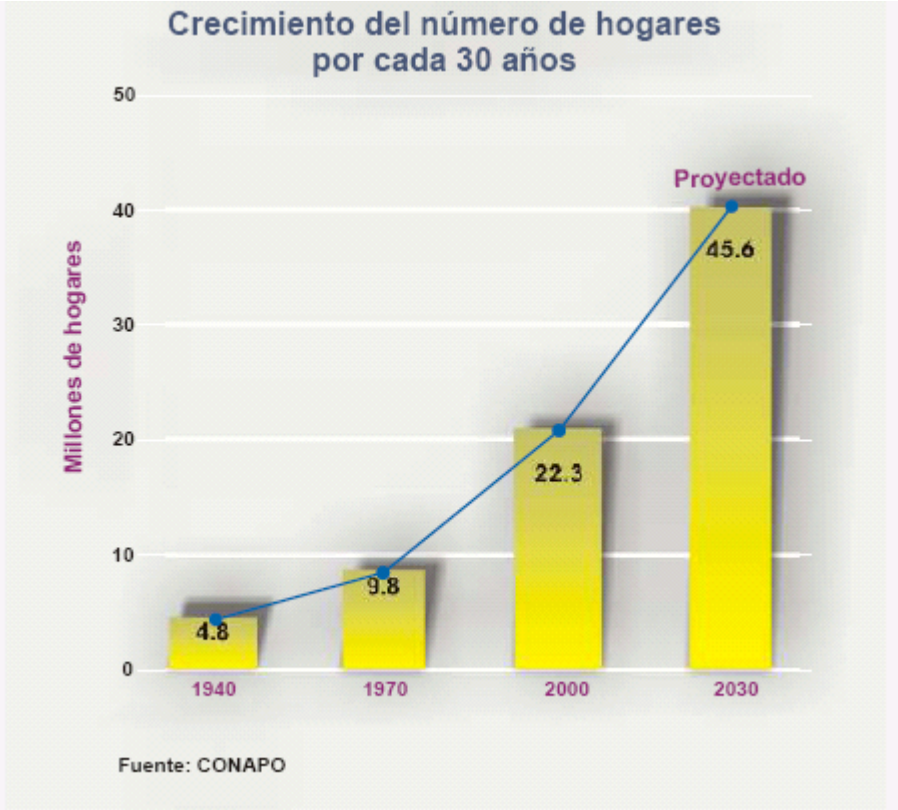
Context

In recent years, housing has been identified as one of the most energy-consuming sectors, especially due to its use of and dependence on fossil fuels that are associated with greenhouse gas emissions. This is also because of its elevated use of natural resources—such as water and construction materials of natural origin and sometimes non-renewable—and because of the sewage and solid wastes generated in basic human activities in residential settings.

In addition, growth in cities around the world generates significant changes in land use and rainwater flows, since the pavement in residential developments modifies the permeability coefficients of the natural terrain.

The Mexican population is experiencing a process of demographic transition characterized by a decrease in the fertility rate and a drop in the population growth rate, however an increase in life expectancy. It is estimated that by the year 2030, the country will add 23.3 million households to the nearly 23 million registered as of 2000. This will signify a total of 46 million households, with an average increase of 800,000 additional households every year.

Figure 1. Increase in number of households every 30 years



Translation of Figure:

Heading: Increase in number of households every 30 years

y-axis: Millions of households

Projected: right-hand bar

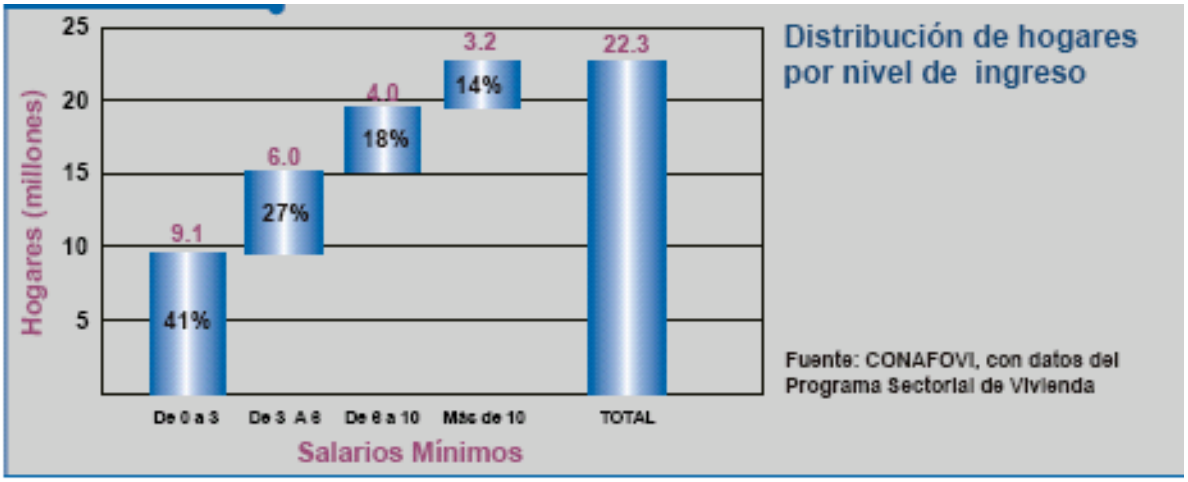
Source: Conapo *Consejo Nacional de Población* (National Population Council).

In addition to the growing need for housing stimulated by the new households established, it is also necessary to consider the current number of inadequate homes, which in the year 2000 amounted to a total of 4,285,000. There are three situations: a housing deficit among families that do not have their own home (750,000); homes that need to be replaced because they have reached their maximum useful life (2,480,000); and housing that needs to be expanded, repaired or improved (1,055,000).

Based on these figures, the federal government proposed financing and building 750,000 housing units every year during the period from 2000 to 2006. Now, with the Mexico 2030 Project, it has ratified its commitment to reach its goal of building a million housing units each year by the year 2010, and to maintain this rhythm until 2030.

Of course, the characteristics and value of these housing units should be in line with the population's saving and purchasing capacity (derived from income levels). We know that 86 percent of households in Mexico have an income level below ten minimum wages, and 41 percent have an income level below three minimum wages—and this defines the economic panorama for housing to be developed.

Figure 2. Distribution of households by income level



Translation of Figure:

Heading: Distribution of households by income level
y-axis: Households (millions)
x-axis: Minimum Wages: 0 to 3, 3 to 6, 6 to 10, above 10, TOTAL
Source: CONAFOVI (*Comisión Nacional de Fomento a la Vivienda*—National Housing Development Commission), with data from the Sector-based Housing Program.

Environmental panorama

Given the growing market for building and financing housing in Mexico, and in light of the direct relationship between housing and the environment, it is important to take into consideration the following points:

- 94.6 percent of housing units have electricity;
- 85.5 percent of housing units have piped-in water;
- 77.6 percent of housing units are connected to a sewage system.

In the context of the commitment to reduce greenhouse gases in programs similar to those in Canada (Royal Architectural Institute of Canada—RAIC) and in the United States (American Institute of Architects—AIA), which project carbon neutrality in 100 percent of new buildings by the year 2030, it is important to consider the following particularities of the situation in Mexico.

Mexico is No. 14 in the world in terms of the total volume of emissions, with 512 million equivalent tons of CO_2 (year 2000). However, if we look at the volume of emissions per inhabitant, Mexico's position is No. 76, with 5.2 metric tons per person—in comparison to 24.5 metric tons per person in the United States, and 22.1 in Canada (ranking No. 6 and No. 7, respectively).

As a signatory country to the Kyoto Protocol, and ratified as a Non-Annex I party, Mexico is allowed to market emission reduction certificates (ERC) in registered mitigation projects.

In fact government and private funds have been created to support the development of projects that are linked to the Clean Development Mechanism (CDM) and that allow the issuing of ERCs. Semarnat promoted—through an agreement with the Secretariat of the Treasury (*Secretaría de Hacienda*)—the creation of the Mexican Carbon Fund (*Fondo Mexicano de Carbono*—Fomecar) designed to promote and facilitate projects linked to the Clean Development Mechanism.

Mexico's commitment to the responsibilities and obligations acquired in the Kyoto Protocol should gradually deepen, however, this review of obligations should be based on the following conditions:

1. In accordance with its current capacities, a country should engage in mitigation efforts on the basis of voluntary adoption of policies and measures, with quantifiable results at the sector or sub-sector level.

2. Voluntary commitments will not compromise the basic right to development, and in particular, the aspiration to reach a level of energy consumption that is in line with the population's basic needs.

3. The international system will include elements or mechanisms for cooperation and incentives, aimed at increasing and complementing mitigation efforts.

4. The voluntary adoption of mitigation policies and measures should not involve any type of penalization for possible non-compliance.

From Mexico's point of view, the voluntary expansion of the system of commitments should be gradual, and should be based on a process of building capacities for measuring and monitoring the greenhouse gas emissions of the various sectors, and for identifying opportunities for mitigation and for developing projects aimed at reducing emissions.

Adaptation and mitigation are necessary strategies, and neither can occur to the detriment of the other. The issue of adaptation should be integrated in the framework of transversality agendas for sustainable development, in the programs operated by federal public administration offices.

The activities of generating and using energy include opportunities for mitigation, specifically: energy savings, use of clean, renewable sources of energy, as well as the use of more efficient and cleaner energy technologies.

If political, legal, economic, social and international conditions permit these opportunities to be taken advantage of, the growth rate of emissions in the residential sector could be reduced significantly. And from now to the year 2014, it may be possible to avoid the generation of nearly 100 million metric tons of CO_2 emissions—even when calculations include the increase in energy supply required in the coming years.

These mitigation opportunities are specified in the Climatic Lines of Action for Generation and Use of Energy:[1]

1. Incorporate new actors and new initiatives in government energy savings programs.

2. Standardize energy savings in federal facilities.

3. Raise the goal in the proposed Law for Making Use of Renewable Energy Sources.

4. Build capacities for quantifying greenhouse gas emissions and propose projects for reducing such emissions in Mexican companies, through the CDM and other carbon markets.

5. Consider the costs of environmental impact and other externalities in the economic assessment of projects (direct costs and also those derived from failing to take action).

6. Review the current contract for connecting to the Federal Electricity Commission (*Comisión Federal de Electricidad*—CFE) in order to facilitate and motivate the development of co-generation projects and the use of renewable energy sources.

7. Permit the sale of electricity between individuals.

[1] CICC, Hacia una estrategia nacional de acción climática, Inter-Sector Commission on Climatic Change (Comisión Intersecretarial de Cambio Climático—CICC) and the Secretariat of the Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales—Semarnat), Mexico, 2006.

8. Achieve the fiscal reform necessary for decreasing the amount of taxes contributed by *Petróleos Mexicanos* (Pemex), and free up resources to reinvest in the company, particularly to improve its efficiency, productivity and competitiveness.

9. Guarantee natural gas supply.

10. Increase the performance of vehicles in Mexico, through policies for promoting the acquisition of vehicles that use less fuel per kilometer or per tankful, and that reduce greenhouse gas emissions.

11. Use biomethanol and biodiesel in PEMEX fuels.

12. Integrate efficient public transportation policies in urban development programs.

13. Return to using railway transportation for both freight and passengers.

14. Define goals and objectives for energy efficiency in potable water and wastewater management.

Protection measures against effects from climatic change have been focused on two perspectives: one is preventative in nature and oriented toward mitigation measures for controlling and reducing the volume of greenhouse gas emissions; and the other emphasizes adaptation measures for minimizing the damages and risks derived from climatic change.

Various studies indicate that the adoption of mitigation measures would diminish the rhythm of global warming by only 0.1 degrees centigrade per decade. In addition it is important to observe that the implementation of measures designed to diminish gas emissions are exceedingly difficult, since energy use patterns are highly established in the world economy.

Nevertheless, researchers have identified mitigation options that contribute to addressing the problem of climatic change, and that simultaneously provide economic, social and environmental advantages. These options include an increase in energy efficiency, as well as the use of "cleaner" energy sources and technologies.

In Mexico the primary objective is to improve the population's quality of life. To achieve this objective it is necessary to surpass the national economic growth rate registered in recent years (4.2 percent annually), and to count on the energy resources necessary for such growth.

Consequently, Mexico's energy policies acknowledge the need to satisfy the requirements for a range of productive activities and for Mexican households—in order to facilitate economic growth and an improvement in the population's quality of life, in a context of competitiveness, sustainability and harmony with the environment.

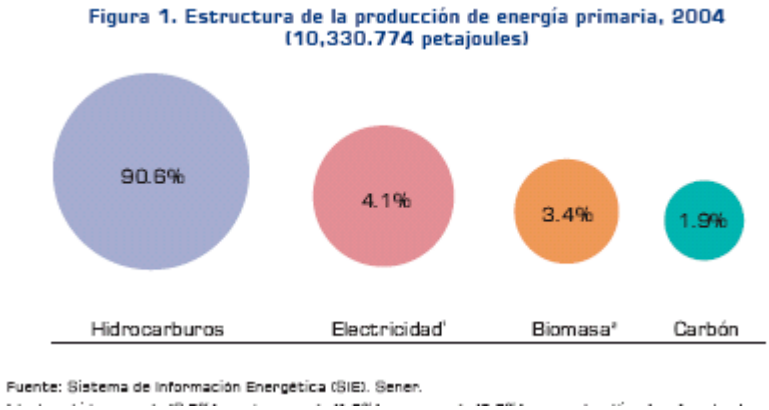
Energy sector policy and results

National energy policy aims to establish a balance between promoting economic growth and protecting the environment. Consequently, it is aimed at guaranteeing the energy needs of both productive and household activities in a context of efficiency and harmony with the environment.

This policy is the result of having analyzed the potential costs and benefits for every action in energy supply and demand, not only in economic or financial terms but also from social and environmental perspectives.

The need for a policy on renewable energy sources is clear, since we can see that these sources will not play a more significant role in the national energy balance unless a comprehensive, coherent strategy with ambitious goals is established. Technological progress on its own will be unable to eliminate non-technological barriers that obstruct or limit the capacity of renewable energy sources to penetrate energy markets. The prices for most traditional energy sources have stabilized at historically low levels, and this works against the establishment of renewable sources. Given this situation, it is imperative to adopt policy measures that reestablish a balance in favor of renewable energy sources, in light of their advantages in energy supply security and environmental protection.

Figure 3. Structure of primary energy production, 2004



Translation of Figure:

Structure of primary energy production, 2004
(10,330.774 petajoules)

Hydrocarbons Electricity Biomass Coal

Source: *Sistema de Información Energética* (SIE), Secretariat of Energy (Sener).

Energy saving and efficient use

Measures for saving and efficient use of energy are aimed at obtaining products and services of the same or better quality than traditional ones, however with less energy consumption, lower costs and lower greenhouse gas emissions. In order to promote these measures, the National Energy Saving Commission (*Comisión Nacional de Ahorro de Energía*—Conae) and the Program for Energy Savings in the Electricity Sector (*Programa de Ahorro de Energía del Sector Elécrico*—PASE) were created in 1989. And a year later, in 1990, the Trust Fund for Electricity Savings (*Fideicomiso para el Ahorro de Energía Eléctrica*—FIDE) was established. In all three cases, there are two focuses: supply and demand.

Supply. The primary lines of action are directed at promoting efficiency in oil and natural gas extraction and electricity generation, with a reduction in losses in the production, transportation, storage and distribution of hydrocarbons, as well as in the transmission and distribution of electricity.

Demand. On the demand side, the focus is on saving energy, since the extent to which less energy is used—without diminishing economic activity—greenhouse gas emissions will be reduced.

FIDE's Incentives Program is aimed at decreasing energy consumption and promoting a transformation in the market toward the use of high-efficiency equipment. There are two sub-

programs, one directed at household lighting and the other at the productive sector. The first seeks to replace incandescent light bulbs with more efficient compact fluorescent bulbs, to be sold at competitive prices, and included in users' electricity bills.

It is worth emphasizing here that the Trust Fund for Thermal Isolation in Housing Program in the Mexicali Valley (*Fideicomiso para el Programa de Aislamiento Térmico de la Vivienda en el Valle de Mexicali*—Fipaterm) was established in 1990. Today it is called the Comprehensive Systematic Savings Program (*Programa de Ahorro Sistemático Integral*—ASI), and it is aimed at contributing to electricity savings through financing for promoting the sale and generalized use of high-efficiency equipment, apparatuses and measures. ASI consists of four sub-programs:

- Thermal isolation in 59,426 housing units, with an annual savings of 31.6 GW/h, and 22 MW reduction in energy demand.
- Replacing air conditioning equipment with high-efficiency equipment, with an annual savings of 65.2 GW/h, and 65 MW reduction in energy demand.
- Replacing incandescent light bulbs with compact fluorescent bulbs (to date, 500,000 units), with an annual savings of 2.6 GW/h and a 31 MW decrease in demand.
- Installing sealing around doors, producing an annual savings of 43.8 GW/h, plus 3 MW reductions in demand.

During the last three years, 16 Mexican Official Standards (*Normas Oficiales Mexicanas*—NOMs) were published in the area of energy, establishing minimum consumption coefficients for electrical home appliances, bulbs, electric motors, pumps, air conditioning systems and interior and exterior lighting, as well as criteria for materials used in thermal isolation. Through the effective implementation of 12 standards related to electricity, a savings of 2,870 GW/h has been calculated, in comparison to using traditional equipment and systems.

Human settlements and urban development are accompanied by growing demands for the building of new housing, infrastructure for transportation and availability of food, water and energy, among other factors. This demand often generates the irrational use of natural resources and the degradation of ecosystems.

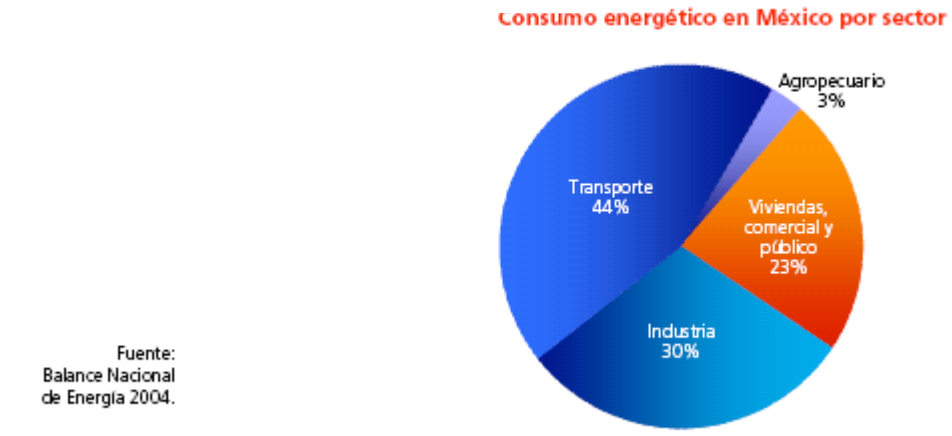
In addition, the migration of rural populations has increased the demand for services in metropolitan areas—and especially the consumption of energy resources used in transportation and electricity—with the consequent increase in levels of air pollution and greenhouse gas emissions.

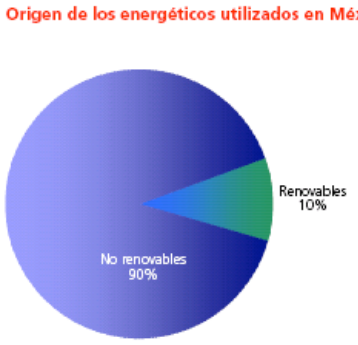
Energy in Mexico

The current status of energy in the country is as follows:

- The energy sector represents 3 percent of the Gross Domestic Product.
- Oil exports represent 8.4 percent of all national exports.
- Taxes on hydrocarbons represent 37 percent of fiscal income.
- Approximately 40 percent of all public investment is dedicated to energy projects.
- Mexican holds ninth place in the world in proven reserves of crude oil, and fourth place in natural gas reserves in the American continent, after the United States, Venezuela and Canada.
- The CFE generates 98 percent of national electricity, and also transmits and distributes 94 percent.
- Most consumption corresponds to non-renewable energy sources, such as natural gas, fuel oil, coal, oil, etc.

Figures 4 and 5. Energy consumption in Mexico, by sector and by origin of energy (2004)





Translation of Figure:

Energy consumption in Mexico, by sector

Transportation
Agriculture
Housing, commercial and public
Industry

Source: *Balance Nacional de Energía 2004*.

Origin of energy resources used in Mexico in 2004

Renewable
Non-renewable

The costs of supplying electricity in the residential sector are subsidized by approximately 45 percent, however this generates additional pressures on investment in public infrastructure works related to energy generation.[2]

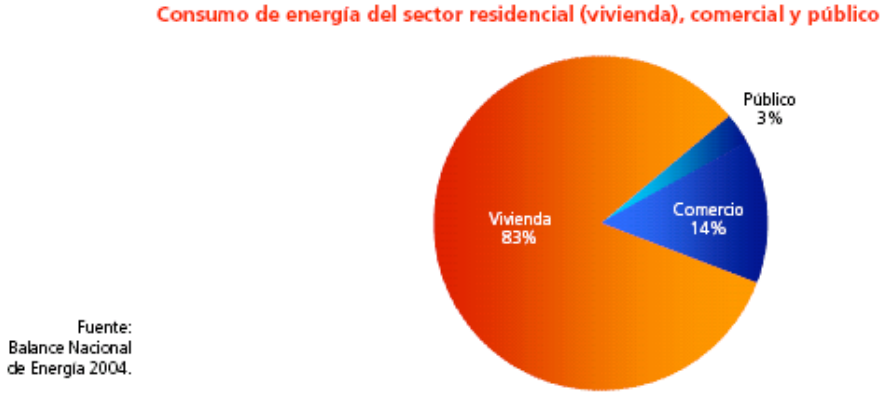
While the tradition of saving energy began in Mexico more than a decade ago, the benefits are not yet palpable. Mexican society needs new housing designs that adapt to its needs and that modify current technologies—which are high energy consumers—without affecting the purchasing value of these buildings.

Significant role of housing in the national electricity market

The housing sector has historically been one of the sectors with the greatest growth, in both energy consumption and number of users. In 2004, residential, commercial and public sectors together required 873.4 pentajoules, and of this total, 83.8 percent corresponded to housing, 13.7 percent to the commercial sector, and 2.6 percent to public services, such as lighting and water pumping.

[2] INE, Estrategia Nacional de Acción Climática, National Ecology Institute (Instituto Nacional de Ecología—INE), Mexico, 2000.

Figure 6. Energy consumption in residential (housing), commercial and public sectors



Translation of Figure:

Energy consumption in residential (housing), commercial and public sectors

Housing Public Commercial

Source: *Balance Nacional de Energía 2004*.

In 1996 CO_2 emissions from fixed and area sources associated with energy consumption reached a volume of 217,537 gigagrams (16 percent higher than in 1990), and in 1998, this amount increased to 254,788 gigagrams (31 percent higher than in 1990). The evolution of CO_2 emissions in various sectors in Mexico during the 1992–1998 period is presented in Figure 9. We should clarify here that the electricity generated is distributed among industrial, commercial, agricultural, residential (housing), commercial and public sectors. And we would add that the emissions registered for each sector would actually be higher if we would add their proportional share from the generation of electricity.

Table 1. Electricity consumption by housing sector in Mexico

Consumo de Energía Eléctrica por las Viviendas

Año	*Consumo Nacional de Energía Eléctrica (GWh)*	*Consumo del sector doméstico (GWh)*	*Usuarios total nacionales (miles)*	*Usuarios domésticos (miles)*
1990	92,123	20,390	16,285	14,318
1991	94,768	21,984	17,154	15,098
1992	97,570	24,051	17,975	15,843
1993	101,276	25,510	18,690	16,494
1994	109,533	27,782	19,434	17,157
1995	113,365	28,462	20,143	17,807
1996	121,571	28,497	20,668	18,293
1997	130,254	29,645	21,387	18,907
1998	137,213	31,690	22,155	19,562
1999	144,996	33,370	22,917	20,236
2000	155,349	33,130	23,881	21,055
2001	157,201	38,344	24,851	21,872
2002	160,201	39,032	25,912	22,784
2003	160,384	39,863	26,954	23,692

Fuente: FIDE 2004.

Translation of Table:

Electricity consumption by housing sector

Year
National Electricity Consumption (GWh)
Consumption by household sector (GWh)
Total national users (thousands)
Household users (thousands)

Source: FIDE 2004.

Table 2. Carbon dioxide emissions associated with energy consumption (Tg)

Emisiones de bióxido de carbono asociadas al consumo de energía (Tg)

	1992	1993	1995	1996	1997	1998	1998
Industrial	55.757	56.149	61.070	62.083	60.935	62.408	25%
Industrias energéticas	38.586	35.980	32.201	38.976	41.606	47.301	13%
Viviendas	20.114	20.676	21.985	22.361	22.471	22.580	9%
Comercial	5.370	5.306	5.377	5.828	6.043	6.418	3%
Agropecuario	5.169	5.204	5.072	5.421	5.797	5.738	2%
Generación electricidad	67.761	70.350	77.958	82.868	92.146	101.343	42%
Total sin biomasa	192.752	193.663	203.662	217.537	228.998	245.788	100%

Fuente: INE 2004.

Translation of Table:

Carbon dioxide emissions associated with energy consumption (Tg)

Industrial
Energy industries
Housing
Commercial
Agricultural
Electricity generation
Total (without biomass)

Source: INE 2004.

Water balance in Mexico

In many countries growth in major urban areas has provoked an accelerated increase in the use of freshwater—which is increasingly scarce, located at a greater distance and already designated for use. The scarcity experienced in recent years and the degradation of this resource, in addition to the threats posed by climatic change, point to uncertain scenarios with regard to the future availability of water.

Mexico's average annual precipitation is 777 mm, which is equivalent to an average volume of 1,528 km^3 of water countrywide. Together with the 49.8 km^3 received from the United States and Guatemala, this comes to a total of 1,577.8 km^3. Of this amount, the majority (70 percent) returns to the atmosphere through evapotranspiration, and 469 km^3 of the water is available (of which 84 percent is surface water, and the rest is incorporated into aquifers). The availability of water varies greatly among the country's hydrological regions. The average natural availability of water in the southern border region is more than 155 km^3, however, it is not even 15 km^3 in the Rio Bravo region and even less in Baja California.

Figure 7. Water flows in Mexico

Translation of Figure:

Receives from the United States
Precipitation
Turned over to the United States
Surface water flow
Evapotranspiration
Replenishes aquifers
Available water
Receives from Guatemala

The ongoing increase in the population and in industrial activity brings conflicts and competition for water use among different sectors, urban and rural areas, cities and neighboring states.

The excessive extraction of water from aquifers and the increasing contamination of this water aggravate the already serious problem of water scarcity. Water distribution networks must have adequate apparatuses for measurement, control and automation, in order to prevent water leaks. In Mexico, it is calculated that approximately 30 percent of the water intended for the daily supply per inhabitant is lost through leaks.

Water infrastructure and the relatively limited water supply must be managed more efficiently in order to satisfy the growing demand. Emphasis must be placed on conservation, recycling, and the re-use and rational use of water—not on mega-projects for extracting and distributing water.

With regard to wastewater, urban centers generated a total of 8 km^3 (252 m^3/s) of wastewater in 2001. Of this amount, 20 percent was treated and the rest was discharged into sewage systems.

Table 3. Methane emissions generated by treatment of wastewater (giga-grams CH_4/year)

Residuo	1992	1994	1996	1998
Aguas residuales municipales	499.0	525.5	546.73	552.4
Aguas residuales industriales	601.1	626.1	714.2	829.2

Fuente: INE-Semarnat 2000.

Translation of Table:

WASTE

Municipal wastewater
Industrial wastewater

Source: INE-Semarnat 2000.

In a country like Mexico, characterized by irregular and seasonal regional distribution of water, low availability per person, and the over-use of a great number of aquifers, it is vital that actions be adopted to optimize water use; to promote the additional collection of water from non-conventional sources—most importantly, by harvesting rainwater; and to reassess the re-using of treated wastewater in order to reduce the consumption of first-use water.

Used water should not be considered a waste product, especially when this resource is so scarce. It is important to identify areas of opportunity for doing a better job of using and conserving this resource, reducing the problems of inadequate supply, and promoting practices for saving water.

The future supply of water, especially in regions where this resource is scarce, will no longer depend on ambitious projects for extracting and distributing water, but on conservation, recycling, and the re-use and efficient use of water.[3]

[3] It is important to point out that this will generate increased methane emissions from new treatment plants, and consequently the design of these new plants must incorporate solutions for mitigating these emissions.

Generation of wastes

An ecological footprint measures the consumption of natural resources by a country, city, community or individual—specifically, the amount of land and water used to produce what is consumed and used to absorb all that is discharged as waste, in line with a given lifestyle.

To assure sustainability, an ecological footprint should be less or equal to the biological capacity of a given region. If this is not the case, resources will be exploited at a rate beyond the region's production rate. An arid territory will, because of its low productivity, have less biological capacity than a forest.

In 1996 the biological capacity and ecological footprint of Mexico's territory were 1.65 and 2.67 hectares, respectively, indicating a non-sustainable use of natural resources and the need to reduce human impact on nature.

As a nation's population increases, the generation of wastes also increases. According to a study published by the Secretariat of Social Development in 1999, the average national amount of wastes generated had increased to 865 grams per day per person.

The increase in waste generation corresponds to changes in consumption habits, and the reality that plastic wrappers have become nearly indispensable. It is calculated that 46.2 percent of wastes—most are organic wastes—come from homes.

Sanitary landfills will reach their point of saturation in the short term, and this will translate into a serious problem for cities. It is thus necessary to address the comprehensive management of these wastes.

Some individual and community initiatives have made it possible to make progress in this area, by separating, re-using and recycling by-products, and by making use of organic wastes to produce compost. Efforts have also been made to seek other alternatives for breaking down trash, however this tradition is still very limited and it will be necessary to seek mechanisms for promoting new practices.

In Mexico, 10 percent of the wastes generated are recycled. This figure is not so far from the level of recycling in countries such as Germany or the United States, where 15 percent of what is discarded is re-used.

Government actions

As of 27 June 2006, the new Law on Housing—the provisions of which are public in nature and of social interest—establishes and regulates national policy, programs, instruments and assistance for generating a supply of decent, dignified housing. Article 71, section 6 of this law, dedicated to the topics of quality and sustainability of housing, incorporates the attributes required for new housing, including criteria for sustainability and energy efficiency.

Also, the National Housing Commission (*Comisión Nacional de Vivienda*—Conavi) is working on the creation of a housing code that incorporates sustainability concepts in energy efficiency, the use and management of grey water and sewage, the use of rainwater and disposal of solid wastes.

Summary

In recent years, the annual production of housing units in Mexico has increased from approximately 250,000 to 750,000 (in 2006). It is estimated that an average of a million new housing units will be built every year for the next 25 years.

This rise in housing construction has, in turn, generated increased pressure on potable water and sewage services, electricity and the management and disposal of solid wastes.

Growth in the housing sector has also spurred a new tradition of caring for the natural environment, expressed in conservation practices and the appropriate use of indispensable natural resources. The aim is to obtain levels of quality of life that are adequate for the demands of the 21st century.

It is estimated that 23 percent of energy consumption in Mexico corresponds to the residential, commercial and public construction sector,[4] and of this amount, 83 percent is consumed in residential building. This explains the importance of adopting measures for integrating green (sustainable) design and building concepts into housing construction. Some of the important concepts include: appropriate bioclimatic architectural design; analysis of the surroundings of buildings; incorporation of construction materials and practices that reduce energy consumption; highly efficient technologies for appropriate climatic design of housing, and a tradition of sound energy management with corresponding practices, incorporating the use of alternative energies such as wind and photovoltaic energy.

It is also important to emphasize that 90 percent of energy consumed in Mexico comes from non-renewable energy sources (predominantly oil and natural gas). This means there are two important aspects to be addressed: first, greenhouse gas emissions and their consequent impact on climatic change; and second, diminishing hydrocarbon reserves and the resulting problems for Mexico.

In relation to the issue of water, it is important to mention that Mexico has, on the average, reserves amounting to 4,841 m^3/inhab./year,[5] which is considered within the low category (between 1,000 and 5,000 m^3/inhab./year), according to the World Health Organization.

Since the water available in Mexico is limited, it is important to formulate programs and uses of technologies for saving water; to apply new technologies in sewage treatment; to promote a tradition of re-using water in agricultural and industrial sectors, for example; and to explore possibilities for injecting harvested rainwater into aquifers.

There are obstacles to be confronted when implementing all of these innovative practices:

1. The lack of standards for promoting practices that use less natural resources (and here, government participation is fundamental, at the federal, state and municipal levels). It is

[4] Secretariat of Energy, *Balance Nacional de Energía*, 2004.
[5] National Water Commission (*Comisión Nacional del Agua*).

important to mention that typically the implementation of new standards and regulations is perceived by the private sector as a factor that involves increasing costs.

2. The lack of an adequate system of financing. Generally, technology is considered to be an expense that directly impacts costs, instead of something that can be financed from the benefits obtained from savings in services (energy, potable water, sewage treatment)—and this is where new, appropriate measures would be applied. The possibility of "green" financing mechanisms—such as "clean energy coal bonds"—is important in this regard.

3. The lack of statistical baselines on inputs and consumption, necessary for adequately evaluating the impacts generated by new technologies and their implications for savings and for potentially reducing greenhouse gas emissions.

4. The lack of an adequate program for disseminating information, necessary for generating a responsible tradition based on a commitment to sound management of natural resources.

5. The lack of an adequate system for assessing and certifying applied green building practices, with the capacity for making measurements and comparisons, and with the objective of carefully avoiding any confusion for the final market.

6. As a consequence of the points listed here, there is a need for a system in the financial sector that awards and promotes green design and building practices, through one of the two following schemes:

a) An increase in buyers' credit capacity, in consideration of the potential savings in payments of services, calculated at present value and throughout the period covered by the guarantees of efficient use offered by applied technologies.
b) A decrease in the rates for mortgage loans, since the risks of falling behind on loan repayments may be less if one has additional income from the savings generated in payment of services.

It is important to mention that although option b) is more common in certain countries, the application of option a) in Mexico offers the possibility of equalizing the supply and demand, since the income level of approximately 70 percent of the economically active population is between two and three minimum wages.

Recommended practices and actions are in line with the program proposed by the federal government, expressed through the objectives specified in the National Housing Commission's Green Building Program:

- Modify current housing standards from a perspective of caring for the environment.
- Design guidelines for defining and classifying a housing unit as "green."
- Promote technology transfer and exchange with international entities.
- Promote the use of new technologies that assure the environment will be protected.

- Design and develop schemes for fiscal incentives directed at housing developers and users.
- Disseminate information with the aim of promoting the use of ecotechnologies.