

# NATIONAL STRATEGY FOR SUSTAINABLE HOUSING

## Environmental Component of Sustainability



Implementación, Diseño,  
Evaluación y Análisis de Políticas Públicas

Financed by the British Embassy in Mexico



Embajada Británica  
en México



SOCIEDAD  
HIPOTECARIA  
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Published by Fundación para la Implementación, Diseño, Evaluación y Análisis de Políticas Públicas,  
*Fundación IDEA, A. C.*

Mexico, 2013

CONAVI  
Infonavit  
SHF  
CONUEE  
CONAGUA  
GIZ

Funded by the British Embassy in Mexico

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Translation: CLOSER Traducciones

ISBN: 978-607-95249-4-4

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## Workgroup and acknowledgements

This document was created to integrate the current plans and future vision for sustainable housing of the National Housing Commission (CONAVI), the Institute of the National Housing Fund for Workers (Infonavit), the Federal Mortgage Company (SHF), National Commission for Energy Efficiency (CONUEE) and the National Water Commission (CONAGUA). Fundación IDEA was in charge of drafting the document, and aimed to summarize the actions taken by national and international organizations on creating a more environmentally responsible housing sector in Mexico, and above all, a better quality of life for its inhabitants. Through interviews with these institutions, plans for the development of a National Strategy for Sustainable Housing were collected for this document. Furthermore, several sections of this publication are based on documents or discussions generated by the Transversal Board for Sustainable Housing, in which many national and international institutions and organizations participate that are involved in the promotion of public policy of housing sustainability in Mexico.

The current document was funded by the British Embassy in Mexico as part of a project currently implemented by Fundación IDEA to integrate an environmental evaluation system for housing. The project is titled *“Assistance in the design, validation and implementation of a multi-agency effort to encourage green development in the Mexican mortgage market through energetic efficiency enhancement of housing complexes by using a unified methodology”*.

The authors would like to thank the integral revision, recommendations and suggestions provided by María Estela García Heredia and Carlos Gaitán Lastras of the Infonavit, Jorge León Wolpert Kuri and Tomasz Kotecki Golasinska of the CONAVI, Jorge Armando Guerrero Espinoza of the SHF, Andreas Grüner of GIZ, Guillermo de Cárcer Christlieb and Francisco Javier Moreno Hernández of the CONAGUA, Odón de Buen of the CONUEE, and Angélica Stoecklein and Salvador Rodríguez Kuri of GOPA. The authors would also like to thank the valuable proofreading of some sections of this document by Rocío del Peral of Environment Canada, and Irma Uribe and Alessandra Rountree of Fundación IDEA. Finally, the authors thank María Julia Gutiérrez, Juan Carlos López, María González Millán and Theresa Wildgrube for reviewing the translation of the document.

Any mistake or omission is responsibility of *Fundación IDEA*.

## About *Fundación IDEA*<sup>2</sup>

*Fundación IDEA* is a Mexican think tank formed in 2005. It is a non-profit, independent and apolitical organization. Its mission is to design and promote innovative public policy that produces even opportunities for Mexicans through economic development and poverty reduction, as well as being a reliable source of independent analysis for public servants and public knowledge.

Our vision is a poverty-free Mexico with a vigorous economy, where public servants make decisions through a clear understanding of their choices, and citizens have the information and tools to demand accountability from their authorities about their decisions and performance.

We evaluate current public policy through high quality analysis and research. We offer creative and politically viable proposals to solve public issues in Mexico. We use the best tools and ideas generated internationally. Our analysis is strict and our conclusions are based on reliable evidence.

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<sup>2</sup> For further information, please visit our website: [www.fundacionidea.org.mx](http://www.fundacionidea.org.mx).

## PROLOGUE

### **The National Housing Commission (CONAVI)**

Building a sustainable housing policy is an ever-evolving challenge. Once starting questions are solved, the answers generate new questions that need to balance contrasting paradigms that become more and more complex each time. In this regard, Mexico has developed programs that aim to build housing that will allow its inhabitants to develop fully and comprehensively in a safe environment, with enough and adequate infrastructure and equipment available for all its social groups. Sustainable housing supports these goals on the one hand by diminishing operational costs, and on the other hand, through reducing the emission of pollutants. Generated savings in water, electricity and gas consumption – as can be seen in programs created in recent years – allow families to save money for education and health care.

These savings are not only reflected in the families' economy, but also in savings of subsidies for energy consumption, which allows the optimization of investments in infrastructure through the evaluation of lower demand. Additionally, sustainable housing fosters research, innovation and development of new technology. It also boosts the country's economy, which is an important opportunity for both Mexican and foreign companies.

The cooperation of development banks and international agencies, as well as the direct support of governments that sympathize with the objectives of sustainable housing programs has been crucial in generating the first steps towards sustainable housing. Two main activities have been the strengthening of current institutions and the consolidation of governance mechanisms that permit traceability and ensure the achievement of the expectations of donors and, primarily, of the low-income Mexican population.

These actions require continuous coordination and work with national and local organizations of this sector. It's also necessary to strengthen the housing market and its surroundings in order to build a country comprised of sustainable cities. These actions require new and better mechanisms that allow the use of current housing, suitable intra-urban lands and supply of new well located housing that encourages an appropriate environment for harmonic community life with neighbors.

The challenges are increasingly complex and the commitments more binding. However, it is possible to achieve the development objectives that are set for Mexico to face climate change and benefit its inhabitants, especially the most vulnerable ones.

## **The Institute of the National Housing Fund for Workers**

The Institute of the National Housing Fund for Workers (Infonavit, its Spanish acronym) aims to improve the quality of life of its beneficiaries and their families, and has since 2007 developed the strategy “Vivir Infonavit” (Live Infonavit in Spanish) which undertakes the social responsibility of promoting higher quality sustainable housing, environment and community; through programs with a high impact on the three core areas of sustainability: economic, social and environmental. Each one of the three aspects has their own measurement indicators. However, in 2011 the program “Vida Integral: Vivienda Sustentable” (Integral Life: Sustainable Housing) was created, and it combined the indicators that are considered as most relevant from each one.

Among the programs and actions the Institute develops, the Program “Hipoteca Verde” (Green Mortgage) is renowned for its innovation and international recognition. Through it, a supplemental amount is added to the mortgage loan so that the beneficiaries can purchase a house with efficient equipment for energetic and water consumption. This increases family savings; more efficient and comfortable houses and environmental respect are fostered as well. This program has nationally spearheaded sustainable social housing. The results of the Green Mortgage Program have generated important economic, environmental and social benefits. Because of this, it has been awarded by the United Nations and the BSHF the “World Habitat Award 2012”, and the “Beyond Banking” prize given by the Inter-American Development Bank.

“Hipoteca Verde” is a program of constant improvement and transformation. In collaboration with the German International Cooperation Agency (GIZ) and the British Embassy in Mexico, and being aware that the most efficient houses are those that take adequate materials and designs for the comfort of their inhabitants into account at the time they are constructed, Infonavit has developed a device that measures the environmental and energetic performance of the houses in an integral way, given the specific location of each house in the country. This device is known as the “Green Housing Evaluation System” (Sisevive-Ecocasa).

Infonavit has made sure that its initiatives contribute to the construction of a vision of sustainability in the housing sector, with an emphasis on social housing. Therefore, the Sisevive-Ecocasa system is an evaluation device that combines and supports the housing sustainability efforts currently in progress in Mexico through several institutions, and it is an example of collaborative work among institutions that will unify evaluation and decision criteria related to incentives and programs that have an effect on the sector providing more efficient, comfortable and environmentally-friendly housing.



This document, whose contribution to this field is regarded as relevant by the Infonavit, aims to describe the programs and efforts that have been recently developed in Mexico towards housing sustainability and the inhabitants' well-being, as well as to present the characteristics that the National Strategy of Sustainable Housing should include as envisioned by several institutions in the housing sector. Particularly, this document describes the role that Sisevive-Ecocasa plays in this strategy as a system that encourages more ambitious goals on housing environmental sustainability, and allows measuring the fulfillment of these goals.

### **The National Commission for Energy Efficiency (CONUEE)**

The National Commission for Energy Efficiency (CONUEE, its Spanish acronym) is an independent agency within the Ministry of Energy, which is formed following the Law on Sustainable Energy, published on November 28, 2008.

Amongst its objectives is to promote energy efficiency and to become a technical body in the field of sustainable use of energy. One of its main tasks is to provide technical advice on energy savings and energy efficiency to the departments and agencies of the Federal Government and the governments of the states and municipalities that request it.

In turn, the Federal Law on Metrology and Standardization, which is in effect from July 16, 1992 and its regulations since January 15, 1999, stipulate that the agencies of the federal government, in its field of competence, constitute the National Advisory Committee for Standardization (CCNN) to issue Official Mexican Norms (NOM) on products, processes, methods, facilities, services or activities, and to promote their implementation and monitor their compliance. In this regard, the Ministry of Energy, through the CONUEE, has the power to issue Official Mexican Norms for Energy Efficiency, which are made by the National Advisory Committee for the Preservation and Rational Use of Energy Resources (CCNNPURRE, its Spanish acronym), which is headed by the Director General of the CONUEE.

In this way and in this context, CONUEE has the power to define, guide, support and implement energy efficiency measures in all sectors of the economy of Mexico. Particularly and impacting the housing sector, CONUEE has developed a set of Official Mexican Norms on Energy Efficiency (NOM-ENER) that regulate energy consumption of those devices that, because of their energy demand and number of required units in the country, offer a potential for savings which is satisfying with respect to costs and benefits for the country and its sectors of production and consumption.

NOMs are technical specifications, available to the public, developed with the cooperation and consensus of those involved; mandatory for all products and facilities in Mexico within its field of action.

There are currently thirteen existing NOM that are related to housing: four for miscellaneous equipment (water heaters, refrigerators, washing machines, and pumps and motor pumps), three related to air conditioners (central type, package or split; the fourth type; and split type, discharge free and air ducts free), two related with envelope materials (heat insulation materials and glasses and glazing systems), three for lighting (lamp for general use, fluorescent compact lamps and light emitting diodes (LED) integrated for general lighting), and one for the envelope of buildings for residential use.

When applied, this set of NOM has represented and continues to represent a strong and significant contribution from CONUEE to the development of the sustainable housing in Mexico.

### **The British Embassy in Mexico**

Nowadays, cities face challenges that demand sustainable solutions. The threat of climate change means that we need to find new ways to design and build our cities, so that urban design must take its consequences into account.

This document is relevant for the British Embassy in Mexico given the importance of the topic, as well as the collaboration that both countries – Mexico and the United Kingdom – have made on sustainability. Currently, the British Government supports the project *“Assistance in the design, validation and implementation of a multi-agency effort to encourage green development in the Mexican mortgage market through energetic efficiency enhancement of housing complexes by using a unified methodology”*. It is focused on encouraging energetic efficiency in the housing sector and the development and implementation of Infonavit’s Green Housing Evaluation System. This document is a result of such proposal, and through it, efforts are being made in order to have measures similar to the United Kingdom’s that establish an evaluation system that fosters energetic efficiency and green housing.

One of the ways in which the United Kingdom assists Mexico is through financing mechanisms such as the Prosperity Fund. The goals of this fund are to develop public policy that mitigates climate change and to support the global economy, investment on energetic efficiency technology and development of energy from renewable sources. The concept “prosperity” is encompassed within the development of low-carbon economies that the British Government fosters as a new progress paradigm for the United Kingdom and the world.

Only multi-agency efforts can promote prosperity and urban sustainable development, in which institutional coordination supports a better impact in our society. Thus, this document manages to organize collaboration among the main stakeholders involved that work daily for sustainability in the housing sector in Mexico.

Through such initiatives, the transition to a global low-carbon economy will be achieved locally, and this will foster commerce, investment and a higher employment rate that leads to green development and well-being to Mexican society, as well as strengthening the relation between Mexico and the United Kingdom.

### **German International Cooperation Agency (GIZ)**

There is great potential for making energy and water consumption more efficient in housing in Mexico, which is a great opportunity to mitigate greenhouse gas emissions and contribute to the sustainable development of the country. Since 2008, assigned by the Federal Ministry for Economic Cooperation and Development (BMZ), and since 2010 by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), the GIZ and GOPA-INTEGRATION have supported the Mexican government in establishing and reinforcing public policy, strategies and the technical concepts that contribute to a more sustainable housing. The action lines of the technical cooperation between Germany and Mexico on the housing sector, which are depicted in this document, consist of technical advice on the development of the Sisevive-Ecocasa and the Nationally Appropriate Mitigation Actions (NAMA) of new and existing sustainable housing.

**Sisevive-Ecocasa:** Under the Program of Sustainable Energy in Mexico by the BMZ and searching continuous improvement for the Green Mortgage, GIZ itself and GOPA-INTEGRATION by its assignment in collaboration with CONUEE, CONAGUA, CONAVI, SHF and *Fundación IDEA*, among others, have consulted Infonavit on the development and implementation of the Green Housing Evaluation System. It counts on two calculation devices: DEEVi (based on the German Passive House Institute's PHPP and adapted to Mexican circumstances), to assess energetic performance, and the SAAVi to assess housing's water consumption. The final grade takes three aspects into account: total specific demand (refrigeration and heating), primary energy demand (gas and electricity) and planned water consumption.

**Sustainable housing NAMA:** In 2011 and 2012 under BMU's Mexican-German Program for NAMA, GIZ has consulted CONAVI on developing the first NAMA for the social housing sector. The technical concept of NAMA – an innovative approach in Mexico – is based on the “global performance”

of housing, taking into account the total energetic efficiency of the building. Three performance standards are proposed (Eco House 1, Eco House 2 and Eco House Max) for the main bio-climatic regions in the country. All this aims to widen the use of basic efficiency standards (similar to Green Mortgage) in the market of new housing in Mexico, and to decrease the emissions of CO<sub>2</sub> too.

With programs such as the Sisevive-Ecocasa and the NAMA for existing and new housing, GIZ provides technical advice and cooperates with the institution in charge of raising awareness among the beneficiaries and stakeholders involved in the housing sector, fostering a low-carbon market and significantly diminishing greenhouse gas emissions; helping to achieve the goals set in the PECC and following the Climate Change Act in Mexico.

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## DICTIONARY OF ACRONYMS

AEAE	Companies Association for Energy Savings in Construction (Asociación de Empresas para el Ahorro de Energía en la Edificación, A.C.)
ANFAD	National Association of Household Appliances Manufacturers (Asociación Nacional de Fabricantes de Aparatos Domésticos A.C.)
BANOBRAS	National Bank of Public Works and Services S.N.C. (Banco Nacional de Obras y Servicios Públicos)
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Germany)
BMZ	Federal Ministry for Economic Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung)
CANADEVI	National Chamber of the Industry of Housing Development and Promotion (Cámara Nacional de la Industria de Desarrollo y Promoción de Vivienda)
CEV	Residential Building Code (Código de Edificación de Vivienda)
CMIC	Mexican Chamber of the Construction Industry (Cámara Mexicana de la Industria del Construcción)
CMM	Centro Mario Molina
CONACYT	National Council on Science and Technology (Consejo Nacional de Ciencia y Tecnología)
CONAGUA	National Water Commission (Comisión Nacional del Agua)
CONAPO	National Population Council (Consejo Nacional de Población)
CONAVI	National Housing Commission (Comisión Nacional de Vivienda)
CONUEE	National Commission for Energy Efficiency (Comisión Nacional para el Uso Eficiente de la Energía)
COP	Conference of the Parties (Conferencia de las Partes)
CTF	Clean Technology Fund (Fondo de Tecnología Limpia)
DEEVI	Energetically Efficient Housing Design (Diseño Energéticamente Eficiente de la Vivienda)
DUIS	Sustainable Integrated Urban Developments (Desarrollos Urbanos Integrales Sustentables)
ENSV	National Strategy for Housing Sustainability (Estrategia Nacional para la Sustentabilidad de la Vivienda)
FIDE	Trust for Electric Power Saving (Fideicomiso para el Ahorro de Energía Eléctrica)
FONADIN	Infrastructure National Fund (Fondo Nacional de Infraestructura)
FOVISSSTE	Housing Fund of the Institute of Social Security and Services for Government Workers (Fondo de la Vivienda del ISSSTE)
FVC	Green Climate Fund (Fondo Verde para el Clima)
GHG	Greenhouse Gases (Gases de Efecto Invernadero)
GIZ	German International Cooperation Agency (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH - Agencia Internacional de Cooperación Alemana)
GOPA	GOPA Consultants
IDB	Inter-American Development Bank
INE	National Institute of Ecology (Instituto Nacional de Ecología)
INEGI	National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía)
INFONAVIT	Institute of the National Housing Fund for Workers (Instituto del Fondo Nacional de la Vivienda para los Trabajadores)
IPCC	Intergovernmental Panel on Climate Change (Panel Intergubernamental sobre Cambio Climático)

ISSSTE	State's Employees' Social Security and Social Services Institute (Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado)
ISV	Housing Sustainability Index (Índice de Sustentabilidad en la Vivienda)
KfW	Reconstruction Credit Institute
MDL	Clean Development Mechanism (Mecanismo para un Desarrollo Limpio)
MIC	Mechanism of Joint Implementation (Mecanismo de Implementación Conjunta)
MRV	Monitoring, Reporting and Verification (Monitoreo, Reporte y Verificación)
NAMA	Nationally Appropriate Mitigation Actions (Acciones de Mitigación Nacionalmente Apropriadas)
NOM	Official Mexican Norm (Norma Oficial Mexicana)
OECD	Organization for Economic Co-operation and Development (Organización para la Cooperación y el Desarrollo Económico)
UN	United Nations (Organización de las Naciones Unidas)
OREVI	State Housing Organization (Organismo Estatal de Vivienda)
PECC	Special Climate Change Programme (Programa Especial de Cambio Climático)
PHPP	Passive House Planning Package
PND	National Development Plan (Plan Nacional de Desarrollo)
PNUD	United Nations Development Programme (Programa de Naciones Unidas para el Desarrollo)
PNV	National Housing Programme (Programa Nacional de Vivienda)
POA	Programme of Activities (Programa de Actividades)
PROCASOL	Program of Solar Water-Heaters (Programa de Calentadores Solares)
PRONASE	National Programme for the Sustainable Use of Energy (Programa Nacional para el Aprovechamiento Sustentable de la Energía)
PSE	Sectorial Program of Energy (Programa Sectorial de Energía)
PVS	Transversal Programme of Sustainable Housing (Programa Transversal de Vivienda Sustentable)
RHA	Hydrological-Administrative Regions (Regiones Hidrológico-Administrativas)
RUV	Unified Housing Registry (Registro Único de Vivienda)
SAAVi	Simulator of Water Saving in Housing (Simulador de Ahorro de Agua de la Vivienda)
SCE	Emissions Trading System (Sistema de Comercio de Emisiones)
SEDESOL	Ministry of Social Development (Secretaría de Desarrollo Social)
SEMARNAT	Ministry of Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales)
SENER	Ministry of Energy (Secretaría de Energía)
SHF	Federal Mortgage Company (Sociedad Hipotecaria Federal)
UNFCCC	United Nations Framework Convention on Climate Change (Convención Marco de las Naciones Unidas sobre el Cambio Climático)
USCO	Urban Service Company (Empresas de Servicios Urbanos)
VESAC	Association of Sustainable Housing and Environment (Asociación de Vivienda y Entorno Sustentable A.C.)
VS	Sustainable Housing
WB	World Bank



## EXECUTIVE SUMMARY

The greatest threats to the Earth's sustainability in the medium and long term are climate change and water scarcity. These phenomena, mainly caused by inefficient and pollutant activities in humanity's daily life, risk the economic, social and environmental stability of the planet. Thus, humanity has a chance to face this challenge by cutting down on our greenhouse gases (GHG) emission levels and water consumption. To do it, more efficient technology and clean energy sources can be used, and consumption habits need to change. The solution is at hand, and each sector of the economy must contribute to it.

As can be seen on chapters 3 and 4, not only is Mexico currently facing this reality, but it plays a relevant role in this global challenge; it has lead on the issue and at times has also been an example for other nations working for sustainability. Particularly, the housing sector in Mexico is an important one when it comes to actions and policy for cutting down on polluting emissions, working against climate change and towards sustainable consumption of water, power and gas. The above always seeking housing to provide a better quality of life for the inhabitants. In this way, the Mexican government and the housing industry have united their efforts in order to reach a more sustainable housing sector through the promotion of energetic and environmental efficiency in the Mexican homes.

In chapters 5 and 6, this document highlights the main actors that are involved in working towards a sustainable housing sector, as well as actions and programs developed about it. Regarding the stakeholders involved, there is emphasis made on the role of CONAVI as the organization that coordinates federal public policy on the housing sector; the CONUEE as the institution that promotes energetic efficiency and is a technical agency on sustainable use of energy; the CONAGUA as promoter of water efficient consumption and saving measures, the Infonavit as a social mortgage institution that finances 65% of the country's mortgages (including half a million green houses - *viviendas verdes* - per year) and the SHF as a development bank that promotes the supply of sustainable housing through programs such as ECO CASA. Along these organizations, soon FOVISSSTE will join its efforts to reach sustainability for the housing it finances. The participation of the actors involved from municipal, state and federal governments, as well as private and international ones that have become central for the efforts towards sustainable housing is also remarkable.

On actions and programs, this document describes some of the main efforts to provide Mexican housing with sustainability elements, especially related to water and energy consumption efficiency, and its urban environment. With respect to the Infonavit, in 2008 it changed its

institutional vision in order to put special emphasis on its commitment with its beneficiaries' quality of life, and assuming the strategy "*Vivir Infonavit*", that promotes sustainable housing, environments and communities. In this vision, the programs "Green Mortgage" and "Integral Life: Sustainable Housing" are to be highlighted. The first one is an effort which received international recognition because of its scope of giving access to nearly a million houses to ecotechnologies through an innovative system that combines economic and energetic savings for the families. Meanwhile, "Integral Life: Sustainable Housing" promotes environmental, economic and social sustainability values.

At the same time, the CONAVI has driven efforts with similar aims using the diverse public policy instruments that this institution has. First, Operating Rules of the federal subsidy program "*Ésta es tu casa*" (Spanish for "This is your house") have included minimum sustainability requirements since 2009. In the beginning, these regulations were focused on the existence of ecotechnologies in housing, while recently their aims widened to encourage housing which is better located, vertical and efficient in water and energy consumption. Another effort by the CONAVI covered in this document is the publication of the second edition of the Residential Building Code in 2010 as a regulation model that fosters the establishment of sustainability criteria in local regulations.

Other programs analyzed by this document are the Promotion Program for Certification of Products, Processes and Services of the CONUEE which takes into account the issue of a certificate as "efficient house" for new housing, as well as the program ECOCASA, which is operated by the SHF, in alliance with IDB and KfW, that supports actions for housing to reach higher sustainability and efficiency levels. Also, this document highlights DUIS (Sustainable Integrated Urban Developments), an initiative coordinated by the SHF that unites the efforts of several private and public institutions in order to foster sustainable housing complexes in the broadest sense of the concept.

Even if these actions and policies have been successful and have fostered a relevant change in the housing sector, it is necessary to generate more ambitious public policy when it comes to sustainability. To achieve this, public policy on housing must encourage a change in the common practices in the sector. Particularly, it is necessary to promote progress in the design methods and construction materials through the encouragement of a bioclimatic practice and by incorporating more efficient technology for consumption and management of energy and water that allows granting a higher well-being to inhabitants without risking the environment.

To foster this transformation, it was necessary to define a National Strategy for Sustainable Housing, which is materialized in this document and presented in detail in chapter 7. This strategic vision, shared by the involved institutions, acknowledges families' quality of life as its main goal. Given its impact in the satisfaction and health of people, it has been important to recognize housing as a space for well-being that must satisfy an energy demand, as well as fulfill the water and energy daily necessities of its inhabitants. It has also been important to acknowledge that this well-being at home must be provided with the minimum possible impact on the environment, for which it is necessary to carry out several actions depending on the climate and water conditions of each region.

Particularly, this national strategy takes the following principles into account:

- Evolving towards an integral and comprehensive concept of sustainable housing that encompasses housing and its surroundings.
- Encouraging the development of evaluation and analysis methodologies on housing behavior and the situation of the sector, accordingly to an integral and multidimensional vision.
- Encouraging bioclimatic design of housing fitted to the characteristics of each locality.
- Developing new high quality and efficiency building systems.
- Broadening the coverage of current programs and adapting them to a new integral vision to take sustainable housing in Mexico to a higher efficiency level and make it provide: greater comfort to its inhabitants.
- Achieving more ambitious systems of energetic and environmental efficiency.
- Improving financing programs to make more efficient and comfortable housing affordable to lower-income families. Accessing national and international financial resources to make this transformation possible.
- Supporting the design of public policy that includes specific social groups that have been excluded in traditional programs.
- Fostering the development of a national green industry that innovates with new technology fitted to the current economic and climate circumstances in Mexico.<sup>2</sup>

The National Strategy for Sustainable Housing exists through coordinated transversal and joint efforts that follow the five pillars explained in chapter 7.

The first pillar is formed by the National Board for Sustainable Housing, which was formed by the CONAVI in 2012. Its aim is to enhance coordination among the several stakeholders involved

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<sup>2</sup> Fondo de Desarrollo científico y tecnológico para el fomento de la producción y financiamiento de vivienda y el crecimiento del sector habitacional, CONAVI and CONACYT.

and define a collaborative work strategy, as well as cooperation and agreement of goals, and institutional actions. This group is formed with public and private, national and foreign entities. The second pillar is constituted by a financing program that will allow evolution towards more ambitious sustainability goals by accessing national and international resources. In this pillar, the NAMA for new housing by the CONAVI, stands alone as one of the first international examples of financing for measures to reduce gas emissions in housing. The NAMA program includes a Monitoring, Report and Verification component of the NAMA for new housing. Within these mitigation actions, as a joint initiative by the SHF, the BID and the KfW, ECO-CASA program is included encourage the supply of sustainable housing in Mexico through soft financing for construction<sup>3</sup>. Furthermore, NAMAs for current housing and sustainable urban environment are under development. Finally, this text briefly describes the actions that are carried out in Mexico on Clean Development Mechanisms (MDL, its Spanish acronym) and its Program of Activities (POA), both also aiming to finance sustainable housing.

The third pillar that supports this national strategy is the development of evaluation instruments. Such instruments pursue the establishment of sustainability standards in the housing industry, generating clear information for the sector altogether and focusing resources on the more efficient housing. With this regard, Sisevive-Ecocasa program by the Infonavit is essential as a complement for two reasons. First, it allows an integral evaluation of energetic efficiency and water consumption of housing in Mexico. It rate its design and equipment: enabling the evaluation and verification of thousands of houses in Mexico. Second, an implementation strategy has been developed which will allow its massive and transversal use. Sisevive-Ecocasa will be used by the Infonavit and the SHF. Additionally, CONAVI will make the best of the design of Sisevive-Ecocasa to complement the NAMA program on new housing. Besides, the Index of Sustainable Housing designed by Centro Mario Molina and launched by VESAC is an ambitious effort to evaluate the: life cycle of housing and its surroundings altogether, including social, economic and environmental dimensions of to sustainability.

The fourth pillar is the definition of regulation standards for the housing sector in Mexico. In this sphere, several public entities such as the CONUEE and the CONAGUA among others, have worked in the development of regulation for minimum efficiency of water and energy consumption by the main devices in the houses. Also, guidelines that foster water and energy consumption in urban and housing environments have been developed. For its impact on the housing sector in Mexico, the publishing of the norm NOM-020-ENER-2011 is to be highlighted, which establishes the minimum efficiency conditions for housing and induces reductions on energy consumption used by air conditioners and heating devices.

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<sup>3</sup> Soft financing is a credit that is given in a long term and with low interest in order to favor an investment.

Finally, the fifth pillar which is beyond this document refers to the development of capabilities and resources on housing and sustainable surroundings at the municipal level. Constitutionally, local municipalities are the main players when it comes to housing planning and regulation. It is in this territorial administration sphere that housing projects are materialized, thus, it is at this level where the objectives and actions must be grounded that aim to encourage higher quality housing, offer greater comfort and be environmentally friendly.

In summary, this document identifies four big challenges to grant the success of the National Strategy for Sustainable Housing: First, lack of information and awareness of the public when it comes to the objectives of this strategy. Second, a transformation of policy and market incentives that currently are not oriented towards sustainability and consumption efficiency. Third, the current policy of subsidies on energy that does not reward efficient consumption, and municipal and state policies on running water fees that do not reflect its value and shortage are concerning. Finally, there are regulating and institutional issues that make the implementation of this long-term integral vision difficult and require to be modified in order to impulse this strategy. To this end, the short term that local municipalities are forced to work in due to their institutional design is the main challenge.

## 1. PRESENTATION

According to the Population Census 2010 by the National Institute of Statistics, Geography and Informatics (INEGI, its Spanish acronym), there are 112,336,538 inhabitants in Mexico living in 28,607,568 houses, with an average of 3.9 inhabitants per house.<sup>4</sup> Population in Mexico is expected to rise up to 137.5 million by 2050.<sup>5</sup> Furthermore, by the third decade of the century, Mexico will approximately have 50 million houses. It is estimated that 11 million new houses will be needed between 2011 and 2030, and 9 million houses will need full or partial renovation within the same period.<sup>6</sup> This significant growth of population and housing represents big challenges on housing, water and energy supplies across the country.<sup>7</sup>

Both current and expected figures show that the housing sector must play a relevant role in public policy in order to reduce pollutant emissions, work against climate change, and work for a sustainable use of energy, water and gas while attempting to provide a higher quality of life to the inhabitants. To that end, both government and housing industry have driven important efforts to reach a more sustainable housing sector through the promotion of energetic and environmental efficiency in housing.

This document seeks to inform the players in the housing sector at the three levels of government (local, state and federal), private and academic sector, international organizations and the general public about:

- 1) The main actions and programs that Mexico has driven in order to reduce polluting gas emissions and water consumption caused by housing.
- 2) The integral vision of the National Strategy for Sustainable Housing. In this regard, the programs that form it, their objectives, commitments, involved players and its itemization in three axis (financing, housing evaluation and definition of standards) are described.
- 3) The characteristics of Sisevive-Ecocasa, which was designed to complement the efforts on sustainability in Mexico. Among its objectives there is the unification and support of a national system of energetic and environmental efficiency evaluation in housing.

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4 INEGI, Población y Vivienda, Censo 2010.

5 CONAPO (Consejo Nacional de Población), Población en la República Mexicana al 1° de enero. Available in <http://www.conapo.gob.mx/es/CONAPO/Nacional>.

6 Supported NAMA for Sustainable Housing in Mexico - Mitigation Actions and Financing Packages.

7 *Idem*.

In this way, these questions are answered: What are the goals of the actions that encourage housing sustainability in Mexico? Who are the most relevant stakeholders involved? Whom is sustainable housing directed to? Where are these actions leading to?

It is to be highlighted that while in developed countries the promotion of sustainable housing started among the higher-income sector, Mexico has fostered the adoption of sustainability in the housing that belongs to the lower-income sector of population through organizations such as the CONAVI and the Infonavit, and recently also the SHF and the FOVISSSTE.

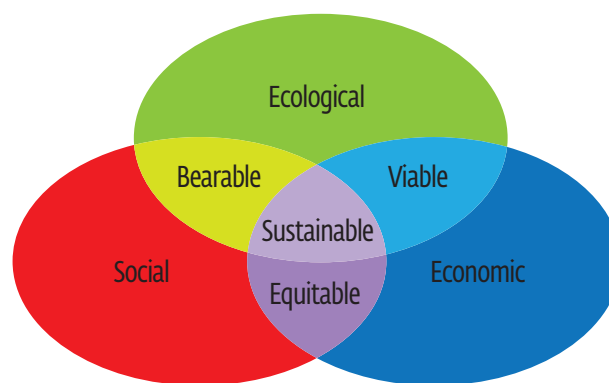
This document opens with a summary of global efforts and the leadership of Mexico on the mitigation of climate change and water conservation. Second, it describes the relevance of the housing sector for its size and growth expectation, as well as its environmental impact due to water and energy consumption. Third, it compiles the actions and programs that have been implemented in the housing sector in Mexico in order to grant the well-being of population and environmental sustainability. Fourth, it presents the goals and general characteristics of the national effort to promote housing sustainability. This document also explains the process in which these actions and programs coincide in a common and integral strategy for sustainable housing.

## 2. INTRODUCTION: CLIMATE CHANGE, LACK OF WATER AND HOUSING IN MEXICO

The biggest threats to sustainability in our planet in the medium and long term are climate change and water scarcity. Both are the result of inefficient and pollutant practices in daily human life, and endanger the social, economic and environmental stability at a global level. Therefore, it is mandatory that every country takes action in order to grant a more efficient use of energy and water for the sake of their current inhabitants and future generations. That means that as a global society we must radically modify our relationship with the environment and natural resources to preserve and respect them, and stop wasting and polluting, in order to guarantee a sustainable and integral development and a higher quality of life. In this challenge, *housing, as the place where many of the most basic human activities are carried out, must be the center of the integral strategy for sustainability.*

### What is meant by sustainability?

The concept of sustainability has been linked to that of sustainable development proposed by the Brundtland Commission and adopted by the UN since 1987. This commission defined sustainable development as that one which “satisfies present needs without compromising the needs of future generations.” The World Summit of 2005 outlined that the sustainability approach must reconcile three pillars: environmental, social and economic. That means the development of countries and individuals must be sustainable in these three areas, sacrificing one area for the others is not legitimate.



The Association of Sustainable Housing and Environment (VESAC, its Spanish acronym) which consists of the main public institutions in the housing sector, as well as some of the leading housing development companies and the Centro Mario Molina; defines a **sustainable house** as “the space through



which we can improve our standards of living, generate economic savings and increase the added value of our territory, while optimizing the use of resources like water, energy and land. This view also includes the creation of better structured and organized communities, in order for them to be competitive and responsive to the climatic conditions of each region of the country.”

Furthermore, the concept of sustainability in housing should be considered as an integral and multidimensional vision, which is not limited to the building edification and its interior, but also addresses the characteristics of the urban environment and the community.

Source: VESAC, Declaración conjunta para consolidar la sustentabilidad de la vivienda, March 29, 2012.

The environmental, social and economic impact that climate change has on life on Earth is alarming and it could have irreversible effects. Thus, as a first step to face climate change, countries around the world have decided –through conventions and global events– to reduce the excessive emissions of greenhouse gases that cause global warming. Climate change is, to a large extent, a consequence of the high level of CO<sub>2</sub> emissions that mainly are the result of the use and combustion of fuels such as gas, oil, carbon and wood. According to the International Agency of Energy, the main economic sector that produces greenhouse gas emissions worldwide is energy –approximately 80%.<sup>8</sup> Similarly, the not rationed use of electric power and use of low efficient devices in several daily activities contribute to global warming.<sup>9</sup>

At the same time, lack and uncontrolled use of water are a remarkable problem. The world’s annual water availability is approximately 1,386 million cubic kilometers, of which 97.5% is salt water and only 2.5% (35 million km<sup>3</sup>) is fresh water.<sup>10</sup> Out of this 2.5%, about 70% is not available for human consumption as it is contained in the glaciers, in form of snow and ice. Global warming causes melting of the glaciers and snow banks in mountains, excessive raining and droughts. Water is a non-renewable resource and it is essential for life on Earth.

With this regard, humanity faces the challenge and opportunity to fight these concerning phenomena by decreasing our GHG emissions and water consumption. To do so, we must use more efficient technology, cleaner sources of energy and modify our production and consumption habits. The solution is at hand, and every economic sector must contribute to build it up.

Although sustainability must be approached from different angles, the housing sector is particularly relevant due to its size and growth projection. According to the National Balance of Energy 2011, approximately 16% of energy use in the country belongs to the housing sector, which

<sup>8</sup> Secretaría de Energía (2010). Balance Nacional de Energía 2009.

<sup>9</sup> Fundación IDEA (2011). Energy and Environmental Efficiency in Housing.

<sup>10</sup> CONAGUA. (2011), Estadísticas del Agua en México, edición 2011, Capítulo 8 Agua en el Mundo, SEMARNAT.

is around 5% of total GHG emissions in Mexico.<sup>11</sup> In 2009, the water destined to housing represented 14.1% of the total public supply.<sup>12</sup>

We understand housing as the space (either a new or an existing house) where a family builds its home. An integral approach of housing recognizes that this space is not limited to the building, but rather it also takes into consideration the social and urban environment.

Given the above and the potential growth of consumption levels of water and energy in housing, the housing sector plays a very important role in the sustainability strategy in our country. Additionally, we must acknowledge that housing is the location for home, and thus the place where we as humans are raised. Therefore, the actions taken on sustainability in this sector have a collateral impact and contribute to generate an environmentally respectful culture.

In line with this challenge, several high impact actions have been taken in order to foster the construction and equipment of new and more efficient housing when it comes to water and energy consumption. It is to be highlighted that these actions have been focused on the low-income population. Not only are natural resources protected by doing so, but also the most vulnerable groups of society are favored by enabling them to have considerable savings in the use of water and energy. These programs have been successful; however, it is convenient to strengthen them through an integral view that takes Mexican housing to the next more ambitious level of sustainability.

On this note, Mexican policy on housing must acknowledge the fulfillment of the constitutional right of all Mexicans to a decent house as its first objective. Thus, this policy must firstly focus on housing to be welcoming, healthy, endurable (30 years, average) and that it contributes to enhance the quality of life of its inhabitants. The environmental goals have to coincide with this primordial objective.

During the last decade, the rate of housing construction has been very high, partially because of the improvement of financing mechanisms for the low-income population groups that belong to the formal sector, and because of the diverse subsidiary programs that favor the poorest families. Although it is predictable that this construction rate will decrease in the upcoming years, it will still be quite relevant. Plus, a growth in the market of second-hand housing is expected, as well as the use of renovation programs.

When talking about actions and public policy in Mexico, CONAVI, Infonavit and CONUEE are main players in the housing sector. CONAVI is the legally mandated organism in charge of coordinating the federal public policy of the housing sector. Lately, it has both fostered the design

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11 Secretaría de Energía (2012). Balance Nacional de Energía 2011.

12 CONAGUA. (2011), Estadísticas del Agua en México, edición 2011, Capítulo 3 Usos del Agua, SEMARNAT.

of a national strategy on sustainable housing, and directed the subsidies of the program “*Ésta es tu Casa*” to housing complexes that satisfy sustainability requirements. On the other hand, Infonavit, which gives 65% of the mortgage credits in the country, is one of the most influential players in the housing sector in Mexico. The institute has used its influence on the market to move the sector towards the construction of housing that is more efficient at water and energy consumption through programs such as “*Hipoteca Verde*”, and housing with better urban and community surroundings through the program “*Integral Life: Sustainable Housing*”. Finally, CONUEE, as responsible for defining the public policy on energy use efficiency, has fostered several programs and regulations that force the market to develop more efficient housing and household appliances. These organizations and their actions are described thoroughly in chapter 6.

While these actions and policy have been successful and have promoted a relevant change in the housing sector, a more ambitious transformation in terms of sustainability is necessary. Common practices in the sector must be changed, especially when it comes to design and construction materials, in order to encourage a bioclimatic vision as well as the inclusion of more efficient technology for water and energy consumption in housing that allows providing a greater well-being of its inhabitants without risking the environment.

To impulse this transformation, the institutions of the sector have decided to shape the National Strategy for Sustainable Housing, which considers the following principles among others:

- Evolving towards an integral and comprehensive concept of sustainable housing that encompasses housing and its surroundings.
- Encouraging the development of evaluation and analysis methodologies on housing behavior and the situation of the sector, accordingly to an integral and multidimensional vision.
- Encouraging bioclimatic design of housing fitted to the characteristics of each locality.
- Developing new high quality and efficiency building systems.
- Broadening the coverage of current programs and adapting them to a new integral vision to take sustainable housing in Mexico to a higher efficiency level and make it provide greater comfort to its inhabitants.
- Achieving more ambitious systems of energetic and environmental efficiency.
- Improving financing programs to make more efficient and comfortable housing affordable to lower-income families.
- Accessing national and international financial resources to make this transformation possible.
- Supporting the design of public policy that includes specific social groups that have been excluded in traditional programs.
- Fostering the development of a national green industry that innovates with new technology fitted to the current economic and climate circumstances in Mexico.<sup>13</sup>

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<sup>13</sup> Fondo de Desarrollo científico y tecnológico para el fomento de la producción y financiamiento de vivienda y el crecimiento del sector habitacional, CONAVI y Conacyt.

The strategy attempts to create awareness within the relevant players of the sector and the public on the economic, environmental, and quality of life-related importance of favoring environmentally-friendly housing, housing complexes and habits that consume less energy and water; that produce their own power and that are better located and in urban places that offer the required services for the optimal development of their inhabitants. Among these stakeholders involved, the ones in charge of public policy at the federal, state, and mainly, municipal levels in the housing and energy sectors, materials and technology suppliers and designers, business people of the housing sector, inhabitants, and private mortgage appraisers are worth mentioning.





**3**

# **BACKGROUND ON THE EFFORTS AGAINST CLIMATE CHANGE**

In order to understand the context in which the actions presented in this document happen, it is necessary to go over the characteristics of climate change and the commitments and measures taken locally and internationally to face this problem.

### 3.1 GLOBAL ACTIONS AGAINST CLIMATE CHANGE

#### What is climate change?

**Climate change** is the modification of the climate “directly or non-directly attributed to human activity, which alters the composition of the world’s atmosphere” adding itself to climate records on a global or regional scale. It is considered as one of the greatest environmental problems of our time.

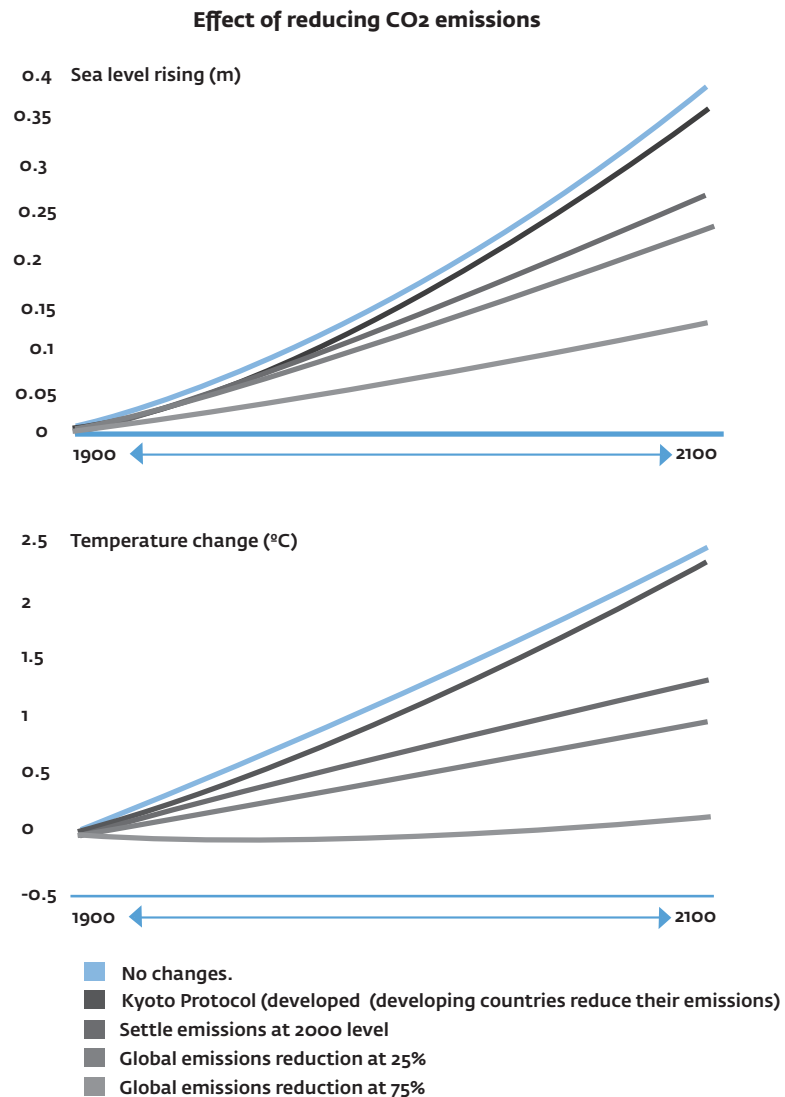
Source: CMNUCC, 1992.

Climate change is the result of the excessive generation of **greenhouse gases** (GHG) emitted by population growth, industry, deforestation, and above all, combustion of fossil fuels such as carbon, gasoline and other petroleum products. GHG such as steam, carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) are both naturally and human produced. The **greenhouse effect** is a natural atmospheric phenomenon that increases global temperature by retaining the energy from the sun.<sup>1</sup> GHG can retain and re-emit energy inside the atmosphere. The excessive production of GHG makes the Earth become a gigantic greenhouse as it absorbs energy that heats the planet.<sup>2</sup> This heating has negative and in some cases irreversible effects such as melting of glaciers, significant rise of the temperatures of the oceans, sea-level rising, soil degradation, changes in the raining patterns that cause floods or droughts and forest fires among others.<sup>3</sup> Figure 1 shows the predictable effects of climate change on the sea levels and the change of temperatures under several scenarios – what would happen if nothing were done to reduce GHG emissions, and on the contrary, what would happen if as society we are able to reduce CO<sub>2</sub> emissions at a maximum level of 75%.

<sup>1</sup> BBC World: “Global Climate Change - Greenhouse effect”.

<sup>2</sup> Instituto Nacional de Ecología (INE) de México: Baede, Ahlonsou, Ding, Schimel, “The Climate System: an Overview”, 2001. [www.grida.no](http://www.grida.no).

<sup>3</sup> INE, EEA, [www.globalpost.com](http://www.globalpost.com).

**Figure 1. Sea level and temperature effect by reducing CO<sub>2</sub> Emissions**

Source: BBC Mundo. Cambio Climático Global. El efecto invernadero.<sup>4</sup>

The data shown above supports the urgency to design effective actions in order to find ourselves in the scenarios that are described in the lower lines of the graphics. With this regard, several conventions, initiatives and global protocols have been created in order to define, debate, and agree on the possible goals and clear integral commitments to reduce GHG levels worldwide. Several global conventions such as Intergovernmental Panel on Climate Change (IPCC), the Earth Summit and the United Nations Framework Convention on Climate Change (UNFCCC) serve as examples of the efforts to construct a world agenda against climate change that have resulted on agreements for reducing GHG.

<sup>4</sup> BBC World, "Global climate change - Greenhouse effect" <http://www.bbc.co.uk/spanish/especiales/clima/reduced.shtml>.



It is important to briefly get to know some of these actions, as while their effectiveness has been limited in reaching the set goals, they are the international context in which a national sustainability strategy can and must be based on so that Mexico is able to reduce its GHG emissions.

The **United Nations Framework Convention on Climate Change (UNFCCC)** was founded in 1992 during the Earth Summit in Rio de Janeiro, Brazil. It is a general intergovernmental structure that provides a framework in order to find a solution for climate change for current and future generations. It acknowledges that climate change problem requires a common commitment from human kind, who is affected by the pollution caused by the industry.<sup>5</sup> In addition, developed countries – who both historically and currently are the ones that produce the highest levels of CO<sub>2</sub> worldwide – have committed not only to reduce their emissions, but to support the developing countries in their own reduction efforts. Since its foundation, Mexico has had an active role in the Convention, which has been strengthened during recent years.

**CO<sub>2</sub> emissions per capita in developing countries** are still relatively small, however, it is considered that the total proportion of emissions generated by these countries will increase in the short term, as these will require satisfying their needs of social and economic growth. The UNFCCC recognizes that the economies of these developing countries depend on the production, use and export of fossil fuels, which is why the UNFCCC seeks mechanisms to alleviate the difficulties these countries face in adapting their activities to reduce GHG emissions.

In order to reach this goal, developing countries need to increase their energy consumption, taking into account the possibilities of achieving greater energy efficiency through the application of new technologies that benefit their economy and their society. In many occasions these new technologies, due to its cost and complexity, are beyond the reach of developing countries. Support from developed countries via financing as well as technology and knowledge transfers, is critical to effectively implement this energetic transformation.

Source: CMNUCC, 1992.

The **Conference of the Parties (COP)**, founded in 1995, as a supreme organ of the UNFCCC has capacity of decision-making and is made up with all the nations that signed the Convention.<sup>6</sup> The most difficult task of the COP is to reach specific agreements that are measurable and feasible, in order to analyze achievements and obstacles. To do so, the **Kyoto Protocol** was signed in 1997, which is a legal instrument that establishes measurable commitments to limit the GHG

<sup>5</sup> UN (1992). United Nations Framework Convention on Climate Change.

<sup>6</sup> CONAVI (2011). Desarrollos Habitacionales Sustentables ante del Cambio Climático.

emissions during the period 2008-2012. The Protocol was not ratified by the United States, and it does not oblige China, India and Brazil as they are emerging economies.<sup>7</sup> The big difference between the Kyoto Protocol and the UNFCCC was that the first not only fostered GHG reductions, but it also compelled the developed countries to legally commit to quantitatively reduce their emissions by 5% accordingly to the levels in 1990.

To help the developed countries meet their goals on emissions reduction, and foster the involvement of the private sector in a global mitigation effort, the Kyoto Protocol includes three flexibility mechanisms: the Clean Development Mechanism (MDL), the System of Emissions Trading (SCE) and the Joint Implementation Mechanism (MIC).<sup>8</sup> These initiated the *carbon markets*, where reductions on GHG emissions are traded.

#### **What are carbon markets?**

Carbon markets are places where contracts are exchanged, sold and purchased in which one party pays the other for a certain amount of emission reduction of greenhouse gases.

Nowadays, COPs are the most relevant forums where countries discuss and agree the global actions to fight climate change in a joint and coordinate way.

### **3.2 MEXICO IN THE GLOBAL EFFORT AGAINST CLIMATE CHANGE**

In the last years, Mexico has taken relevant leadership at the global level to foster climate change mitigation actions in the COPs framework. An example of this was the recognition awarded to President Felipe Calderón Hinojosa during the COP15 in Copenhagen, Denmark in December, 2009, for the leadership he provided in placing environmental issues on the national agenda and on international funds successfully. The Global Legislators Association (GLOBE) –integrated by legislators from Brazil, India, Germany, France, Chile, China and the United States, among others– decided unanimously to give President Calderón the International Environmental Leadership Award.<sup>9</sup>

The same year, Mexico was recognized for its public policy on sustainable housing for programs like “*Hipoteca Verde*” of the Infonavit, and subsidy “*Ésta es tu Casa*” of the CONAVI (both further described in chapter 6) with the “International Star of Energy Efficiency” award, given by the “Alliance to Save Energy”.

<sup>7</sup> Canada quit the Kyoto Protocol in 2011.

<sup>8</sup> <http://finanzascarbono.org/finanzas-carbono/>.

<sup>9</sup> Blanca Valadez. Reconocen liderazgo de Felipe Calderón en cumbre del Cambio Climático. Milenio. Copenhagen, Dinamarca. December 17, 2009.

During the COP15, Mexico addressed the NAMA project as means to support the goals set in the Special Program on Climate Change (PECC, its Spanish acronym). Following up on this issue, the CONAVI and the SEMARNAT are currently developing a NAMA project, which is pioneer in the housing sector and will allow accessing international financing to strengthen the programs on sustainability for the sector by establishing volunteer emissions reduction goals (see 7.2.1).<sup>10</sup>

After the leadership recognized in the COP15, Mexico was appointed as host country of COP16, and responsible for directing its efforts to effective results. Being so, the 16<sup>th</sup> edition of the Conference of the Parties of the UNFCCC, and the 6<sup>th</sup> Conference of the Members of the Protocol of Kyoto (COP16/CMP6) were inaugurated in Cancun, Quintana Roo in 2010. There, a series of international commitments oriented to stop pollution and carbon emissions were established and a sustainable development plan that includes financing, research, technology, and economic development was introduced.

In the COP16, Mexico committed to reduce its GHG emissions by 50% by 2050, compared to the emissions emitted in 2000.<sup>11</sup> Also, Mexico proposed a **Green Climate** Fund with a 30,000 million USD financing for 2012, and a goal was set to raise it up to 100,000 million USD starting in 2020 using the contributions of developed countries. The aim of this fund is to finance mitigation action projects as well as climate change adaptation projects in developing countries.<sup>12</sup>

The Mexican housing sector had a remarkable participation in the agenda of the COP16. Its efforts to mitigate climate change were exhibited through formal and external forums.<sup>13</sup> For instance, the Companies Association for Energy Saving in Construction (AEAE, its Spanish acronym) organized the event “NZEH a Climate Change Solution: Global Perspectives” where leading private companies, suppliers, housing developers and construction companies gathered to work with national and international organizations on the positioning and fostering of the Energy Efficiency of Buildings.

Also, the pilot program Net-Zero (Zero Energy Homes) was presented. Within this context, the Federal Government, through the program “*Ésta es tu Casa*” – coordinated by the CONAVI, defined a basic package of ecotechnology that housing must have to access the federal subsidy. This basic package is part of the ecotechnology of Net-Zero housing (further information under the heading “International Organizations”).<sup>14</sup> Other forums took place, such as the meeting led by SEDESOL, SEMARNAT and CONAVI named “Towards low carbon cities in Mexico”, and the round table “NAMAs and its expectations as efficient public policy for facing climate change.”

<sup>10</sup> Diario Oficial de la Federación (Official Gazette of the Federation). Afternoon issue, August 28, 2009, p.27.

<sup>11</sup> SEMARNAT, definición de PECC, <http://www.semarnat.gob.mx/programas/semarnat/Paginas/PECC.aspx>.

<sup>12</sup> COP16/CMP6, Mexico 2010, [http://www.cop16.mx/es/sala-de-prensa/comunicados/press-releasesspeeches\\_2010121554062.htm](http://www.cop16.mx/es/sala-de-prensa/comunicados/press-releasesspeeches_2010121554062.htm).

<sup>13</sup> CONAVI, El Sector Vivienda Mexicano en la Cop 16, Cancún, Mexico, December 1, 2010.

<sup>14</sup> *Idem*.

After its participation in the COP16, the Federal Mortgage Company (SHF, its Spanish acronym), proposed to the most experienced housing developers in the area of energy efficiency, the implementation of a sustainable housing program with support of the Inter-American Development Bank (IDB), as the responsible agency for the Clean Technology Fund (CTF) and the KfW, through the program ECOCASA, which consists on pilot housing projects across the country. The aim of this new project is that housing reaches higher standards of energetic and water consumption efficiency taking bioclimatic design and ecotechnologies into account.

Furthermore, the **Association of Sustainable Housing and Environment** (VESAC, its Spanish acronym) was created under the direction of Dr. Mario Molina and it includes the participation of several main stakeholders involved in the national housing sector committed to the development of housing complexes and their urban surroundings that are more environmental friendly. This association comprises public institutions such as the CONAVI, the FOVISSSTE, the Infonavit and the SHF, and important companies such as Casas GEO, Consorcio ARA, Grupo SADASI, Grupo VINTE and URBI.<sup>15</sup>

The following year, during **COP17** in Durban, South Africa, the main objective was to continue the discussion about GHG emissions reduction, and agree on the continuation of the Kyoto Protocol, which expired in 2012. COP17 was an attempt to make commitments beyond the Kyoto Protocol in order to cut down the emissions; all this within a transparent effective context and following a binding international process.<sup>16</sup>

Mexico spoke for the renewal of the Kyoto Protocol, the fulfillment of the agreements in COP16 and reaching a consensual treaty. Also, Mexico asked the UN Secretary-General, Ban Ki-moon, to negotiate with the US and Saudi Arabia to achieve the approval of the Green Fund.<sup>17</sup> The NAMA for new housing was also presented and approved in the COP17, and it was confirmed that there are international institutions interested in financing it.

Recently, the XXI Assembly of Ministers of Housing and Urban Development of Latin America and the Caribbean (MINURVI, its Spanish acronym) took place in Mexico City. The MINURVI was created to build general agreements on public policy and foster regional coordination and cooperation on housing, sustainable urban and land development, and search solutions for current problems. A relevant statement was emitted, in which the following commitments are to be highlighted:

- Fostering sustainable development for human settlements, particularly developing sustainable cities that allow people to flourish.
- Decreasing the cities' environmental impact from an integral vision that takes housing unity, construction and territorial order into account.
- Specially, promoting the design, building and operation of adequate housing that

<sup>15</sup> Mesa Transversal, Tercera Sesión del Grupo Coordinador, Reporte de Avances y Resultados al 13 de Junio de 2012, Definición conjunta, p.2.

<sup>16</sup> COP17/CMP7, Durban, South Africa – Official Webpage

<sup>17</sup> CNN México. COP 17: Felipe Calderón pide a ONU mediar para que EEUU y Arabia Saudita aprueben Fondo Verde, December 7, 2011.

is strongly bound to its urban context, with access to basic services, infrastructure and equipment.

The Assembly decided to develop a collaborative and agreed strategy, according to each country's possibilities and necessities, and establishing standard methods and indicators that optimize regional strategies in order to compare and exchange data and experiences. The aim will be to have a higher linking of territorial and housing policies as well as an integral vision that takes the three aspects of sustainability into account.

In terms of environmental material, it was agreed to create regulations on the materials, elements and systems that encourage the development of local technology industries, in order to reduce water and energy consumption and incorporate renewable energy to social housing. The core ideas of this strategy are training, exchanging knowledge on better practices, group discussions and development of public policy.



**4**

# RELEVANCE OF THE MEXICAN HOUSING SECTOR

As mentioned before, sustainability comprises three approaches: social, economic and environmental. Although this document is mainly focused on the environmental dimension of sustainability, in order to view the problematic in an integral way, the way the economic and social aspects are influenced by the housing sector is also briefly depicted.

The **social component** of sustainability is related to the quality of housing because a house is not only a physical place, but also the place where people spend an essential part of their lives. It is the place where the most basic activities such as eating, sleeping and hygiene occur. Also, a significant part of individuality and private relationships are built inside houses, so its quality and surroundings are crucial for the appropriate individual and community development.

When it comes to housing, climatic design (which seeks thermal comfort), habitable space and appropriate distribution are all determinants to the degree of satisfaction each housing unit offers. Housing must provide people with high-quality affordable basic services and privacy. When it comes to housing's surroundings, mobility, accessibility, public services, education facilities, health and entertainment, and sources of employment and community building must be taken into account. It is also in housing and its surroundings where primary social relationships among neighbors and social capital can develop whenever there is diversity at socioeconomic and cultural levels. The combination of these elements is a central component of a sustainable society as it enhances the basic conditions for the lives and projects of people.

The **economic component** of sustainability is related to costs and benefits of housing, its location and services. First, it should be noted that the decision of purchasing or renting a place is one of the most important economic decisions a person makes, due to the direct and indirect costs of such decision. Specifically, the ownership of a house is a central factor in the stability of a family, and one of the main resources in times of economic stress – when the cost of the purchase is not above the capability of the families. The added value of a house in the middle and long term can also become an important asset for people. Finally, the expense of water, gas and power consumption, as well as transport in Mexican homes is most significant. The decrease on such expenses may represent important savings.

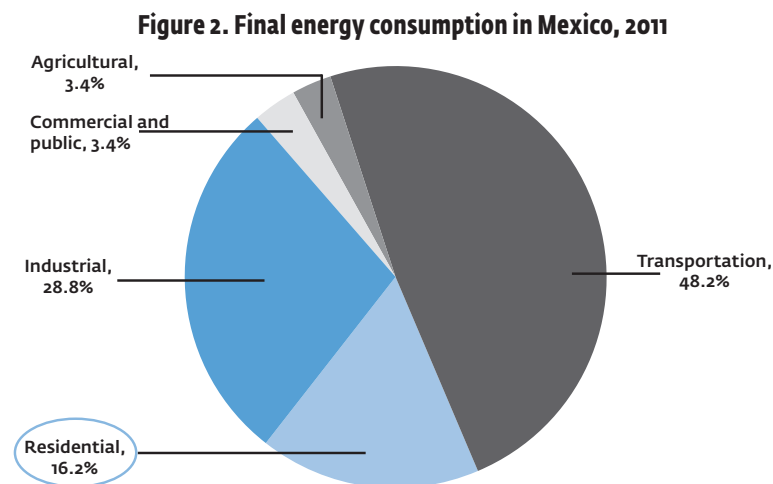
As for the **environmental component** of sustainability, housing plays a relevant role as a fundamental place for daily life of people, and therefore, in the way they relate with the environment. Particularly, housing is the place where energy and water are consumed for the fulfillment of basic human necessities. Also, housing has a deep environmental impact in its location: First, it transforms the use of the soil (from rural or agricultural to urban); second, for the availability of green areas within housing complexes, and third, for the level of efficiency of public services such as lighting, waste management, water uptake and treatment and irrigation, among others. Finally, the distance between housing and basic activity centers – employment, health center, education facilities, services and entertainment – determines the level of emissions that the transfer of people generates, being transport a major environmental impact factor in big cities.

## 4.1 ENVIRONMENTAL COMPONENT OF HOUSING IN MEXICO

According to the Census 2010, population in Mexico is about 112 million people, and it is expected to rise up to 137.5 million by 2050.<sup>1</sup> In addition, starting in the mid-20<sup>th</sup> century, population has tended to build up in urban zones. From 1950 to 2005, the population quadrupled and moved from being mostly rural in 1950 (57.4%) onto being preponderantly urban in 2005 (76.5%). In the third decade of this century, Mexico will approximately have 50 million houses.<sup>2</sup> It is expected that almost 11 million houses will be needed between 2011 and 2030, and about 9 million houses will require partial or total renovation within the same period.<sup>3</sup> This significant increase of population, housing and therefore, water and energy consumption represent major challenges across the country.<sup>4</sup>

It is also important to consider the accelerated way in which this growth has occurred. Between 1980 and 2010, the total surface of cities has grown by 492% while population grew by 96%. This is the result of a lack of public policy on land managing and higher density, which caused speculation on urban land, large vacant lots in the cities and the building of housing complexes far away from the main urban area. Being so, environmentally unfriendly cities were fostered.<sup>5</sup>

The housing sector has been identified by the Mexican government as an opportunity to look after population growth in a sustainable and responsible way with regard to emissions control and environmental goals. According to the National Energy Balance 2011, the housing sector was responsible for 16.2% (Figure 2) of the final consumption of energy in the country and the 4.9% (21.14 Tg of CO<sub>2</sub> eq per year) of national GHG emissions. Furthermore, actions taken on housing construction have a long-term impact: the life cycle of a house is at least of 30 years. This data shows the high potential of housing for GHG emissions mitigation.



Source: Balance Nacional de Energía 2011, SENER.

1 CONAPO Consejo Nacional de Población, "Proyecciones de la población de México 2010-2050". Available in <http://www.conapo.gob.mx/es/CONAPO/Nacional>.

2 Supported NAMA for Sustainable Housing in Mexico - Mitigation Actions and Financing Packages.

3 *Idem*.

4 *Idem*.

5 Sedesol (2011). La Expansión de las ciudades 1980-2010. México.



The rising number of houses, plus the desirable growth of purchasing power of Mexican families and therefore, their level of consumption,<sup>6</sup> project higher participation of the housing sector in water and energy consumption, thus, higher levels of GHG emissions in the near future. So, granting environmental sustainability for housing and families must be a priority in the public policy for this sector.

In this regard, those responsible for public policy, land developers and financial institutions at local and national levels accept the challenge to modify the incentives of the housing sector in order to change housing development and construction methods; to include and promote new technology for energetic efficiency; to apply bioclimatic design and adequate materials to local climate conditions; and finally, to generally introduce environmentally efficient technology and sustainable planning at the urban level. This is one of the main objectives that the National Strategy for Sustainable Housing pursues and it will be elaborated later in this document.

## 4.2 IMPACT OF THE HOUSING SECTOR IN THE ENERGY SECTOR

As seen before, the housing sector is one of the highest energy consumers in the country. This sector has increased its energy consumption by 0.2% annually during 2000-2010.<sup>7</sup> This pace of increase should be higher as the country reaches a higher development level, and more families can access technology that grant thermal comfort inside their houses specially under extreme climate conditions.

On the other hand, only 5% of the energy produced in México is renewable. Compared to the countries of the Organization for Economic Cooperation and Development (OECD), Mexico shows one of the most polluting schemes of energy generation, as CO<sub>2</sub> emissions per kilowatt at power and heat generation in Mexico are higher than the average of the OECD countries.<sup>8</sup>

Mexico and Brazil are the biggest consumers of liquefied petroleum gas (LP Gas) in Latin America, as they consume almost 60% of the total consumption in the region. LP Gas is highly inefficient in terms of pollution compared to alternatives such as natural gas or biomass. According to a study about of the liquefied petroleum gas market by the Ministry of Energy, it is expected that the demand of this fuel decreases by 60% during the period 2008-2024 in the housing and services sectors.<sup>9</sup> The gas consumption and emission generated to satisfy the demand of housing are particularly relevant in the regions where climate conditions require high power or gas consumption to grant well-being of the inhabitants.

Both the expected growth of housing and the polluting nature of the energy sector, allows to

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6 Families with a higher income have also a higher water and energy consumption. For example, housing of a higher socioeconomic level has a higher use of air conditioning and heaters for the provision of thermal comfort. In contrast, the lower consumption by lower socioeconomic level is oftentimes detrimental to the family's comfort and wellbeing.

7 SENER, Balance Nacional de Energía 2010. 2011.

8 IEA Statistics, CO<sub>2</sub> Emissions from Fuel Combustion, 2011 created by the International Energy Agency.

9 SENER, "Prospectiva del mercado de gas licuado de petróleo 2009-2024", [http://www.sener.gob.mx/res/PE\\_y\\_DT/pub/Prospectiva\\_gasLP\\_2009-2024.pdf](http://www.sener.gob.mx/res/PE_y_DT/pub/Prospectiva_gasLP_2009-2024.pdf).

measure the high impact that the housing sector currently has on the environment, and to foresee the significant impact it will have in the middle and long-term. Thus, the efforts that attempt to minimize such impacts will become more and more relevant.

### What is thermal comfort?

The concept of **thermal satisfaction** or **comfort** refers to the principle that the interior of the home must provide the optimum conditions of temperature, i.e., a temperature range in such a way that the demand for heating and cooling of the inhabitants is satisfied.

International law (for instance, norm ISO 73330) defines that the temperature range to maintain thermal comfort varies depending on factors, such as geographic location, time of year and orientation, among others. For the specific conditions of México, this implies that dwellings should be kept in the range of approximately 20 to 25 Celsius degrees in order to ensure thermal comfort.

Among the various roles that housing plays in relation to the well-being of its inhabitants, this document emphasizes the concept of internal thermal comfort. Due to several factors such as lack of thermal insulation technology, extreme temperatures and a predominantly hot climate, Mexican housing shows a high demand of cooling and heating and as a consequence a demand for devices that grant thermal comfort such as air conditioners. Unfortunately, these devices require a large amount of power making their impact very significant. Due to the low income of many households,<sup>10</sup> heating and air conditioning necessities are rarely satisfied through the use of these devices, affecting thermal comfort, and sometimes, the health of families.

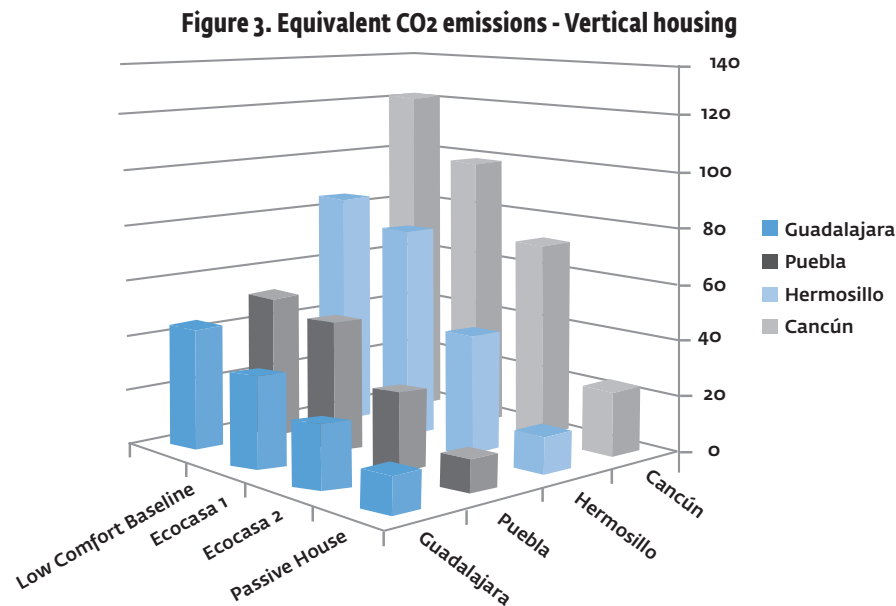
One determinant of the energy demand of a house is climate (temperature, solar radiation and humidity). Because of its location and topography, Mexico has a wide variety of climates. While two thirds of the Mexican territory is arid or semiarid with annual precipitations that are lower than 500 millimeters, the southwest is humid with precipitations that surpass 2,000 millimeters per year in some areas. On the other hand, in 2010 53.2% of the population lived in altitudes over 1,500 meters above sea level,<sup>11</sup> which causes lower temperatures during mornings and nights because of lower atmospheric pressure and lack of reflection of the sun.

The higher attention paid to arid regions over the temperate ones is due to their high energy demand in order to satisfy thermal comfort necessities of its inhabitants, and thus these regions cause a higher level of contamination. Specifically, the energy used for reducing the tempera-

<sup>10</sup> INEGI, “Encuesta Nacional de Ingresos y Gastos en los Hogares”, 2010. About 60% of Mexican families have an income of 10 thousand pesos per month or lower.

<sup>11</sup> CONAGUA (2011), “Atlas del agua en México: Contexto y Estadísticas del Agua en México, Contexto geográfico y socioeconómico”, SEMARNAT 2011.

ture inside homes, both through fans or air conditioners, might be excessive. For example, Figure 3 displays a graphic with simulations for the NAMA program on housing that were carried out by PHI. The high CO<sub>2</sub> emissions of housing located in hot climates due to higher energy consumption are emphasized in this graphic.



Source: Supported NAMA for Sustainable Housing in Mexico - Mitigation Actions and Financing Packages.

As seen before, energy demand in most housing located in extreme and hot climate regions is elevated. Even if many houses of lower social classes do not have air conditioners or cooling devices, this occurs detrimental to thermal comfort, and therefore, affecting life quality of the inhabitants. Ideally, when life quality is granted inside housing, families should be able to satisfy the energy demand for heating their houses under extreme cold conditions, or cooling (through air conditioning) in order to have a comfortable temperature inside housing in hot regions.

It is necessary to consider that easing thermal comfort in housing is required, which sets two possible scenarios: 1) Significantly increase energy consumption, or 2) Build bio-climatically designed housing and use more efficient devices, so that getting comfort will not involve an increase in energy consumption and therefore an increase in GHG emissions.

The first option is neither desirable environmentally, nor economically possible, which means the only way to obtain a high enough quality of life inside houses is through the implementation of energetically sustainable housing. It will minimize energy consumption and GHG emissions without compromising the well-being of its inhabitants. Development of the housing sector under green standards would prevent the emission of 1 to 1.5 tons of carbon dioxide per house, per year.<sup>12</sup> Besides being a solution of energy demand for thermal comfort, an energetically sustainable house would allow its users to save from 30% to 70% of power and gas expenses, which is very significant especially for the low-income sectors of population.

<sup>12</sup> CONAVI (2011), Supported NAMA for Sustainable Housing in Mexico - Mitigation Actions and Financing Packages.

Beyond extreme climate conditions, something that increases the energy demand within Mexican houses is the construction standard. In Mexico, the construction model that has been used during the last decade is a semi-detached or isolated housing model. Generally speaking, vertical housing has not been developed by housing complexes during the last years. This is relevant when considering that only 6.3% of Mexican housing is vertical.<sup>13</sup> This is contrary to sustainability efforts due to inefficient use of soil; plus, vertical housing is the least demanding when it comes to the energy required for thermal comfort as it has a lesser area exposed to the outside.

Secondly, the inefficient design of housing is another determinant. Big housing development companies use the same construction model regardless the local climate, ignoring the benefits of bioclimatic designs that pay special attention to orientation, altitude, shade and natural air circulation of housing. Standardized designs (or lack of adapted designs for each bioclimatic region) also result in an increased energy demand in order to satisfy thermal comfort for the inhabitants.

Thirdly, the predominant construction materials in Mexico (concrete and concrete blocks) are highly inefficient when it comes to thermal comfort for their high thermal conductivity compared to other construction materials. In general, these construction solutions do not include insulation materials that enhance the thermal properties of the building's envelope.

The sum of extreme climate, and isolated or semi-detached housing that lack bioclimatic design and are built with inefficient materials results in highly energy demanding houses; these houses either create high levels of consumption and high costs for their inhabitants or high levels of thermal discomfort, which can create health risks. The Strategy of Environmental Sustainability presented in this document seeks to change this situation.

### 4.3 IMPACT OF THE HOUSING SECTOR IN WATER CONSUMPTION

In order to estimate the environmental impact of housing, it is necessary to integrate measurements other than energy consumption. Some determinants to be taken into consideration are water consumption, waste management, environmental impact of the location of housing and the characteristics of its urban surroundings.

Among the above, water is a priority both for the vital role this resource plays in human life, and for the increasing problems on its availability worldwide. For example, water availability per inhabitant in Mexico has drastically decreased in later years from 18,000 m<sup>3</sup> by 1950 to only 4,422 m<sup>3</sup> in 2010.<sup>14</sup> This implies a low water availability according to international standards.

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<sup>13</sup> INEGI (2010), Encuesta Nacional de Ingreso y Gasto de los Hogares 2010 ENIGH 2010.

<sup>14</sup> CONAGUA (2011), "Agenda del Agua 2030", SEMARNAT, 2011. This could be explained basically by the population growth- in 1950 represented 40% of existing population- and the urbanization of the country.

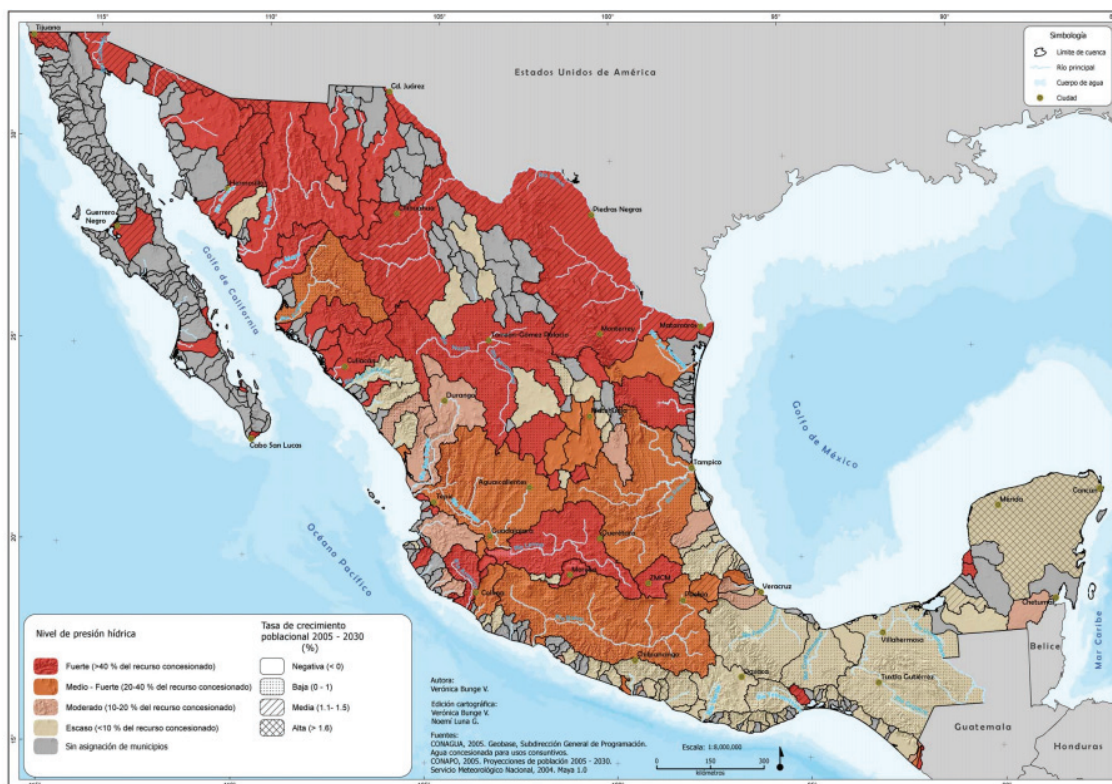
**Table 1. Water availability in the world**

Category	Availability (annual m3 per inhabitant)	Countries in the world
Very low	Less than 1,000	16%
Low	1,000 - 5,000	35%
Medium	5,000 - 10,000	14%
High	More than 10,000	35%

Source: Comisión Nacional de Fomento a la Vivienda, 2005.

It is to be highlighted that water is unevenly distributed across the country. For example, amongst the hydrological-administrative regions (RHA, its Spanish acronym) that the country is divided in, the south border has 23,835 m<sup>3</sup> per inhabitant per year while the Valley of Mexico has only 164 m<sup>3</sup>.<sup>15</sup> Furthermore, Mexico is going through a degree of pressure on water resources of 17.52% which is considered to be moderate.<sup>16</sup> However, as seen in figure 4, in the center, north and northeast of the country an elevated level of pressure on water is being experienced, as it is higher than 40%, and in the Valley of Mexico, pressure on water resources is higher than 100% (see figures 4 and 5).

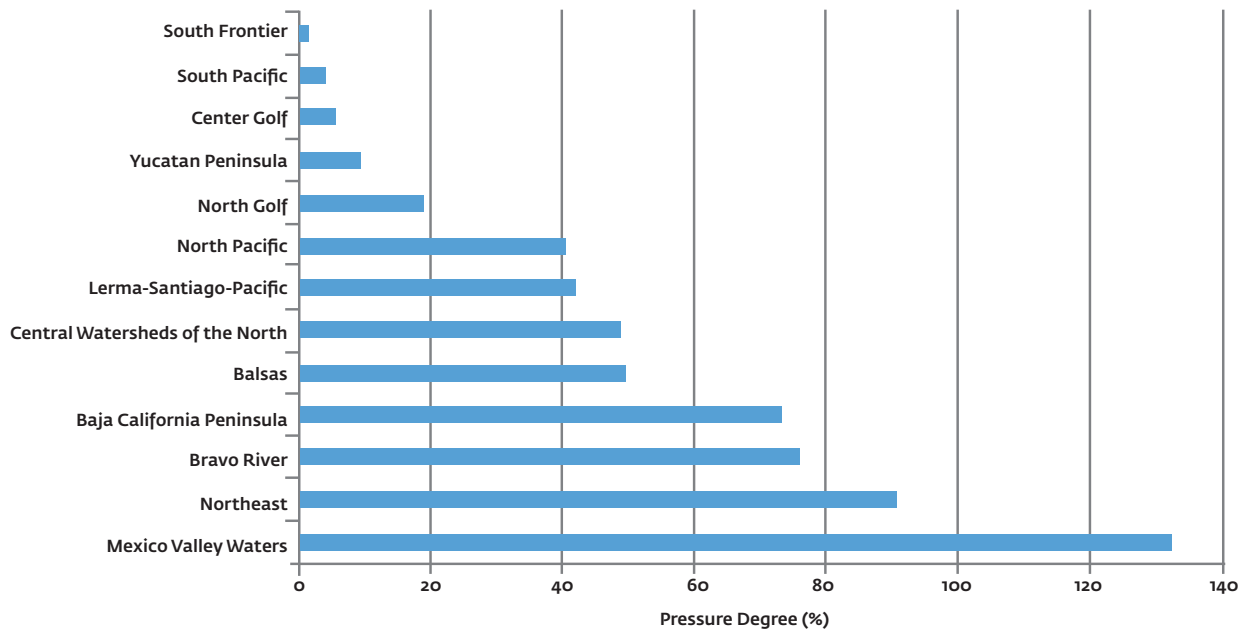
**Figure 4. Water pressure and population growth**



Source: La presión hídrica en las Cuencas de México, Instituto Nacional de Ecología (INE).

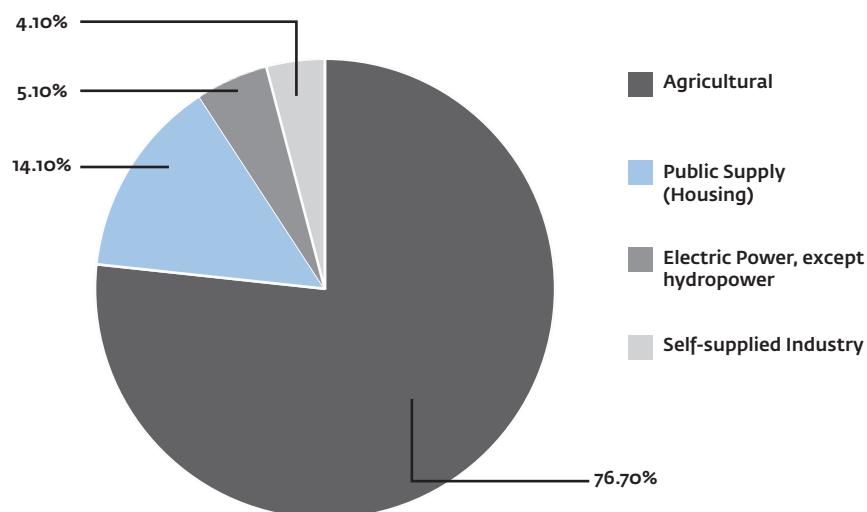
15 CONAGUA (2011), “Atlas del agua en México: Ciclo hidrológico”, SEMARNAT 2011.

16 Degree of pressure on water resources = 100\*(Total given amount of water volume/renewable water).

**Figure 5. Degree of pressure on water resources, by RHA, 2009**

Source: CONAGUA (2011), Estadísticas del Agua en México: Usos del agua. SEMARNAT 2011.

In 2009, the water destined to housing represented 14.1% of the total amount of water distributed for public supplies.<sup>17</sup> Having enough good quality water for human consumption is a basic demand of the population as it affects health and well-being directly. This is acknowledged in the National Development Plan 2007-2012 and the National Hydrologic Plan 2007-2012.<sup>18</sup>

**Figure 6. Distribution of allocated volumes for consumptive grouped uses, 2009**

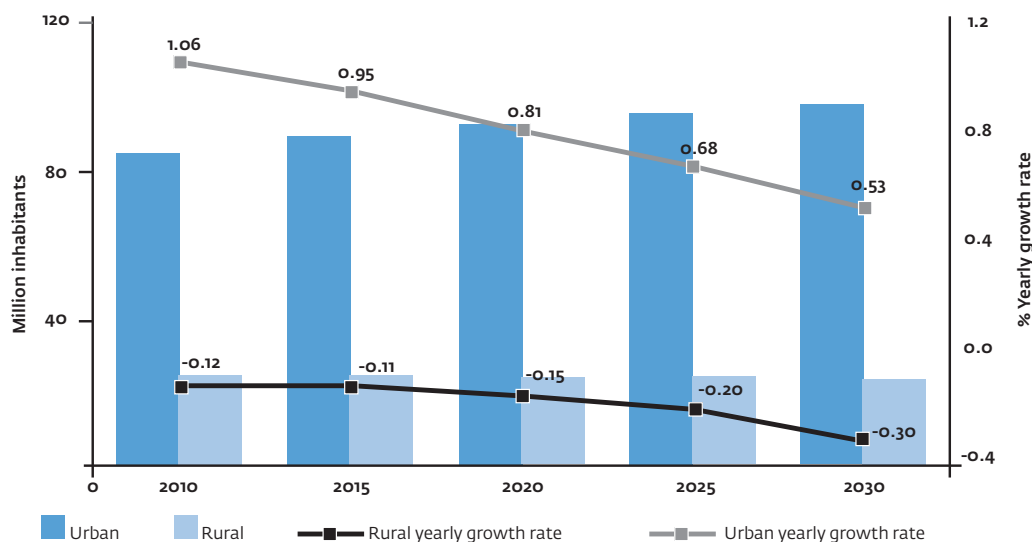
Source: CONAGUA (2011). Estadísticas del Agua en México: Usos del agua. SEMARNAT 2011.

<sup>17</sup> CONAGUA (2011), "Estadísticas del Agua en México: Usos del agua". SEMARNAT 2011.

<sup>18</sup> *Idem*.

Water consumption in housing has become an important component of the public policy due to the growth of the population and its concentration in urban areas. According to the National Population Council (CONAPO, its Spanish acronym), it is expected that during the period 2010-2030 the population will increase by 12.3 million people, and approximately 81% of the total population will live in urban areas, as seen in figure 7.<sup>19</sup> Population growth will cause reduction of renewable water per capita at a national level. The expected decrease is from 4,230 m<sup>3</sup> per inhabitant per year in 2010 to 3,800 m<sup>3</sup> in 2030.<sup>20</sup>

**Figure 7. Projected rural and urban population growth in México, 2010 – 2030**



Note: Population data interpreted as of December 31 of each year. It was considered that rural population integrates localities with less than 2,500 inhabitants, while urban population refers to settlements with 2,500 inhabitants or more. Source: CONAGUA. Subdirección General de Programación, 2010. Made from: CONAPO. Proyecciones de la Población de México 2005-2050, México, 2007.

Source: CONAGUA (2011). Estadísticas del Agua en México: Usos del agua. SEMARNAT 2011.

International studies suggest that one of the ways to grant water sustainability is by controlling and reducing its demand, as well as improving its management. This, given that what can be done about the supply side involves high financial, environmental and social costs, and would risk water availability for future generations.<sup>21</sup> Water consumption reduction appears as vital from the view point of higher efficiency and demand control.<sup>22</sup>

In Mexico, the lack and overuse of water represent a serious and growing threat to sustainable development and environmental preservation. As a result of urban population growth and because local surface and underground sources have stopped satisfying water demand, either

<sup>19</sup> *Idem.*

<sup>20</sup> *Idem.*

<sup>21</sup> Domene Gómez, 2004; Foro Mundial del Agua, 2006.

<sup>22</sup> Most available water is destined to agricultural use (76.7%) while 14% is destined to public supplies that include housing, commercial and industrial use connected to public piped water networks.

for pollution or depletion, many big cities have been forced to import water from even farther basins. This means that water overuse has a double negative impact on the environment: In one hand, the growing scarcity of this resource, and on the other hand, the elevated energy consumption – plus the implicit emissions – created by the necessity of transporting water from thousands of kilometers away to satisfy the cities’ demand.<sup>23</sup>

CONAGUA’s “*Agenda de Agua 2030*” (Water Agenda 2030) for Mexico suggests a series of measures in order to fulfill water necessities in 2030. The proposed solution considers technically possible measures that are rentable for their cost such as control of leaks, increased efficiency in water use and building new water infrastructure.<sup>24</sup>

Amongst the proposed measures, those linked to the housing sector might help to fulfill a reduction of 17% of the gap described above. These are:

- Leak fixing inside and outside housing.
- Reuse of irrigation in public green areas.
- Substitution of showers.
- Introduction of waterless urinals.
- Substitution of domestic toilettes.
- Reuse of treated water.
- Recharge of aquifers.

Based on the above, assuring water consumption efficiency in housing is considered a determining factor that must be considered amongst the actions and programs aiming to reduce its environmental impact.

## 4.4 SOCIAL HOUSING

In recent years, several initiatives of the Federal Government have aimed to reach housing sustainability. Opposite to the developed countries, where the adoption of sustainable measures for housing usually starts amongst the higher income sectors, in Mexico, these efforts have been implemented in social housing, which are precisely the ones that benefit the most from the economic savings of a green home: lesser electricity, gas and water consumption.<sup>25</sup>

As seen before, the population of the country is going to keep growing, thus housing supply, required services and urban integration will remain extremely important. Not only has the public policy on housing focused on social housing for the great need of progress and supply this sector has, but also because the opportunity of building sustainable housing modifies the way that the population relates to the environment. The way in which society creates new habits encourages large scale sustainable awareness and minimizes GHG generation at home.

23 CONAGUA (2009), “Situación del Subsector Agua potable, Alcantarillado y Saneamiento”, SEMARNAT 2009.

24 CONAGUA (2011), “Agenda del Agua 2030”, SEMARNAT 2011.

25 Fundación IDEA (2011), op. cit.



It is expected from the 6 million houses that were purchased during the government of President Calderón, at least 1 million will fulfill sustainability criteria.<sup>26</sup> By 2011, 596,268 sustainable houses have been completed, and it is estimated that each one has mitigated from 1 to 1.5 tons of CO<sub>2</sub> emissions per year.<sup>27</sup>

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<sup>26</sup> CONAVI (2011), Supported NAMA for Sustainable Housing in Mexico - Mitigation Actions and Financing Packages.

<sup>27</sup> SEMARNAT (2011), Vivienda Sustentable en México.

**5**

# **CURRENT POLICY AND PLANNING INSTRUMENTS FOR SUSTAINABILITY IN THE HOUSING SECTOR**

In the face of the impact that climate change has had and the potentiality that Mexico has in working towards its mitigation through sustainable housing, the Federal Government has made significant efforts to include and emphasize the importance of environmental sustainability in its public policy and actions on housing.

The regulatory framework is contained in three relatively recent fundamental laws: The Housing Act, the Sustainable Use of Energy Act and the Climate Change General Act. First, the **Housing Act** was passed in 2006 and establishes the regulatory guidelines for the National Policy on Housing, as well as the necessary instruments and backing for the development of this sector considering the sustainability components and the institutions' coordination and relation with the public and private sector.

This law grants new powers to the CONAVI over design, evaluation and monitoring of the National Policy on Housing. In this way, it establishes the competencies of this institution mainly on program coordination and lines of action with the participation of the public, private and social sectors, amongst other authorities.<sup>1</sup>

Another innovative aspect of this Act is that it establishes as a priority for the National Policy on Housing that territorial organization and urban development consider sustainability as an important factor.<sup>2</sup> Also, it is specified in Article 73 that the actions financed with federal resources that are related to soil and housing must observe the guidelines on equipment, infrastructure and surroundings set by the Ministry of Social Development (SEDESOL, its Spanish acronym) as established in the General Act of Human Settlements.

SEDESOL created a project of guidelines in 2009.<sup>3</sup> The project set the conditions of equipment, urban design and location to be fulfilled by all housing developers in order for them to be financed by public federal organizations. These guidelines are still under public consultation.

Second, on November 28<sup>th</sup>, 2008, the Sustainable Use of Energy Act was passed. It aims to foster sustainable exploitation of energy through its optimal use in all its processes, activities and consumption.<sup>4</sup> The Act establishes that the **Ministry of Energy (SENER** in Spanish) is to lead political decisions on energy efficiency while the execution and supervision of measurements, projects and programs are responsibility of the **National Commission for Energy Efficiency (CONUEE)**.

1 Cámara de Diputados. (2006). Ley de Vivienda. Art.19.Párrafo IV.

2 These provisions are set in the Sixth Title, "Of Quality and Sustainability in Housing", of the "Ley de Vivienda", Mexico.

3 Available in: [http://www.sedesol.gob.mx/work/models/SEDESOL/Resource/1582/1/images/art\\_73\\_31-08-09.pdf](http://www.sedesol.gob.mx/work/models/SEDESOL/Resource/1582/1/images/art_73_31-08-09.pdf).

4 Cámara de Diputados del H. Congreso de la Unión. (2008). Ley para el Aprovechamiento Sustentable de la Energía.

Article 26 of the Act confirms the responsibility of the CONUEE to award certification on processes, products and services with regard to the degree of incorporation of energy efficiency, as well as the degree of regulations fulfillment. In compliance with these provisions and what the National Program for Sustainable Energy Use (PRONASE, its Spanish acronym) establishes, in September of 2010, the CONUEE published the **Promotion program for certification of products, processes and services**, which considers energy efficiency of housing amongst others (see section 6.7 for further information).

Finally, on June 5<sup>th</sup>, 2012, the **Climate Change General Act** came to effect, which commits the country to reduce its GHG emissions and avoid deforestation.<sup>5</sup>

The main elements of the Act are: a) Implementation of national goals to mitigate 30% of GHG emissions by 2020, and 50% by 2050, b) a new institutional framework that establishes the participation of the three levels of government, the private sector and the society, and c) a series of adaptation measures for facing the climate change effects.

In order to meet these goals, the following regulatory instruments were established: Periodic evaluations by an independent board which is integrated by representatives of the scientific community, private institutions and the civil society, the National Inventory of Emissions, the National Registry of Emissions and the voluntary system of carbon credit market. Furthermore, the Inter-secretariat Commission of Climate Change was raised to the category of Act, and the National Institute of Ecology and Climate Change was created to coordinate research and evaluation of public policy on climate change.

This new law confirms Mexico's long term vision, as one of the first developing countries to create a national policy to work against climate change, which was presented in 2007 and later constituting the PECC in 2009. When signing the decree, President Calderón informed that Mexico has met 87% of its goal to reduce 51 million tons of carbon dioxide by 2012.<sup>6</sup>


This legal context supports the programs and actions that Mexico has developed in recent years to fulfill the sustainability goals set for the housing sector in the National Development Plan 2007-2012 (see figure 8).

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5 Cámara de Diputados. (2012). Ley General de Cambio Climático. México.

6 Presidencia de la República - <http://www.presidencia.gob.mx/2012/06/decreto-de-la-ley-general-de-cambio-climatico/>.

**Figure 8. National project for environmental sustainability in the housing sector**

	National Development Plan (PDN) 2007-2012
	Sectorial Program of Energy (PSE)
	National Housing Program (PNV) 2007-2012
	National Program for Sustainable Use of Energy (PRONASE)
	Transversal Program of Sustainable Housing (PVS)
	Special Climatic Change Program (PECC)

The **National Development Plan 2007-2012** assumes as its basic premise the search of Human Sustainable Development<sup>7</sup> and includes environmental sustainability as one of its core ideas.<sup>8</sup> For the first time, the goals and lines of action to reduce the impact of climate change are explicitly set. The PND acknowledges the uneven distribution of water, and it emphasizes the urgency of rationing it to avoid negative effects on the economic and social development of the population due to the fact that the supply consists of 6 km<sup>3</sup> per year.<sup>9</sup> According to the PND, the SENER is responsible for creating the **Sectorial Programme of Energy (PSE**, its Spanish acronym) and setting the commitments of the federal organizations and institutions on energy issues. This program includes the specific goals for 2012 on consumption savings and GHG reduction and it defines objectives and actions for energy efficiency.

Likewise, the **National Housing Programme (PNV**, its Spanish acronym) was created for the 2007-2012 period. The PNV regulates the governmental efforts on housing such as increasing financing programs for housing offered to the population, fostering sustainable housing development, consolidating the National System of Housing through enhancements of public management, and strengthening the public policy of supports to low-income families in order to provide them with access to financing programs with the end goal of encouraging sustainable housing development.

In turn, the objective of fostering sustainable housing development takes into account these lines of action:

<sup>7</sup> Meaning the search of a permanent process of abilities and liberties widening that allows all Mexicans to lead a worthy life without endangering the inheritance of future generations.

<sup>8</sup> Plan Nacional de Desarrollo 2007-2012, Presidencia de la República. [www.presidencia.gob.mx](http://www.presidencia.gob.mx).

<sup>9</sup> Plan Nacional de Desarrollo 2007-2012, Presidencia de la República, Aprovechamiento Sustentable de los Recursos Naturales.

- Instigating the construction of sustainable housing complexes by fostering a certification program, making “Green Mortgage” institutionalized in the national housing organizations and implementing Sustainable Integrated Urban Developments, among others.
- Fostering the availability of land for sustainable development.
- Promoting the upgrade of regulatory frameworks on housing for states and municipalities, modernizing regulations on construction.
- Supporting the maintenance, enhancement and broadening of current urban and rural housing, promoting credits without a mortgage warranty.<sup>10</sup>

In addition to the PSE and the PNV, the **National Programme for Sustainable Energy Use (PRONASE)** attempts to implement a policy on sustainable exploitation of the final uses of energy such as lighting, transport, household appliances and constructions, among others. These represent 56% of the national energy consumption (2008) and more than 90% of this is concentrated in the transport, industrial, housing and commerce sectors.

Both on energy efficiency and sustainable use of energy, these programs include several measures and policies that directly impact the housing sector. Specifically, the PSE fosters energy efficient technology adoption through policy and financial mechanisms in social housing. It establishes energy efficiency requirements in order to obtain financing to purchase a home through CONAVI, Infonavit, and FOVISSSTE. On the other hand, the PRONASE encourages measures that increase the number of energy efficient household appliances and lighting devices as well as establish criteria for house construction.

In order to unify efforts towards the coordination of public policy of sustainable housing, the SENER, the SEMARNAT and the CONAVI signed a collaboration agreement in 2008 to coordinate the **Transversal Programme of Sustainable Housing (PVS)**, its Spanish acronym), which aims to transform the concept and practices of housing construction for social housing and through this, contribute to environmental sustainability and enhancement of quality of life for Mexicans.<sup>11</sup>

The PVS establishes the development of sustainability criteria and recommendations for the main transversal areas such as energy, water, and solid waste. In order to foster housing sustainability and diminish the necessity of increasing the availability of public services, programs of rationed use of resources and incorporation of renewable energy is taken into account.

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<sup>10</sup> Sistemas Integrales de Gestión Ambiental, S.C. Demostración de Adicionalidad y Criterios de Monitoreo para un MDL de Desarrollo Habitacional Sustentable en México, [http://www.ine.gob.mx/descargas/climatico/e2008f\\_md1\\_hab.pdf](http://www.ine.gob.mx/descargas/climatico/e2008f_md1_hab.pdf).

<sup>11</sup> SENER, Diario Oficial, Primera Edición, 6 de Agosto 2009, p.18.

Additionally, the Federal Government created the **Special Program of Climate Change (PECC**, its Spanish acronym) for the 2009-2012 period as an initiative that attempts to demonstrate the interest and contribution of Mexico to the global solution to climate change and to show that adaptation and change is possible without endangering the development process, while obtaining social, environmental and economic benefits.<sup>12</sup> Four main elements are considered for developing an integral policy to integrate the PECC: long term view, mitigation, adaptation, and elements of transversal policy.<sup>13</sup>

The PECC has 105 objectives and 294 goals, classified into:<sup>14</sup>

- Emissions reduction: Energy efficiency, fuel substitution and use of low or zero carbon technology, infrastructure and services modernization, deforestation and degradation, and access to the carbon markets.
- Strengthening of mitigation capabilities: Institutional and economical instruments, and studies.
- Vulnerability reduction: Ecological restoration and preservation, sustainable use and exploitation of natural resources, and adaptation and modernization of large infrastructure.
- Strengthening of adaptation capabilities: Through institutional instruments - multi governmental level, through modernization of infrastructure and cities.
- Strengthening of other transversal capabilities: Through institutional instruments and studies.

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12 SEMARNAT, Programa Especial de Cambio Climático. <http://www.semarnat.gob.mx/programas/semarnat/Paginas/PECC.aspx>.

13 COP16/CMP6 official website: <http://www.cop16.mx/es/mexico-y-el-cambio-climatico/investigacion-sobre-cambio-climatico-programa-especial-sobre-cambio-climatico-pecc/index.html>.

14 SEMARNAT, Programa Especial de Cambio Climático.

**6**

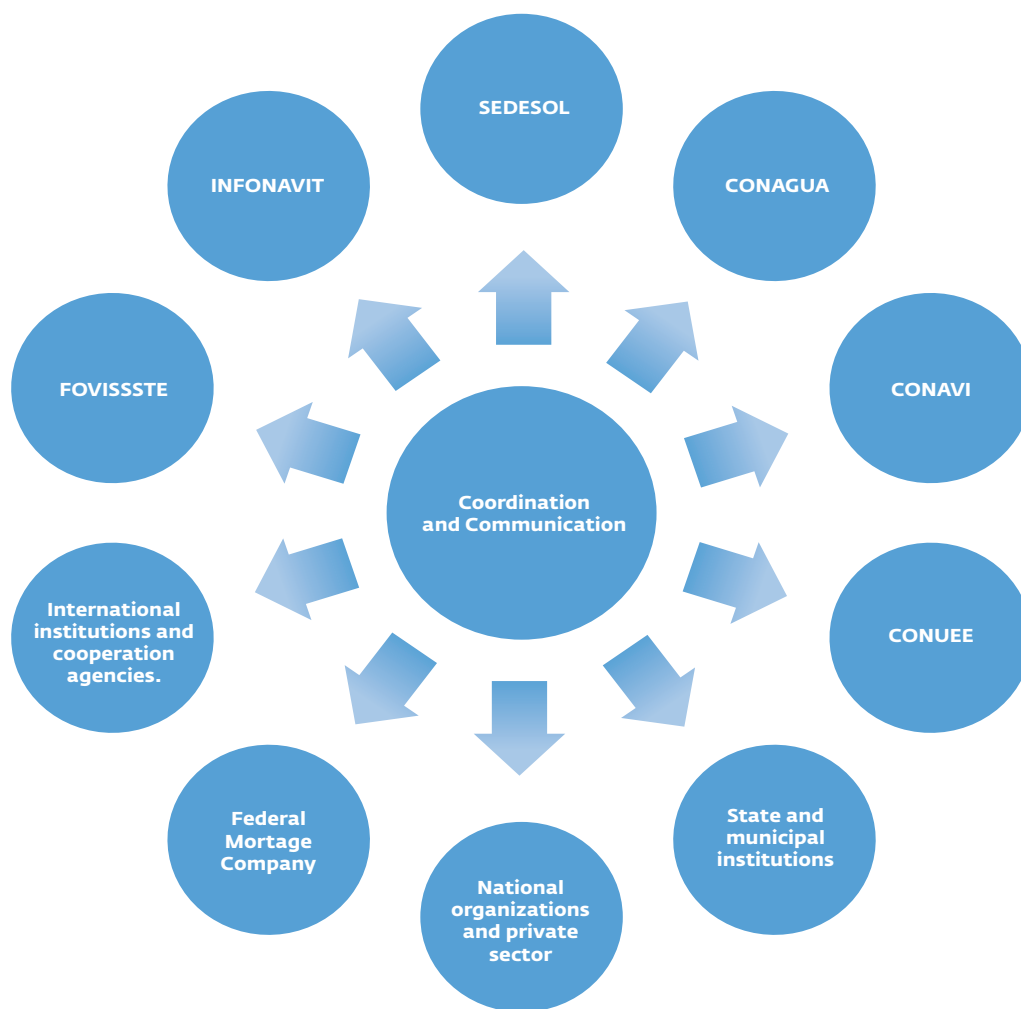
# **MEXICO: OPERATIVE PROGRAMS AND CURRENT ACTIONS FOR SUSTAINABLE SOCIAL HOUSING**



## 6.1 STAKEHOLDERS INVOLVED

Within a sustainable social housing strategy, federal, state, local and international actors need to promote housing that provides its inhabitants with a higher quality of life without endangering the welfare of future generations. In this section, the main stakeholders in the housing sector in Mexico from the federal, private and international sectors are briefly described. Coordination and communication among them are fundamental in order to attain the goal of raising the number of sustainable houses (see figure 9).

**Figure 9. Main stakeholders involved in the housing sector in Mexico**



Source: Elaborated by Fundación IDEA.

### CONAVI

The **National Housing Commission** is the federal organization in charge of coordinating the promotion of the housing sector, supervising that federal objectives on housing are met and that all this is done observing the PND 2007-2012 and the PNV 2007-2012: towards sustainable

housing development. The Housing Act passed in 2006 appoints the CONAVI to supervise the actions on housing considering urban development, territorial organization and sustainable development.<sup>1</sup>

In fulfillment of its mandate, the CONAVI develops and fosters financing, subsidies and saving programs and mechanisms for housing purchasing, which are directed towards low-income families. Since 2007, the CONAVI carries out the program “*Ésta es tu Casa*” (Spanish for This is your House), which aims to support the lower-income sector of society in accessing a housing solution by getting a subsidy through the following methods: purchasing a new or a second hand house, purchasing a piece of land with auto-construction service, and enlarging or renewing a house. The subsidy given varies according to the modality or the value of the house or project.<sup>2</sup>

### INFONAVIT

The **Institute of the National Housing Fund for Workers** is an institution created by a law mandate and run by an Assembly formed by laborers’ representatives, employers and the Federal Government, all equally apportioned. The Institute was created in response to the workers’ request to fulfill their right to purchase decent housing.<sup>3</sup> The Institute’s mission is to provide laborers and their families with integral welfare through: 1) Giving affordable credit solutions for them to solve the necessity of housing in sustainable environments and competitive communities, 2) generating competitive profits for the housing sub-account, and 3) offering information and advice on savings, credits and choices of housing for the workers to build their assets. According to Article 5 in Infonavit’s Act, Infonavit has three main financing sources: Employer’s contributions of up to 5% of laborers’ salaries destined to the Housing Fund, the recovery of the loans it provides, and the contributions in currency, and subsidies and services from the Federal Government.<sup>4</sup>

Nowadays, the Infonavit is a key player in the housing sector for it gives about 69% of the mortgage loans in the country, nearly 500,000 loans per year. It should be noted that 76% of its beneficiaries earn less than 4 minimum wages on a yearly basis. The Institute has been an important driver of sustainable housing, especially through the program “*Hipoteca Verde*”.

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1 [www.conavi.gob.mx](http://www.conavi.gob.mx).

2 Fundación Idea (2011) pp.23-25.

3 INFONAVIT, Historia y Perfil Institucional.

4 Pardo María del Carmen y Velasco Ernesto. El proceso de modernización del INFONAVIT 2001-2009.

## CONUEE

The **National Commission for Energy Efficiency**<sup>5</sup> (CONUEE) aims mainly to foster energy efficiency and functions as a technical organ in matters of the sustainable use of energy. Regulation, design and implementation of public policies for sustainable energy use as well as promotion, diffusion, information and evaluation activities on energy issues are among some of its faculties. It is responsible for executing and supervising programs; advising the public sector; reaching coordination agreements at the state and local levels; and organizing activities for sustainable energy use with the private sector. It is also responsible for the regulation, certification, and verification of the Official Mexican Norms on energy efficiency.

One of CONUEE's most relevant spheres of action is the housing sector as an important consumer of energy. In this regard, the Commission promotes sustainable housing with elements –house envelope, household appliances, and thermal comfort devices, amongst others– that decrease energy demand and have efficient energy consumption.

## CONAGUA

The **National Water Commission** is a decentralized organ of SEMARNAT in charge of managing the country's water resources. The National Water Act grants this institution with the faculty to formulate and propose the national policy on water, as well as to monitor and evaluate its fulfillment. It also aims to foster the efficient use of water and its preservation, increase the water network in the country and enhance the administrative and technical development of the water sector, among others.

The CONAGUA is vital for sustainable housing due to the regulations on efficient use of water, for it establishes the standards at the house and housing developments levels. In housing, the regulations emitted by CONAGUA establish the maximum levels of consumption permitted for devices such as toilets, showers, laundry machines and faucets. Likewise, regulations have been emitted on water network hermetism in order to reduce leaks, and treatment and reuse of water.

## SEDESOL

The **Ministry of Social Development**, through the Sub-ministry of Urban Development, is in charge of designing and implementing land policy focused on fostering and evaluating social development in housing guided by the objectives of reducing poverty and promoting competitiveness, employment, sustainability and quality of life.

Regarding sustainability, SEDESOL directly participates in implementing and supervising the

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<sup>5</sup> The CONUEE substituted the National Commission for Energy Saving (CONAE, its Spanish acronym) since 2008.

Sustainable Integrated Urban Developments (DUIS, further elaborated later on). It also created the guidelines project that will establish basic sustainability conditions for housing complexes that receive federal subsidies and financing, according to Article 73 of the Housing Act.

#### FOVISSSTE

Created in 1972, the **Housing Fund of the Institute of Social Security and Services for Government Workers** is an ISSSTE decentralized organ. It is a pension fund for workers of the public sector that allows financing economical mortgage loans.

Since its foundation until 2011, the Housing Fund has financed a total of 559,571 loans for housing, achieving to satisfy 27.56% of the 2,029,980 laborers under the ISSSTE regime, regardless the Extraordinary Program of Credit, which is currently run through the SHF.

#### SHF

The **Federal Mortgage Company** was founded in 2001 aiming to foster the development of primary and secondary markets for social housing financing, through loans and warranties destined to housing construction, purchase and enlargement, as well as to increase market's productivity.

The SHF is a second-tier development bank, which means it does not work directly with construction companies and housing promoters, but it supports financial intermediaries such as Limited Scope Financial Institutions (SOFOL, its Spanish acronym) and Multi-Scope Financial Institutions (SOFOM, its Spanish acronym), who are the ones in charge of giving and running the loans.

The SHF programs foster appropriate conditions for Mexican families to access mortgage loans and purchase decent houses, built with modern technology, functional spaces and services, and legal security.

Through the DUIS and ECO CASA program initiatives, the SHF has contributed to the efforts of several institutions concerned by the environmental performance and housing energy efficiency. The purpose of the program is that lower-income families can purchase energy efficient housing that provides comfort and allows them to save on water and energy expenses.

#### State and municipal organs for housing and planning

The Mexican Constitution, in Article 115 section V, establishes that Municipalities perform basic duties linked to urban planning, services granting, and development of the housing sector. In this regard, Municipalities are the sphere of action where all efforts of city planning and construction of sustainable housing should materialize.

Often, Municipalities fulfill these responsibilities with the support and collaboration of the states, which play a fundamental role in urban planning and local policy generation to guarantee that inhabitants have access to decent housing.

### National Organizations and Private Sector

The efforts to promote sustainable housing have found relevant support in the private sector and national representative organizations of the housing sector such as:

- Association of Sustainable Housing and Environment (VESAC, its Spanish acronym) a public-private organization aiming to strengthen a sustainable housing development scheme to 2030 (<http://www.ves.ac/contenidos.aspx>).
- Companies Association for Energy Saving in Construction (AEAEE, its Spanish acronym), which aims to promote the positioning of energy efficiency in construction (<http://www.ahorroenergia.org.mx/>).
- National Association of Household Appliances Manufacturers (ANFAD, its Spanish acronym),
- Mexican Chamber of the Construction Industry (CMIC, its Spanish acronym, <http://www.cmic.org/>).
- National Chamber of Housing Promotion and Development Industry (CANADEVI, its Spanish acronym), that seeks to integrate the housing development sector (<http://www.canadevi.org/#quienes-somos/index.aspx>).
- Individual housing developers and constructors.

### International cooperation agencies and organizations

In recent years, several international cooperation agencies and organizations have become relevant allies in the promotion of sustainable housing. They share resources and knowledge in order to subsidize and transfer technology as well as best practices. It is important to note the cooperation of the governments of Germany, the United Kingdom, France and the United States, as well as the participation of the Inter-American Development Bank, the KfW and the World Bank in these endeavors.

## 6.2 PROGRAMS AND ACTIONS

The goals of the Federal Government and national and international organizations towards the mitigation of climate change have been materialized in specific programs. The purpose of these programs is to create energy efficient housing, diminish GHG emissions, reduce water consumption and improve the quality of life for Mexicans. In order to know and understand how

these programs work, it is of prime importance to look at their objectives and achievements for these have been fundamental in order to learn from the gained experience, set more ambitious goals based on this and implement the necessary mechanisms to meet them. The long term goal must be that the vision of these programs are compatible, so that housing sustainability is developed through more integral actions shared by the institutions and stakeholders involved.

The functioning, objectives, achievements and institutional long term vision of the programs that seek the development of sustainable homes and housing environments are presented below:<sup>6</sup>

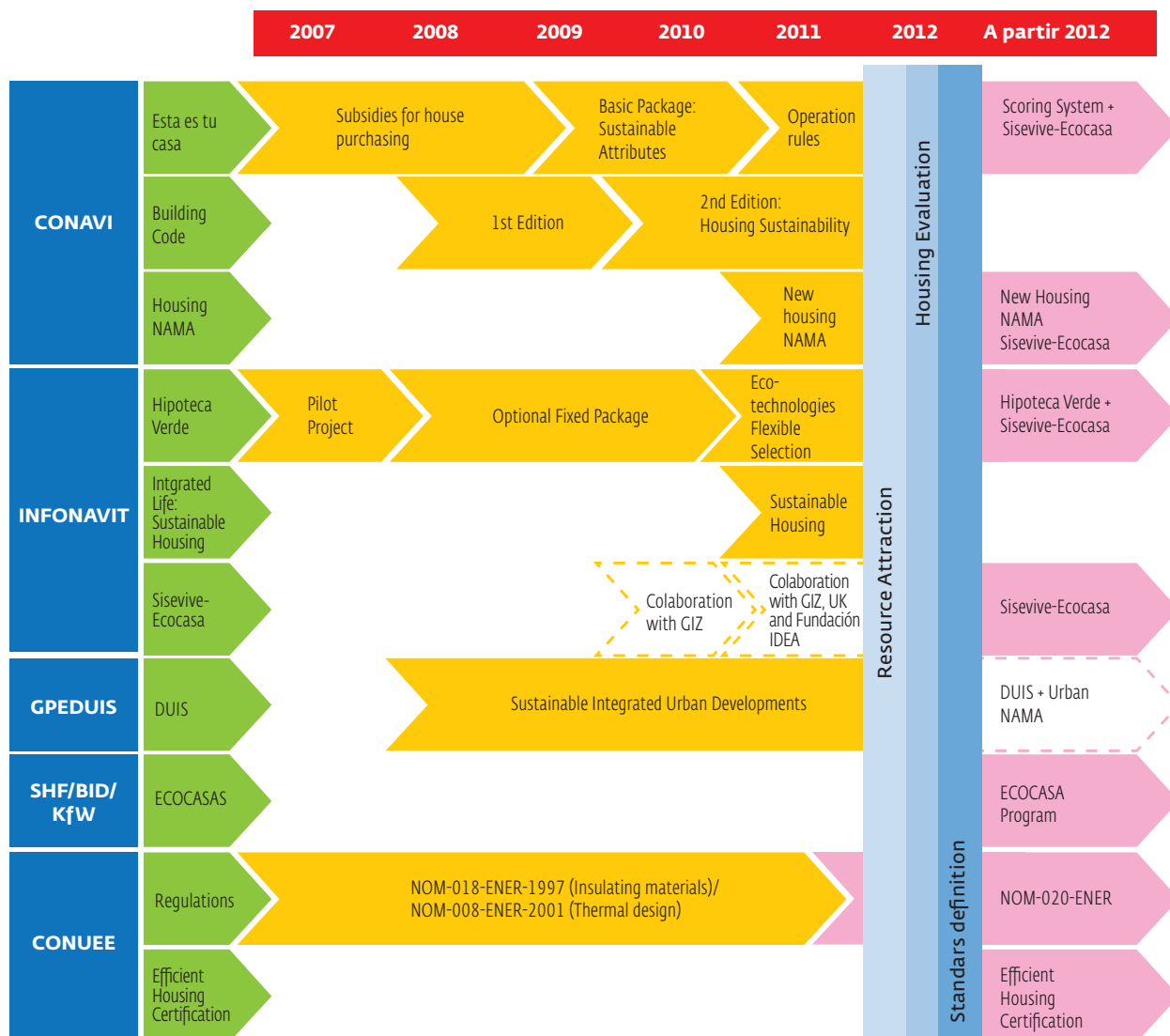
- “Hipoteca Verde” (Green Mortgage) – Infonavit
- “Ésta es tu Casa” (This is your house) – CONAVI
- Residential Building Code (CEV, its Spanish acronym) – CONAVI
- Integral Life: Sustainable Housing – Infonavit
- Promotion Program for Certification of Products, Processes and Services – CONUEE
- Sustainable Integrated Urban Developments – SHF

Figure 10 depicts the chronological context in which the main efforts on housing sustainability have developed since 2007. The diagram attempts to facilitate the comprehension of the following topics presented in the document. In the following sections in chapter 6, the early stages of housing sustainability programs are presented. In chapter 7, the transition stage is described – indicated in the diagram by the three blue shafts – and also, their development towards a more integral and transversal vision is presented.

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<sup>6</sup> There are others that more specifically have fostered use of efficient technology in water or energy management in housing, such as PROCASOL that subsidizes solar water heaters, the program “Programa de Cambia tu Viejo por Uno Nuevo” (Change your old one for a new one) that substitutes inefficient household appliances with efficient ones, and “Luz Sustentable” (Sustainable Light) that exchanges incandescent bulbs for energy-saving ones.

**Figure 10. Timeline of sustainable actions in Mexico**

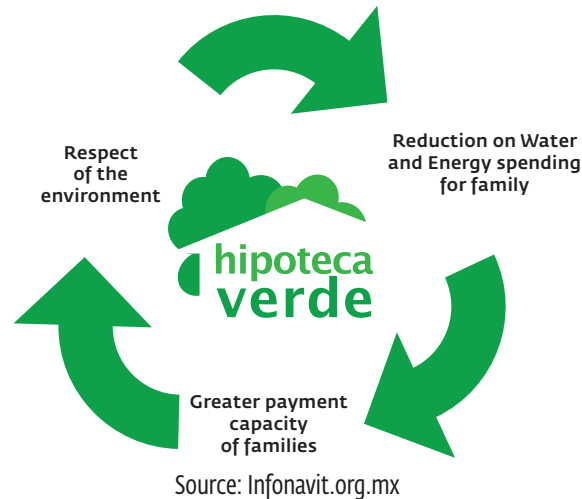


Source: Elaborated by Fundación IDEA

### 6.3 PROGRAM “HIPOTECA VERDE” – Infonavit

Spanish for Green Mortgage, the program started in 2007 and its objective is to promote sustainable measures through the inclusion of ecotechnology in housing. Aside from energy consumption and GHG emissions reduction, the inclusion of this technology implies money savings for the beneficiaries for the decrease in water and energy consumption. These savings represent higher available income that strengthens the capability to pay the loans of the Institute.<sup>7</sup>

<sup>7</sup> Fundación Idea. (2011). Eficiencia energética y ambiental en el sector vivienda. p. 22.

**Figure 11. “Hipoteca Verde” virtuous circle**

Essentially, the program “*Hipoteca Verde*” is a soft credit loan which gives the beneficiaries an additional amount to purchase ecotechnologies for their house. The program started as a pilot in 2007, and after its success, it expanded to national institutional level in 2009. Since that year, it has worked as an optional credit program with a package of different choices of technology according to the bioclimatic region. Since 2011, a new scheme called “*Hipoteca Verde Flexible*” (Spanish for Flexible Green Mortgage) was approved. It allows the beneficiaries to select the technology that best satisfies their necessities from a long list approved by Infonavit.<sup>8</sup>

Since 2011, all mortgage loans given by Infonavit, regardless the type of credit selected, must include an additional amount to purchase ecotechnologies in housing. In other words, “*Hipoteca Verde*” is mandatory for all beneficiaries that receive a loan for all new or second hand houses, renewal, enlargement or auto-construction. The additional amount depends on the laborer’s salary and the selected technology. For its approval, the package must fulfill a minimum saving generated by the selected technology depending on the salary category (aside the consumption habits of the inhabitants, which vary significantly).

**Table 2. Minimum saving in Mexican pesos for ecotechnologies adoption according to levels of monthly income**

Income (integrated minimum monthly wage)		Minimum required monthly saving
From \$1,894.83	\$13,263.81	\$215.00
From \$13,263.82	\$20,843.14	\$290.00
From \$20,843.15	And on	\$400.00

Source: Infonavit’s Hipoteca Verde Program.

<sup>8</sup> The technology and materials included in this list have certifications that confirm the fulfillment of the protocols or regulations on energy or water consumption efficiency.



### Ecotechnologies considered in Hipoteca Verde

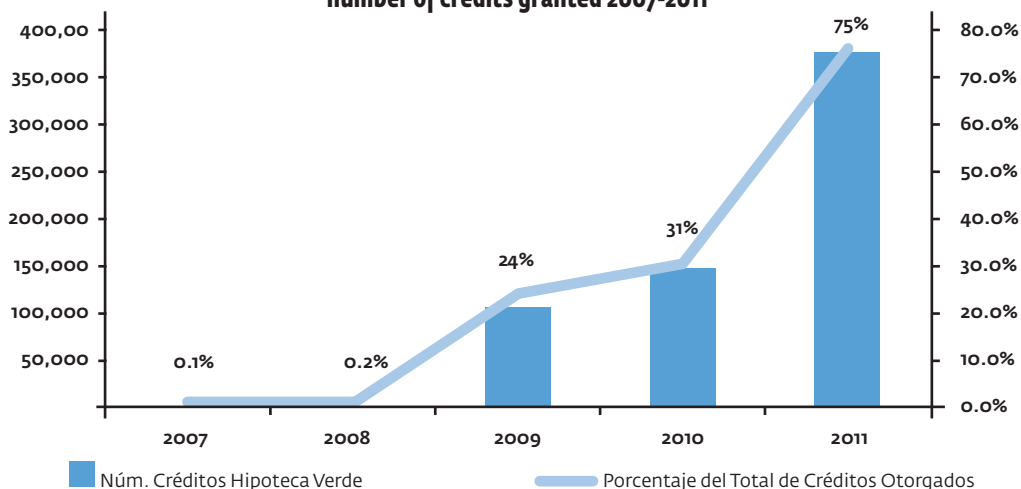
The beneficiary can choose a combination of ecotechnologies that will provide him/her the desired saving level, which vary according to the bioclimatic zone where the house is located. The considered ecotechnologies are:

Saving bulbs (compact fluorescent lamps), high efficiency or low consumption air conditioner equipment, thermal insulation materials in ceiling or walls, reflective coatings for roofs and walls, solar water heater, tankless water heater, water saving toilet, shower with saving device, taps or valves with saving device, double glass and PVC frame windows, amongst others. This list is constantly updated with new equipment, as long as it can provide the certifications or efficiency reports.

Providers of these technologies are previously authorized by Infonavit and each one must meet the corresponding regulations on efficiency (for more details on packages and technologies that Hipoteca Verde includes, browse: [www.infonavit.gob.mx](http://www.infonavit.gob.mx)).

The program has provided thousands of laborers with energy efficient and less polluting housing, giving general access to energy efficiency and reducing CO<sub>2</sub> emissions and water and gas consumption significantly. As seen in figure 12, in 2011 376,815 credits were given with the program, about 75% of the total number of credits given by the Institute that year. Since 2007 and up to October 20<sup>th</sup>, 2012, more than a million credits with “Hipoteca Verde” had been given.

**Figure 12. Number of credits of “Hipoteca Verde” and percentage of the total number of credits granted 2007-2011**



Source: Infonavit’s Hipoteca Verde Program.

Due to the effectiveness in CO<sub>2</sub> reductions and its wide application, in 2010 the IDB awarded the Infonavit program “*Hipoteca Verde*”, with the “Beyond Banking 2010” award. This recognition acknowledges projects of corporate governance, environmental and social sustainability that are run by financial intermediaries in Latin America and the Caribbean.

The United Nations Development Program (UNDP) acknowledged the Infonavit as the Best Practice in the Application of Solar Water Heaters in the housing category –in the context of the 35<sup>th</sup> National Week of Solar Energy through the Initiative for Transformation and Strengthening of the Solar Water Heaters Market. In 2012, “*Hipoteca Verde*” was awarded with the most important housing prize internationally: the World Habitat Award 2012, for being a program that gives great benefits to the low-income population and the environment, for its innovation and its possible reproduction in other countries. In this sense, in 2012 the Infonavit signed a triangular cooperation agreement with Colombia and Germany to help to include “*Hipoteca Verde*” in its housing policy in Colombia.

### **Future Vision for “*Hipoteca Verde*”**

Towards 2013, the program “*Hipoteca Verde*” will be complemented with the Green Housing Evaluation System (Sisevive-Ecocasa) developed by Infonavit. The Sisevive-Ecocasa is an integral measuring tool used, in the first stage, to grade the energy efficiency and the water intake of housing in an integral way. Above all, it incorporates the recognition of housing design as a key aspect of efficiency.

During the second stage, the inclusion of measures on environmental and energy efficiency for the common areas of the housing complex will be evaluated. Furthermore, some other features will be assessed like the housing complex’s location, the public lighting system (with or without renewable energies), rainwater catchments, water management and construction materials, pavement types, solid waste collection and emissions as a result of inhabitant’s mobility, amongst others.

In the third stage it will be measured if the housing complexes are located in municipalities which stimulate respect to environment measures, consideration of the water basin, the respect to flora and fauna of the place and the ecological resilience indicators.

The Evaluation System is explained with more detail in section 7.3.1. However, it’s mentioned previously in order to comment that “*Hipoteca Verde*” will move towards a more inclusive vision for sustainable housing, in which, not only the availability of ecotechnologies will be considered, but also the implementation of bioclimatic designs and the utilization of materials appropriate for the weather conditions of each region. The goal is that “*Hipoteca Verde*” extends its benefits towards the improvement of these new elements of sustainability in the short term, in a way that it encourages the incentives and resources, while homologating the sector’s evaluation criteria.

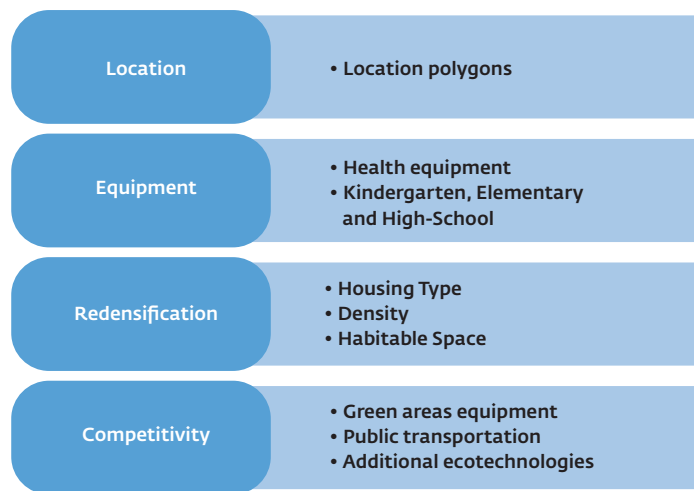
## 6.4 PROGRAM “ÉSTA ES TU CASA” – CONAVI

This program, which was started by CONAVI in 2007, allows the lower-income sectors of the population to purchase a house through the delivery of subsidies in the following modalities: purchase of a second hand or new house, purchase of a plot with auto-construction services and enlargement or renewal of a house. The amount of the subsidy varies according to the modality and value of the house or project.<sup>9</sup>

In 2009, the program included sustainability guidelines and parameters defined by the CONAVI according to the type of housing and the bioclimatic zone considering five categories: site analysis, efficient energy use, efficient water use, appropriate waste management, and equipment and facilities maintenance. In practical terms, these guidelines demanded the inclusion of efficient technologies for water and energy consumption in housing as a requirement to be granted subsidy for purchasing a house (these technologies coincide with the “Hipoteca Verde” list). For their results and program design in alliance with “Hipoteca Verde”, CONAVI and Infonavit were awarded the Alliance to Save Energy International Prize of Energy Efficiency for Energy Saving.

In 2012, new operation rules were created for the authorization of subsidies. These regulations consider new evaluation and granting instruments for gap subsidies based on new criteria for location and housing sustainability. These criteria are reflected in a multidimensional system of points that qualify housing sustainability from an integral view which considers: location, equipment, re-densification and competitiveness (see detailed definitions in figure 13). Based on these criteria, it is decided whether or not the subsidy is granted.

**Figure 13. “Ésta es tu Casa” evaluation criteria – Operation norms**



<sup>9</sup> Fundación IDEA (2011), pp.23-25.

The incorporation of these housing and sustainable environment parameters aims to promote ecological and energy efficient houses as well as housing better located and close to job sources and health, education, and entertainment facilities.<sup>10</sup> Also, to determine the amount of the subsidy, the value of the house and the points given based on these parameters and the data obtained from the Unified Housing Register (RUV, its Spanish acronym) are considered.

### **What is the RUV?**

Between 2003 and 2004, Infonavit developed the Unified Housing Registry in Mexico (RUV, its Spanish acronym), with the purpose of having a tool that would generate statistics to support the decision making process and the creation of a strategic plan of housing development and financing, in order to meet with the requirements on housing supply. CONAVI and housing institutions were incorporated to this system, with the objective of unifying the housing supply register criteria for its processes of loans giving, from the register of suppliers to the loan exercise. The President of the Republic announced its creation during the closing ceremony of the XVIII International Conference on Housing.

The RUV works as a single window for housing offering, in which:

- Private actors integrate their housing information;
- The ONAVIS obtain the needed information for their processes;
- The financing intermediaries find support for the decision-making process;
- Public and private institutions can have an accurate and timely information system, and;
- Register, verification and assessment processes are standardized.

Likewise, the RUV is a database on new and existing houses that allows federal institutions to complete the operative processes in each organism, for example: the evaluations of “Ésta es tu casa” or “Hipoteca Verde”.

<http://www.ruv.org.mx/PortalMiCasa/doctos/ConoceMas/QueEsRuv.pdf>

### **Location**

This component considers three polygonal areas that are evaluated in terms of the available geostatistic information. To be located in the first polygon, housing must be near job sources, services and equipment. To be considered within the second polygon, housing must be located in an urban consolidation area. Finally, in order to be in the third polygon, housing must be located in an area next to the growing urban area and in the vicinity of secondary schools.

<sup>10</sup> CONAVI, Programa “Ésta es tu casa”, ROP2012.

## Equipment

This component is divided into four variables: Health equipment, kinder garden, elementary and secondary schools. Based on distance parameters, points are given to each housing. For example, housing that has health equipment in a radius of 1500m get a higher score than the ones that have it in a radius of 1500m to 2500m, and so on.

## Re-densification

This component has three variables: housing classification, gross density and total habitable surface in square meters. In *housing classification*, vertical housing with three or more levels is given a higher score than a duplex or a single-family house. *Gross density* refers to the neighborhood's regulation or the urban complex plan and it includes traffic surface, equipment and other complementary uses of housing.<sup>11</sup> Finally, *total surface* awards a higher score to housing that have a habitable surface larger than 42m<sup>2</sup>.

## Competitiveness

This is defined as the equipment of common areas, close public transport and additional eco-technologies or environmental measures. These variables are graded in terms of housing proximity and technical criteria included in the Operation Regulations 2012.

### **Future Vision for “Ésta es tu casa”**

The medium-term perspective of the Program “Ésta es tu Casa” is to integrate a vision that considers the housing sustainability and its environment from a more integral and ambitious approach. In this sense, CONAVI looks for the development of more sustainable housing for lower income sectors, which will give greater comfort and quality of life to their inhabitants.

In order to support the development of higher quality and more sustainable houses, and making them available to lower income populations, CONAVI promotes the development of three NAMA projects, for new and existing housing as well as for the urban level.

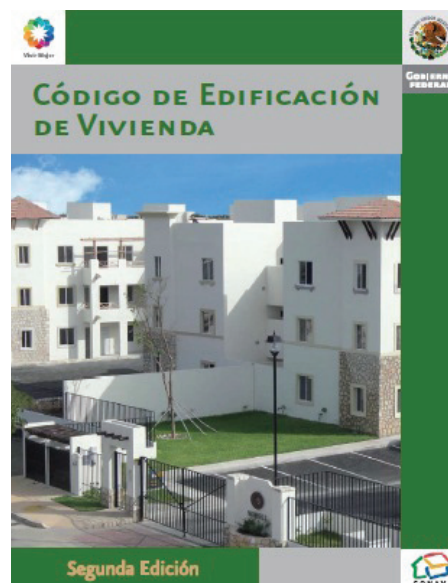
In environmental and energy efficiency matters, the global approach of housing performance (Whole House Approach) recognizes housing as a whole system, with inter-dependent parts: design, energy and water intake technologies, etc.

<sup>11</sup> *Idem*, p.28.

According to this approach, for energy efficiency and the water consumption evaluation, Fundación IDEA suggests that the program “*Ésta es tu Casa*” is supported by the Evaluation System “Sisevive-Ecocasa”, in order to work as a transversal tool that evaluates and certifies housing environmental performance.

## 6.5 RESIDENTIAL BUILDING CODE – CONAVI

In December 2007, the CONAVI published the Residential Building Code (CEV, its Spanish acronym) as a follow up to the Housing Act passed in 2006, which allows the competent authorities to formulate legal dispositions, Official Mexican Regulations, construction codes and construction regulations.<sup>12</sup> The CEV aims to establish a regulation model that encourages the competent authorities – at state and municipal levels – to pass, apply, keep in effect and upgrade the legal dispositions, Official Mexican Regulations, construction codes and construction regulations.<sup>13</sup> Acknowledging the faculties that the Constitution grants to the States and Municipalities on the matter, the Code has a limited effect. It attempts to become a model for the authorities and establish modern sustainable standards for housing and urban development.



In 2010, CONAVI published a second edition of the Code, in which a chapter on housing sustainability is integrated. The Code introduces several requirements on the planning and development of safe, sustainable and reliable buildings in a well-organized and balanced urban context.

This new edition has the following main objectives: 1) That local authorities have an instrument to regulate construction, 2) that available technology and upgrades are considered directly for each bioclimatic zone, 3) that there are standards for products to foster a larger competitiveness in the market and 4) that construction of environmentally sustainable housing is encouraged reducing its negative environmental impact. (See the Code in <http://www.conavi.gob.mx/documentos/publicaciones/CEV%20PDF.pdf>)

<sup>12</sup> CONAVI, Código de Edificación de Vivienda, México, 2010.

<sup>13</sup> *Idem*.

## 6.6 INTEGRAL LIFE: SUSTAINABLE HOUSING – Infonavit

The Infonavit incorporated sustainability in its strategic program “Integral Life” that includes features of environmental, social and economic sustainability. The program emphasizes the enhancement of quality of life for its beneficiaries and value adding to the financed housing. The program is developed through the three central concepts of cities and housings complexes shaping: housing, community and surroundings.

Since 2011, the Institute fosters sustainable housing through this program that observes at least twenty features of housing quality, its surroundings and encourages the neighbors’ responsibility towards their environment and the community. To receive the benefits of the program, the housing must fulfill most of the features considered by the three central concepts or belong to a DUIS. In other words, housing must have public services and social integration centers nearby as well as eco-technologies.<sup>14</sup>

The concept *sustainability* that this program uses refers to *environmental sustainability of homes*, used in “*Hipoteca Verde*”. However, aside from housing, its social and urban environment is also addressed. In other words, it fosters well located, comfortable, modern housing that is also immersed in a caring responsible community according to the standards of the program.

Besides providing certification as Sustainable Housing, the Infonavit offers the housing complexes that have such recognition the following financial incentives:

- The institute pays immediately for Sustainable Housing, regardless the existence of other kinds of housing in queue.
- It receives financing from the institute, even beyond the credit limits for new housing in the delegation.
- It has a higher demand, based on the campaigns launched by the Institute.
- During the orientation workshop “*Saber para decidir*” (Spanish for “Knowing in order to decide”) given by the Institute to its beneficiaries, the benefits of this kind of housing are explained.
- The Institute sends signs to certify the presence of Sustainable Housing to be exhibited at the entrance of complexes, where at least 66% of the houses are certified as sustainable.

Finally, the Institute expects to increase the supply of sustainable housing by backing the developers for them to get a larger loan and recover their investment faster.

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<sup>14</sup> INFONAVIT. *Manual explicativo del programa Vida Integral: Vivienda sustentable.*

### **Future Vision for Sustainable Housing Program**

Fundación IDEA suggests that the Sustainable Housing program will be able to construct important alliances with Urban NAMA for the financing of more sustainable housing complexes, as explained in section 7.2.1.

## **6.7 PROMOTION PROGRAM FOR CERTIFICATION OF PRODUCTS, PROCESSES AND SERVICES – CONUEE**

When it comes to energy efficiency in housing, the role of the CONUEE should be noted as responsible for the elaboration, publishing and supervision of the regulation NOM-020-ENER-2011, further explained in the section “Standards Definition”. The importance of this regulation lies in being the first to establish the minimum conditions that housing must fulfill as for limiting heat gain in order to reduce refrigeration and therefore power consumption. Therefore, it pushes the construction sector to develop housing with appropriate design, materials, shades and thermal insulation, amongst others. Furthermore, CONUEE is responsible for implementing the Promotion Program for Certification of Products, Processes and Services, which encompasses the Certificate of Efficient Housing, on energy efficiency in new housing.<sup>15</sup> The Program is aligned with the strategies and lines of action set by the PRONASE.

This program is grounded on the Law on Sustainable Energy Use (LASE, its Spanish acronym) passed on November 28<sup>th</sup>, 2008. The LASE establishes in Article 26 that private individuals can voluntarily evaluate their operations regarding the degree of energy efficiency and the fulfillment of the regulation through the certification of products and services and a methodological test. Furthermore, it establishes CONUEE’s responsibility to develop a program to award such certificates. Article 31 of LASE regulations appoints CONUEE to give a distinction that private individuals and companies can exhibit in the certified products.

This program should observe:

1. Certification methods.
2. Approval and accreditation system for auditors and experts.
3. Training programs for audits and experts.

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<sup>15</sup> Fundación IDEA, pp.12-13



#### 4. Recognition system for those who obtain the certificate.

Meanwhile, the PRONASE 2009-2012 addresses two objectives linked to the certification program:

- Objective 3: Improving efficiency of the products and promoting the purchase of efficient products by the final users, for which it is established:
  - Line of action 3.1.1: Implementing a certification and distinction program and campaign for equipment, to reduce energy consumption in housing and buildings through the purchase of efficient equipment. Also, it is acknowledged that both the program and the campaign must be an integral effort of searching and unifying all programs of certification and promotion of efficient products in Mexico through the distinction that CONUEE will award.
- Objective 5: Reducing energy consumption through environment conditioning in buildings, for which it is established:
  - Line of action 5.2.3: Developing a certification of the estimated energy consumption in new buildings that will promote awareness amongst the population as for energy and money savings derived of implementing energy efficiency measures in buildings. To do this, a certification that identifies more efficient buildings must be developed.

In fulfillment of these dispositions, the CONUEE published the Promotion Program for Certification of Products, Processes and Services in September, 2011. It aims to acknowledge the efforts on energy issues achieved by companies, private individuals and public institutions, thus fostering adoption of certified products and services in the market. It is established that products, private individuals or institutions that fulfill the requirements set in the program will be awarded recognition, a symbol of energy efficiency, given by the CONUEE.<sup>16</sup>

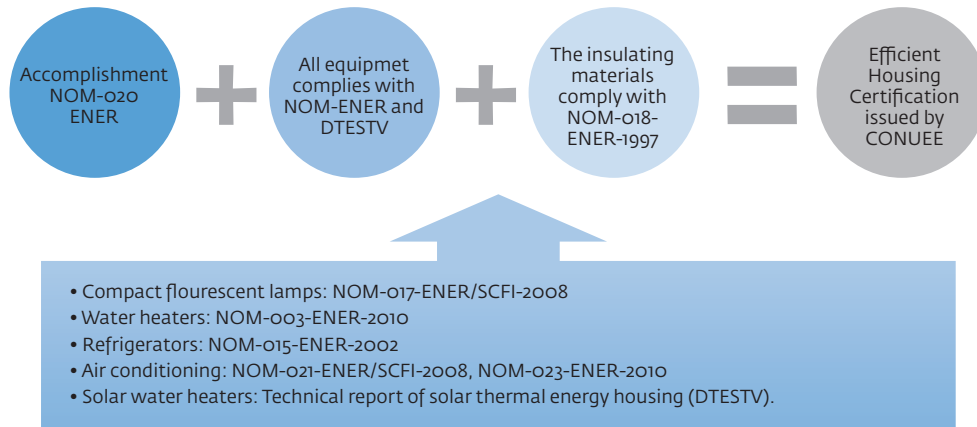
The program addresses four categories to certify:

- Products under regime of NOM-ENER,
- New residential buildings (housing)
- New nonresidential buildings, and
- Industrial plants.

As for housing, the Program establishes that the recognition is to be given to houses that fulfill the following conditions:

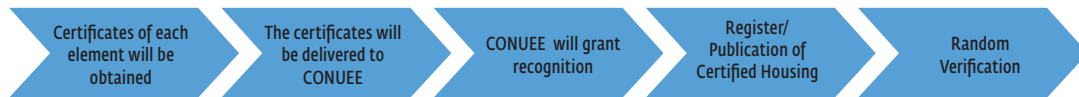
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<sup>16</sup> <http://www.conuee.gob.mx/work/sites/CONAE/resources/LocalContent/7328/6/certificacion.pdf>.

**Figure 14. Efficient Housing Certification requirements issued by CONUEE**

Source: Elaborated by Fundación IDEA

As well, it sets the following procedure to obtain the certificate:

**Figure 15. Procedure on Efficient Housing Certification issued by CONUEE**

Source: Elaborated by Fundación IDEA

### Future Vision

Fundación IDEA suggests that the Evaluation System Sisevive-Ecocasa could become a supportive tool for the CONUEE's Efficient Housing Certification program.

Utilizing the logistic platform from Sisevive-Ecocasa installed in the RUV is feasible in two senses:

- Exploiting the Infonavit and Sisevive verification network, in order to verify and certify the NOM-020-ENER-2012, and
- Exploiting the Sisevive-Ecocasa computing platform, specifically the DEEVI, so that the developers may obtain a pre-evaluation of the norm compliance.

The foregoing, acknowledging that Sisevive-Ecocasa is an Infonavit's tool, independent from the standard NOM-020-ENER-2011. Energetic efficiency in edifications – Buildings envelope for residential use; which is an official Mexican norm of compulsory application, thus its compliance assessment will be performed through a Verification Unit certified and approved by the corresponding dependence, in concordance with the Federal Law of Metrology and Standardization.

## 6.8 PROGRAM “ECOCASA” – SHF

Aiming to promote the construction of housing with a lower environmental impact in Mexico, the Federal Mortgage Company, in collaboration with the Inter-American Development Bank (IDB) and the German Development Bank (KfW, its German Acronym), launched the “Financial Cooperation Program for the supply of Sustainable Housing in Mexico (ECOCASA)”. The program seeks:

1. To ensure its beneficiaries access to more environmentally efficient housing.
2. To provide housing developers with instruments to negotiate with suppliers and authorities about lower prices on materials, ecotechnologies and rates.
3. To have indicators to negotiate conversion of consumption subsidies to subsidies in advance on water and energy consumption.
4. Generate awareness amongst population on optimal use of resources.

To meet these objectives, financial resources have been provided by:

- The KfW, in context of the initiative for climate and environment protection: 80 million Euros, and
- The BID, under the Conditional Credit Line for Investment Projects (CCLIP) with resources of the Clean Technology Fund (CTF): 50 million dollars.

With these resources, the SHF will grant bridging loans for sustainable housing with a given minimum rank of energy efficiency that considers bio-climatic design (architecture, construction system and materials) and ecotechnologies. To define this minimum rank of efficiency, the Program will be based on Sisevive-Ecocasa.

Additionally, the KfW and the CTF will earmark non-refundable resources to support the Program with technical assistance:

- Recommendations to federal, state and municipal organs that operate water services on charge for water consumption.
- Recommendations to the federal organ in charge of power supply on its rates.
- Recommendations as for the advisability of substituting subsidies on consumption with subsidies in advance for implementing bio-climatic design and housing construction.
- User manual and knowledge transfer to developer trainers to implement campaigns of education for neighborhood associations on use and maintenance of ecotechnologies.

## 6.9 SUSTAINABLE INTEGRATED URBAN DEVELOPMENTS

**Sustainable Integrated Urban Developments (DUIS)** are projects recognized by several federal institutions that observe the integration of housing, industry, infrastructure, equipment, entertainment and other supplies or services. Their main and inherent feature is that housing is near all the basic services that are necessary for daily life as well as employment sources. Through this, transportation of inhabitants is reduced to the minimum, as well as a great amount of energy that is consumed by it. This translates into less CO<sub>2</sub> emissions and savings and higher quality of life for the families. Furthermore, better use of soil and its re-densification are pursued, actions that also carry significant environmental benefits.

DUIS are the result of a transversal strategy that integrates efforts of the Federal and State governments and municipalities in alliance with the private sector. The developers that wish to propose a complex for its recognition as DUIS must present their project to a group of evaluators that encompass the Ministry of Finance and Public Credit, the SEDESOL, the SEMARNAT, the SENER, the Ministry of Economy, the CONAVI, the Infonavit, the FOVISSSTE, the BANOBRAS, the FONADIN, the PROMEXICO and the SHF. The group has a methodology of technical assessment that observes 83 criteria and parameters integrated by 11 determinants, 23 pre-requirements and 48 indicators.<sup>17</sup> For their characteristics, two types of DUIS have been defined: 1) Intra-urban projects, which foster smart re-densification through use of the available soil in cities, and 2) circum-urban projects, which develop large plots with varied uses of soil (housing, equipment, services and industry, among others) where new communities can flourish. Preferably, these complexes must be developed near cities.

Until early 2012, six DUIS have been certified. They carry nearly 280,000 houses.<sup>18</sup> There are developments in Baja California, Guanajuato, Jalisco, Puebla, Sonora, Tabasco, and Yucatán.<sup>19</sup>

### Future Vision

It has been planned to continue with the DUIS expansion in other regions of Mexico. Fundación IDEA suggests that in the middle term this program is strengthened by the integration of Urban NAMA, as explained in section 7.2.1

<sup>17</sup> Fundación IDEA, op. cit., p.26.

<sup>18</sup> SEDESOL. (2012). DUIS y Proyectos Existentes, <http://www.conorevi.org.mx/pdf/Chihuahua/Ponencias/1%20Arq.%20Sara%20Topelson%20Fridman.pdf>.

<sup>19</sup> Política Pública de Vivienda Sustentable, SOFTEC-La evolución del modelo inmobiliario rumbo al 2012, CONAVI y Vivienda Sustentable de México, COP 17, SEMARNAT.





7

# NATIONAL STRATEGY FOR SUSTAINABLE HOUSING

The most important public policy efforts to promote sustainable housing with programs like those described above -and others not described in this text- have achieved significant advances in the reduction of social housing's environmental impact and in the improvement of its inhabitants' quality of life. In a relatively short time, the topic of sustainability has been established in the center of the housing sector's agenda, and outstanding, concrete results have been obtained. As it is commented in this text, these programs have remained in a permanent revision, adjustment and improvement process, defining ever more ambitious goals and a more integral vision.

However, the various programs have so far tackled the challenge of environmental sustainability from various -and not always coordinated- perspectives and actions, criteria and different tools. To these programs, criteria and measurements we could add the valuable actions which some international cooperation agencies like Environment Canada, GIZ or Prosperity fund (through the British Government) have promoted. Because of the above, it is necessary to consolidate these diverse efforts and to coordinate this emergent vision for sustainable housing.

Amid the diversity of these actions and policies, the programs related with sustainable housing propose the same final objective: The reduction of the environmental impact of housing without jeopardizing the inhabitants' quality of life. This policy must keep the dynamism and efficiency of the housing sector, which has become a motor of the social and economic development of the country. Having this shared goal as a basis, it is important to seek in the immediate future, the integration and coordination of the various perspectives on the matter, looking for a common vision of sustainability for housing which allows to reach more ambitious achievements and to guarantee the welfare of inhabitants.

This joint vision acknowledges the quality of life of the families that inhabit the houses as a main objective. It is crucial to recognize the housing as a space of well-being that must satisfy an energy demand to obtain thermal comfort inside home, as well as to satisfy the water and energy intake the inhabitants need. In addition, as a second aim, the home's welfare must be provided with the minimum possible impact on the environment, for which it is necessary to develop different actions, depending on the climate and hydrological conditions in every region.

Having both of these goals in mind and based on the achievements reached by the ongoing sustainable housing programs, the National Strategy for Sustainable Housing seeks to promote a more comprehensive approach to housing, under the approach of "Whole-House Approach" (overall housing performance). This approach acknowledges the house as one system, made up of various interdependent elements that define the energy demand and the water and energy

intakes. Unlike previous efforts on sustainable housing matter, which have favored the incorporation of efficient technology in energy and water intake, the holistic approach stimulates bioclimatic design practices and the use of efficient materials whose impact is reflected in a major thermal satisfaction of the inhabitants within the previous home and in a decreasing in the housing energy intake – particularly the one linked with the house’s previous climate control.

The holistic approach promotes the design specialization and the equipment of the dwellings depending on the climate and hydrological conditions of the site where they are located. For example, it is necessary to encourage the bioclimatic design in the houses – shadings, orientation, ventilation, windows’ measurements, ceiling height – which correspond to the region’s weather (temperatures, winds, radiation). The implementation and measurement of the benefits of these bioclimatic elements are more complex and imply a deep change in the current building practices. However, the impact of these modifications is very favorable because it is reflected in a better quality of life, environmental benefits and in a higher duration of the impact – compared with ecotechnologies – as benefits remain for the lifetime of the house.

Besides the comprehensive view of the housing towards the inside of the building, the National Strategy of Sustainable Housing considers the dwelling as a part of a living, urban and community environment. This means that the Strategy recognizes that sustainability in housing depends on an organized and efficient urban development. This way, the view of the public policy in Mexico also must bear in mind the environmental, social and economic surroundings of a home. Regarding the evaluation of the efficiency in the consumption of water and energy, and the resultant GHG emissions on these intakes, the urban approach demands to consider the use of water and energy in the housing complex (lighting, wastewater treatment and waste management, amongst others) and the resultant intakes of the location (commuting and type of public transportation, amongst others).

A dwelling is found immersed in a housing complex with common characteristics and with which it shares lighting, green areas and wastewater treatment, among other characteristics. When observing the housing as a whole, it is possible to propose ecological measures that individually are not feasible by its size or cost, however when they are seen from a wider approach, they can generate a great impact in the sustainability of the housing complex being economically feasible. For example, in a housing complex a system for collecting rainwater and sewage treatment can be implemented. Electricity production systems can also be encouraged on a large scale through solar panels that illuminate the common areas of the housing developments, as in the case of some pilot projects Net-Zero.



Just as the dwelling is found immersed in a housing complex, the complexes are part of a community that includes them. The communities present different opportunity areas to foster the sustainability of the housing. For example, in a community where the homes are relatively near the inhabitants' jobs, they travel less distances in transportation, public or private, and this results in reduced CO<sub>2</sub> emissions in the atmosphere. The diminished traveling also represents a series of economic and social benefits for families and their communities. Similar benefits depict the proximity to education, health, commercial and entertaining services, etc.

Based on this sustainable housing approach, which considers both, the factors of the home and their environment, a joint vision and strategy amongst the main stakeholders involved in the sector to impulse sustainable housing is developed. This strategy seeks to identify, evaluate and encourage investments and efforts, public and private, oriented to promote more sustainable housing that provides social, economic and environmental benefits to families and society as a whole and to future generations.

## 7.1 CHARACTERISTICS OF THE NEW STRATEGY

Starting from the commitments held by the country's authorities and the current sustainability actions, **Mexico aspires to achieve a higher sustainable performance of the housing and a better quality of life for its inhabitants.** The actions mentioned in chapter 5 have established the basis for building and broadening of sustainable measurements to a larger scale for the existing social housing programs and to establish a transversal strategy for the sustainable housing, which allows the cooperation with the different relevant stakeholders involved of the public, private and international sector.

In order for this housing sector new joint strategy to be effective and for the new opportunities of improvement to be fully exploited, Mexico must implement appropriate institutional and financial mechanisms that target the resources accurately and efficiently, towards the national priorities. It is critical that the classification, measurement and evaluation of sustainable housing is developed under a consensual vision by the main stakeholders involved, and contains economic, environmental and social criteria, allowing the transition towards a housing sector that is based on the national sustainability strategy. It is necessary to establish a reference and methodological framework that serves as the basis to evaluate what sustainability is, and where and how it can be replicated.

Based on this great goal, in March 2012, The National Housing Commission (CONAVI), with the support of GIZ, established the Transversal Board of Sustainable Housing in Mexico. Its general aim is to improve the coordination amongst the diverse stakeholders involved in the matter of

sustainable housing in Mexico, to “foster and define a work strategy towards a common objective to enrich, enhance and expand programs and schemes that are taking place or are being developed, [...] besides standardizing the rules, indicators and rules”.<sup>1</sup> The Transversal Board is the workspace for sustainable housing in the country and where the relevant entities and stakeholders interested in contributing “through funding, technical cooperation or capacity building, to extend, optimize and obtain quantifiable results on those programs”<sup>2</sup> participate.

Its specific aims are “to coordinate the planning and implementation of actions and to create synergies amongst the members of the Board, with approach in results, as well as to elaborate a joint Program of Activities for the year 2012 and to monitor its accomplishment”.<sup>3</sup> The main stakeholders in the Transversal Board are: the CONAVI, the Infonavit, the SHF, the FOVISSTE, the CFE, the VESAC, the World Bank, Environment Canada, BID, GIZ, Point Carbon, KfW, the British Embassy, Fundación IDEA, Enervalia, Carbonding, the AEAEE, Mario Molina Center, RUV, ANFAD, amongst others.

In addition, the Transversal Board is the space where the different relevant stakeholders converge with the goal of constructing the National Strategy for the Housing Sustainability. In order to facilitate the exposition, three conceptual levels in which this strategy lands are identified: objectives, components and programs or actions.

### **Objectives:**

The main objective is to improve the quality of life of the inhabitants of the social housing, at the same time that it guarantees the social, economic and environmental sustainability of the housing sector in Mexico.

More specifically, it seeks:

In the short term:

- The expansion of housing which provides greater comfort, welfare and opportunities of development to its inhabitants.
- Housing highly efficient in their resources intake, particularly energy and water. It seeks to take housing to more ambitious efficiency goals.
- The environmental efficiency is conceived from a comprehensive approach that understands the housing as a system. In this sense, the strategy looks for improving, first, the design of the dwellings and, secondly, its equipment with more efficient technology.

<sup>1</sup> Mesa Transversal, Tercera Sesión del Grupo Coordinador, Reporte de Avances y Resultados al 13 de Junio de 2012.

<sup>2</sup> *Idem.*

<sup>3</sup> *Idem.*

- The housing must be conceived inside their urban and social surroundings. Particularly, the location of the dwellings and the equipment of the environment are high impact factors with respect to the economic, social and environmental sustainability.
- Developing a new generation of programs and actions for the governments and institutions in Mexico in order to impulse and fund this new strategy (For example, evolution of the programs: “*Ésta es tu casa*”, “*Hipoteca verde*”, “*ECOCASA*”, Regulations, etc.)

In the medium and long term:

- To achieve a joint view that is accepted by the various stakeholders in the housing sector in Mexico, which would allow streamlining the totality of the housing construction.
- To transform the way in which housing is built and equipped in Mexico, favoring quality of life and sustainability. The design of the social housing must prioritize the urban planning and the bioclimatic design.
- Foster the solid waste treatment and the generation of clean energy in housing complexes, boosting this way, the creation of jobs and the environmental education.
- To stimulate the development of human capital, in the private and public sector, in matter of sustainable housing.
- Lower the national strategy of sustainable housing to state and municipal government levels. Specifically seek for the development of capacities, regulation and actions that share the comprehensive view of the housing as a system that takes part of a housing complex and a specific urban environment.
- Boost a national industry that develops efficient, sustainable technology and materials, appropriate to the characteristics and needs of the Mexican climate and population.
- To support the development of a culture of sustainability to guide the habits of inhabitants and that generates a market where consumers and housing suppliers value and reward the efficiency of the houses.

### **Action lines:**

In order to reach these ambitious goals, the National Strategy acknowledges three components or main lines of action:

- 1. Financing:** Through programs and actions that seek to raise national and international funds that promote sustainable edifications. In first place, the evolution of the programs and actions on sustainable housing matter is sought (like “*Hipoteca Verde*” or “*Ésta es tu casa*”) to foster the development of more efficient housing from a holistic vision. Additionally, in this action line there are the NAMAS, the MDL and the program ECOCASA as axes to obtain international resources that allow the development of the National Strategy of Sustainable

Housing. It is important to note that, to access international climatic financing, the country has had to define methodologies, tools and common processes.

**2. Housing Evaluation:** programs that evaluate the housing environmental performance or that evaluate the results obtained by the programs in point 1. In this group, the system of Evaluation “Sisevive-Ecocasa”, the Measurement, Report and Verification mechanisms, (MRV) and the Housing Sustainability Index (ISV) outstand.

**3. Standard definition:** Guidelines that establish the necessary regulatory context to develop sustainability programs. This group refers to the official Mexican norms, particularly, the NOM-020-ENER-2011.<sup>4</sup>

### **Actions and Programs:**

Within the programs and actions that are being developed and that have been designed to meet the evolution process of existing programs, joint work, standardizing of methodologies to evaluate the housing and the financing, outstand:

- The NAMA program for new and existing housing, coordinated by CONAVI,
- The program ECO CASA, developed by SHF, KFW and BID, with the purpose of promoting the supply of sustainable housing with higher levels of efficiency.
- The Green Housing Evaluation System (Sisevive-Ecocasa) driven and coordinated by Infonavit, and adopted by all the public stakeholders in the sector as a tool of evaluation for the industry.
- The projects Mechanism of Clean Development (MCD) and its modality of Activities Program (PoA), coordinated by the CONAVI,
- The NAMA at urban level, coordinated by the CONAVI, and
- The Housing Sustainability Index, promoted by the VESAC.

These actions have the purpose of raising international funds so the housing sector makes the transition to materials, designs and more sustainable devices, as well as assisting in the implementation of standards and actions of public policy that improve the living standard of Mexican population in their homes. Furthermore, there are other policy instruments such as the NOM-020-ENER-2011, which regulate the construction of housing by establishing minimum standards of energy efficiency of the housing envelope<sup>5</sup> to promote the bioclimatic design and the use of insulation materials.

Based on these financing and evaluation methodologies and instruments, an adaptation of the current programs and actions is envisioned in order to reach higher levels of efficiency which result in an improvement of inhabitants’ quality of life and in benefits for the environment.

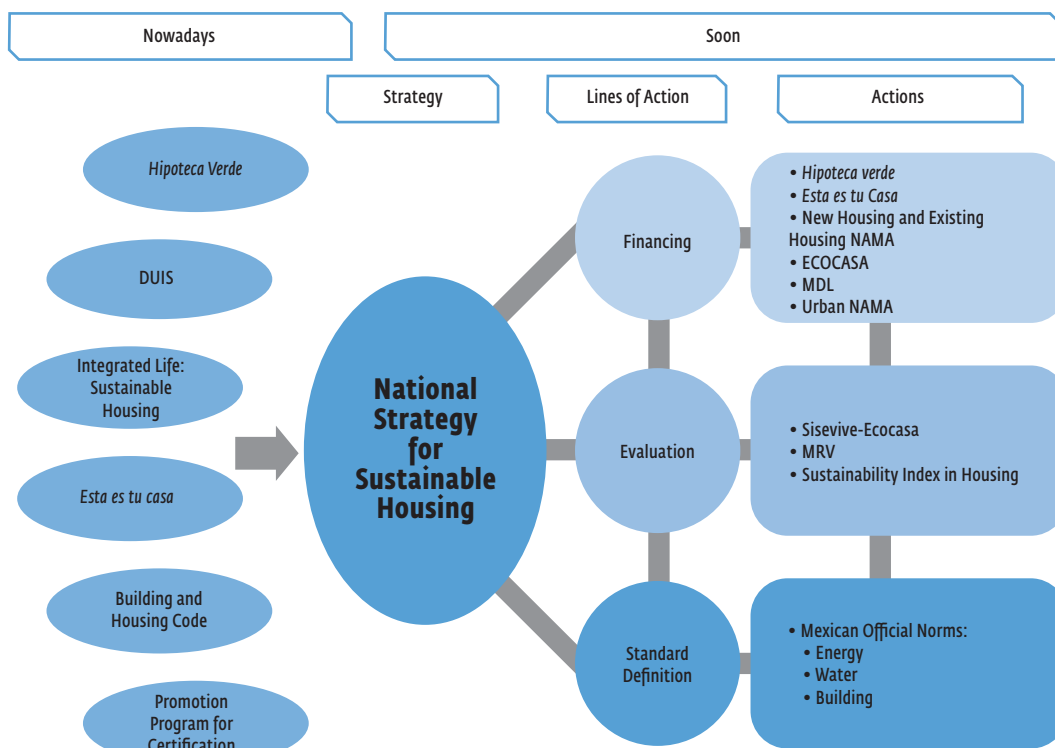
<sup>4</sup> Norma Oficial Mexicana NOM-020-ENER-2011. Eficiencia energética en edificaciones. Envoltante de edificios para uso habitacional.

<sup>5</sup> The NOM-020-ENER-2011 defines that the envelope refers to the ceiling, walls, openings, doors, floors and inferior surfaces, which compose the interior space of a building for housing use.

In Figure 16, we show a scheme with the components that integrate the National Strategy for Sustainable Housing and the links that have developed amongst them. Each of these components is described below:

## 7.2 FINANCING

**Figure 16. Scheme of the National Strategy for Sustainable Housing**



Source: Elaborated by Fundación IDEA.

The first component of the National Strategy for Sustainable Housing (ENSV) contains the programs that promote the sustainability of the housing through existing incentives and international supports. On the one hand, it has the support of international organizations through funding and advice. On the other hand, there are programs that seek to implement measures necessary for Mexico to participate in international markets on carbon emissions.

In both cases, the raising international funds adds to the financing and subsidy programs existing in Mexico, like: “*Hipoteca Verde*” and “*Ésta es tu Casa*”. The financing actions could also include the generation of new national resources as a result of redirecting part of the subsidies targeted today to reduce tariffs of water and energy consumption towards financing efficiency measures.

In order to reach these goals, diverse collaboration alliances between various international or-

ganizations and national stakeholders in the public and private sector are promoted. In the recent years, these alliances of technical collaboration, knowledge and resources' transfer, have been a very important factor in supporting Mexico to reduce the GHG emissions and to reach the proposed goals. Some of the international organisms supporting Mexico in these activities are shown in Figure 17.

**Figure 17. International institutions**

	<p><b>World Bank (BM)</b></p> <ul style="list-style-type: none"> <li>• Development of renewable energy sources</li> <li>• Encouragement of reformatons on regulation through the PECC</li> <li>• Financing to Sustainable Housing through SHF Schemes</li> </ul>
	<p><b>Inter-American Development Bank</b></p> <ul style="list-style-type: none"> <li>• Credit line for technical assistance in sustainable housing</li> <li>• "ECOCASA" program financing</li> </ul>
	<p><b>The British Embassy in Mexico</b></p> <ul style="list-style-type: none"> <li>• Technical assistance through Fundación IDEA for the development of the "Sisevive-Ecocasa" Evaluation System</li> <li>• Development of technical abilities for local governments in sustainability through the ICLEI</li> <li>• Development of pilot programs in matter of sustainable transportation with the Centro de Transporte Sustentable.</li> </ul>
	<p><b>German International Cooperation Agency (GIZ)</b></p> <ul style="list-style-type: none"> <li>• Technical Assistance for New and Existing NAMA Project's development</li> <li>• NAMA Pilot</li> <li>• Assistance for the development of the system "Sisevive-Ecocasa"</li> <li>• 25,000 Solar panels program: subsidy along with "Hipoteca Verde"</li> <li>• Training projects for local governments</li> <li>• Assistance and promotion on the Transversal Board of Sustainable Housing</li> </ul>
	<p><b>German Financing Cooperation (KfW)</b></p> <ul style="list-style-type: none"> <li>• Financing for the NAMA pilot along with BID and SHF</li> </ul>
	<p><b>Environment Canada</b></p> <ul style="list-style-type: none"> <li>• Net Zero Pilot Program: Development of highly efficient housing and energy generators</li> <li>• Building Science methodology workshops, for developing capacities on housing developers and local officials</li> <li>• Financing and technical assistance for the NAMA pilot</li> </ul>
	<p><b>French Institute for Research on Development</b></p> <ul style="list-style-type: none"> <li>• Workshops focused on the renovation of the housing stock of social, existent housing, the necessary articulation of housing policies, urban development and massive transportation. The workshops are also about the articulation of policies, tools and instruments for the redensification and urban rehab.</li> </ul>

### 7.2.1 NATIONALLY APPROPRIATE MITIGATION ACTIONS (NAMA)

As we have said previously, Mexico has taken various actions in order to meet the goal of reducing GHG emissions significantly, generated in the low and medium income level housing sector. In order to take these actions to a higher efficiency level and to multiply the reductions in

resultant emissions and energy and water intake in the dwellings, the Mexican government developed worldwide the first Nationally Appropriate Mitigation Actions (NAMA) for the energetic efficiency on housing sector (This, with the support of the BMU of Germany through the GIZ).<sup>6</sup> This NAMA is prepared and partially implemented with an international co-funding.<sup>7</sup>

### **What is a NAMA?**

The Nationally Appropriate Mitigation Actions (NAMA) are financing instruments that seek to reach a country's energy efficiency through the development of a sectorial plan with determined objectives. It is a flexible mechanism that allows the generation of local rules recognized internationally. Furthermore, NAMA is an alternative path to the Clean Development Mechanism (MDL, its Spanish acronym), in order to access the carbon markets and to be financed by the national efforts on GHG emissions reduction.

In the climate change negotiations held in Cancun, the parties involved agreed that developing countries would adopt Nationally Appropriate Mitigation Actions in order to reduce their GHG emissions.

A NAMA is a voluntary activity directed to reduce GHG emissions carried out by an emergent or developing country not subject to the mitigation commitments held by the UNFCCC. These actions are done under a sustainable development context, supported and enabled by technology, financing and capacities building, in a measurable, reportable and verifiable way, consistent with the development level, economic growth and capacities of each country.

Given its flexibility, it allows the interested parties to find the most profitable solutions, depending on the necessities of each actor, without forcing a specific "recipe".

The open and flexible character of NAMAs has given place to three types of measurements according to its funding source. In all of those, monitoring, report and verification (MRV) of the results must be done:

**Unilateral** – implemented with local financing

**Supported** – implemented with other kind of financial support, from international organizations or from the Green Climate Fund.

6 CONAVI, NAMA Vivienda, 2012.

7 Carpeta de la Mesa Transversal, Tercera Sesión del Grupo Coordinador, Reporte de Avances y Resultados al 13 de Junio de 2012, pp. 6-7.

**Accredited** –implemented with actions integrated in the supported NAMAs, with a strict MRV system in order to generate Emissions Reduction Certificates that may be put on sale in the world carbon market.

The General consensus of MRV and NAMA’s parameters is that they should allow greater flexibility and simplicity in comparison to the current parameters of the Clean Development Mechanisms.

The sustainable housing NAMA is categorized as a supported NAMA, because it seeks to raise international funds.

Unlike previous activities, which have focused on promoting and measuring the impact of isolated technology, the NAMA focuses on energetic efficiency from the perspective of the “Whole House Approach”. Under this approach, efficiency standards for the total intake of primary energy by housing typology are established considering the different bioclimatic zones.

This approach allows the different stakeholders involved to find the best cost-benefit solution instead of prescribing specific technologies, giving incentives to reduce the total energy demand, and considering the interaction of the implemented measures. Under the NAMA concept, the passive design, as for example, the efficient design of windows or longer cantilevers, competes with technological innovations as solar and water heaters. On the other hand, this approach allows donors to orient their support through specific activities aligned with their development priorities, and favors flexibility to raise the strictness of the program with time.

The sustainable housing NAMA determines the guidelines of a housing sector concerted action, aiming for the following goals:

- 1) Evaluate the dwelling through its global performance on energy intake (electricity and gas),
- 2) Ensure the reduction of GHG emissions of each of the houses, and
- 3) Offer social and economic co-benefits (i.e.: better health and quality of life, savings for the country and for the inhabitants, development of the energy efficiency industry, etc.).

The housing NAMA has two approaches: A) New Housing NAMA that supports the construction of dwelling more efficient in the energy intake; B) The existent housing NAMA for the green upgrading (remodeling and equipment) of the existing housing stock.

Besides these two aspects, an urban NAMA is currently being developed that is independent from the Housing NAMA. The constitution of the Urban NAMA is pursued in order to mitigate



the environmental impact of the dwellings regarding their location and surroundings. As a part of the NAMA proposal, there is the development of financial systems which promote the building and renovation of dwellings of a high energetic yield on the national mortgage market.

#### A) NEW HOUSING NAMA

The new housing NAMA has two main goals:

- Increase penetration of basic energy efficiency standards (similar to “Hipoteca Verde”) throughout the housing sector in Mexico, starting with FOVISSSTE and SHF, and
- Scale efficiency standards to more demanding levels.

For each housing type, the financial incentives of the NAMA Fund will be determined by comparing dwellings to be developed with a system of scales that defines a comparison base line, and various levels with minimum objectives of the full house energy intake. This scale system establishes parameters on energy demand for each housing typology (single family house<sup>8</sup>, single family semidetached house,<sup>9</sup> and vertical multi-familiar unit), and takes into consideration the climate of each region (hot humid, hot dry, temperate and temperate cold). This way, the developers and the beneficiaries can use different measures, according with their necessities, to reach the expected energy level, and to raise financial support that corresponds to that level.<sup>10</sup>

In cooperation with GIZ, GOPA-IZN and the German Institute Passive House (PHI, for its acronyms in German)<sup>11</sup>, CONAVI developed the technical concept NAMA which consists in two energy efficiency standards based on the “Global Performance of Housing” for the four main bioclimatic zones in Mexico. The three energy standards are: Eco Casa 1, Eco Casa 2 and High Efficiency, which vary per each housing typology and bioclimatic zone. They are described as following:

- **Eco Casa 1:** it represents the efficiency level that would be accomplished with the same funding that is needed to reach the Green Mortgage but, unlike this, considers the interaction of all the possible measures based on the global performance of the housing. The specific characteristics of a housing, that meet with Eco Casa 1 level, vary according with the bioclimatic zone, but broadly speaking it could be said that it’s equivalent to equating the dwellings with 2.5 centimeters of thermal isolation on the roof and on the wall with the greatest exposure to sunlight, flow heaters, solar water heaters and an efficient unit of air conditioning (if it’s required).

8 “Single family” refers to a house that is inhabited by an only one familiar nucleus.

9 “Semidetached house” is the one that shares walls with the neighbor’s dwelling.

10 CONAVI (2011). Supported NAMA for Sustainable Housing in Mexico - Mitigation Actions and Financing Packages, pp. 6-9.

11 GIZ/GOPA - Integration (2011). Propuestas de Optimización de la Eficiencia Energética en Viviendas de Interés Social. México. Programa Energía Sustentable Componente Edificación, GIZ.

- **Eco Casa 2:** It depicts a higher efficiency level that is reached if the thermal isolation is applied in every wall, better windows are installed (in order to ensure the hermeticism inside the dwelling) and if highly efficient appliances are installed. These characteristics vary according to the bioclimatic zone.
- **High Efficiency Housing:** It is the level that would be reached if different passive and active actions are implemented, which diminish the energy demand to minimum levels. The PHI considers the Passive House that means it is low in carbon, as a reference case. Some examples of the required measures are: extended isolation, windows with triple glass and mechanical ventilation.

**Figure 18. Bioclimatic zones and their location in Mexico**



Source: Supported NAMA for Sustainable Housing in México – Mitigation Actions and Financing Packages.

Having these energy efficiency standards as a basis, the analysis performed by the Transversal Board points out that the current sustainable housing programs in Mexico include only one part of the new housing market and achieve a level of energy efficiency level that only approaches to the Eco Casa 1. The comprehensive vision of the Mexican government is to explore opportunities to extend these programs in terms of integration of the market and of the efficiency level achieved.

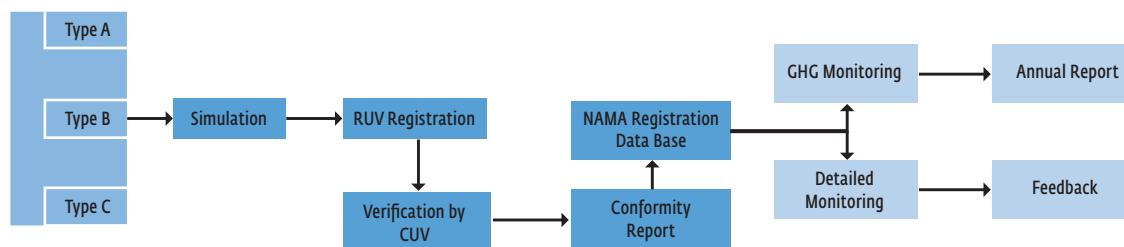
With the purpose of reaching a higher integration and efficiency level, it is necessary to raise additional funds, for instance the financing raised by the reduction of emissions, the international investments and the private resources. These resources have an important role for the extension of the impact of the construction of sustainable housing for the mitigation of GHG, and on the approach of a high energy efficiency level in housing. Investors interested in participating and getting involved financially with NAMA, have a wide range of options to support both direct (houses with certain efficiency standard) and indirect (capacity building, dissemination, etc.) actions.<sup>12</sup>

Regarding its implementation mechanism, the New Housing NAMA is composed by two stages:<sup>13</sup>

**Initial stage:** It refers to the design, register, construction and verification of the project.

1. The developer defines an efficient housing Project with possibilities of mitigation.
2. The Project is divided into blocks by typology and technological solution.
3. With the support of the evaluation system of the environmental and energy efficiency of housing “Sisevive-Ecocasa”<sup>14</sup> the parameters of energy demand, projected electricity intake, gas and water in each of the proposed dwellings are simulated, depending on their design and the technology that will be incorporated (for example, type of lighting, heating water system, thermal insulation use, etc.)
4. The results of the simulations (kWh/m<sup>2</sup>a; liters per person a day; Co<sub>2</sub> emissions) are recorded through the RUV.
5. The RUV emits a report on the housing design, materials and installed technologies, and it asks for verification.
6. Each dwelling identified by the RUV, will be registered in the NAMA Data Base with the characteristics and technology included in the Project.

**Figure 19. Cycle of Housing NAMA**



Source: CONAVI, NAMA Vivienda, 2012

<sup>12</sup> Idem.

<sup>13</sup> Mesa Transversal, Tercera Sesión del Grupo Coordinador, Reporte de Avances y Resultados.

<sup>14</sup> For those pilot projects that are made before the consolidation of the Sisevive-Ecocasa, the simulations methodologies that the developer of the Project defines, will be used, applying the parameters that the Transversal Board defines and that allow the comparison of the results.

**Monitoring Stage:** In order to confirm the compliance with the targeted goals in the matters of electricity, gas and water intakes, and the consistent emissions, it will be necessary to do a simple monitoring of the dwellings that compose the Project.

1. The GHG Monitoring scheme starts.
2. Information is included in NAMA's data base.
3. Annual performance reports are issued.
4. The Detailed Monitoring complements the GHG Monitoring.
5. The compiled data give feedback to the NAMA Project.

#### Monitoring, Report and Verification (MRV)

The main purpose of a NAMA Monitoring, Report and Verification system (MRV) is to measure the implemented actions' impact to evaluate their contribution towards the national and international policies goals on mitigation and climate change.<sup>15</sup>

The objective is that the NAMAs MRV systems must allow greater flexibility and simplicity in comparison to the current parameters of the MDL framework. The proceedings must be practical so they aren't an obstacle for the NAMA application. In other words, the NAMAs must demonstrate that the proposed actions have been adapted and that the progress is measurable towards the reduction of GHG. The MRVs could also be transferable, due to at any moment, the NAMA can be transferred from a unilateral or supported NAMA to an accredited action.

The MRV system must allow monitoring and revising the advances in the mitigation actions of the Housing NAMA, in a consistent, transparent and comparable way, to confirm the addition and to avoid double counting.

Both the Simplified Monitoring System and the Detailed System will be made according to the established protocol of monitoring and report that is defined (by the stakeholders assigned to this task in the Transversal Board). The data will be collected according to the monitoring plan. Finally the compliance is ensured regarding the simulation of the first stage and the Evaluation System is adjusted in accordance with the obtained results.

In order to have this process carried out amongst the different stakeholders, it is necessary to start from the same parameters; this way, the obtained results are comparable. Therefore, the stakeholders in the Transversal Board are embarking to the task of defining common parameters, simulation models, calculus tools and two types of monitoring systems.

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<sup>15</sup> CONAVI (2011), Supported NAMA for Sustainable Housing in Mexico - Mitigation Actions and Financing Packages, p.29.

## Strategy of Monitoring, Reporting and Verification for New Housing NAMA

The new housing NAMA provides two types of monitoring: GHG monitoring and detailed monitoring. **GHG monitoring or Simplified monitoring** aims to learn the consumption of energy, water and gas in housing in compliance with the guidelines defined by NAMA and thus confirm the fulfillment of the objectives set for the reduction of CO<sub>2</sub> emissions. This will be applied to a large sample of homes to secure a high level of confidence in the results. The sample size will be defined as the same housing type with the same level of efficiency. Each house participating in GHG monitoring should provide data on a regular basis according to availability, for example: electricity consumption should be monitored every two months and water and gas consumption annually. The results will be compared with a group of reference or baseline houses, with construction standards and technologies commonly used in Mexico (concrete: no thermal insulation; electricity, gas and water consuming devices of minimum efficiency in accordance with the current regulations). This comparison will show compliance with the emission reduction goals.

**Detailed monitoring** seeks continuous calibration of the actions taken in the housing by region for the continuous development of the program. To do this, there will be a continuous measurement (hourly and/or daily) of electricity, gas and water consumption, as well as energy consumption of some high consuming devices (for example, air conditioning or cooler). Additionally, measurement of outdoor and indoor temperature and humidity of the dwellings will be taken to learn the conditions of thermal comfort inside the home and to simulate unmet energy demand for cooling and heating of these houses according to their design. Finally, measurements will be provided for air quality indoors. This monitoring, due to its high cost and complexity, will be performed only in 3% of the representative sample of GHG Monitoring for each housing type and will have a minimum duration of fourteen months per housing.

Results of the two types of monitoring will be recorded in a NAMA database. Additionally, surveys will be conducted to evaluate its efficiency and calibration as well as other relevant factors such as occupation of housing.

Source: CONAVI, NAMA Vivienda, 2012.

### Projects under the Pilot of New Housing NAMA

The pilot projects in the framework of the New Housing NAMA, consist in the building of dwellings in different bioclimatic zones, with the purpose of proving that the theoretical approaches that are described in the Housing NAMA, are feasible and comply with the established goals.

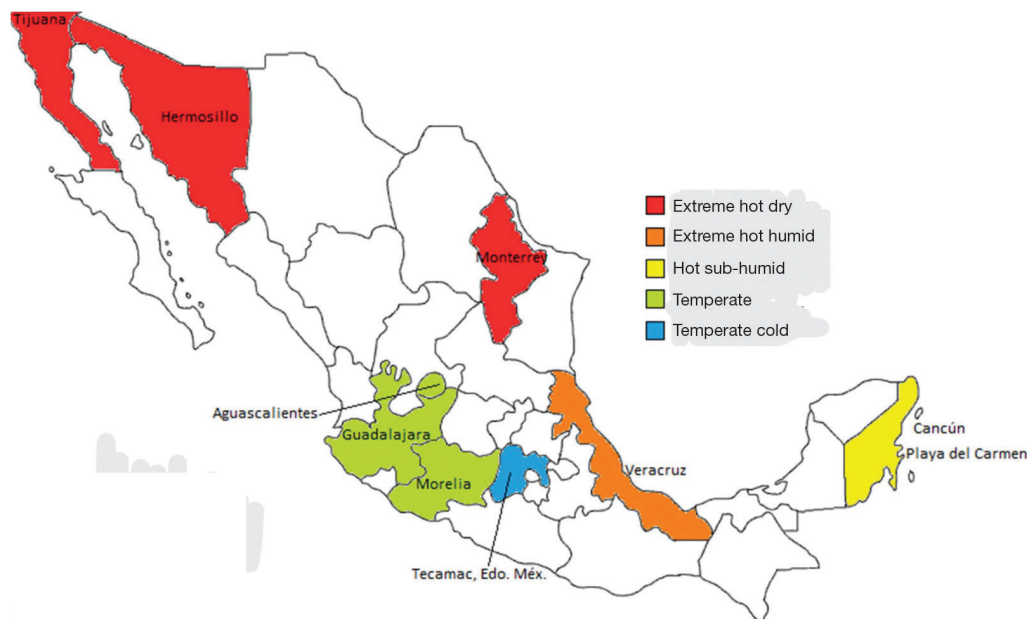
The pilot projects are developed through the funding of international organizations and they are necessary to recognize, prove and demonstrate the approaches and the capacity of the Housing NAMA program. The results of these projects will provide specific elements to set the guidelines for the implementation phase and choose the most efficient models and cost-effective mitigation of GHG emissions, in order to be replicated in Infonavit, FOVISSSTE and SHF.

Pilot projects should include:

- Stages of design, simulation, construction, testing, monitoring, reporting and validation.
- Diversification in the location of the dwellings chosen because they must be in different bioclimatic regions of the country.
- Diversification of housing types.
- Different design characteristics, thermal envelope and ecotechnology.

To apply and adjust the technical design, the MRV system and the mechanism for financing new housing NAMA in Mexico, three pilot projects will be launched, the first financed by IDB, SHF and KfW under the ECO CASA program, the second funded by Environment Canada and Science Building under Net-Zero project, and the third funded by the BMU / GIZ under the Mexican-German Program for NAMA. The pilot projects will be supervised by the Technical group of the Transversal Board. Taken together, these pilots consider the construction of about 3,600 homes, with the participation of several private housing developers and various State Housing Agencies (OREVI's), in five different bioclimatic zones.

**Figure 20. Geographical distribution of the NAMA pilot projects**



Source: Presentación Mesa Transversal de Vivienda Sustentable, 4ª sesión mesa de coordinación.

Pilot projects will share the following characteristics:

- In the design stage, they will provide a detailed description of the projects, indicating the potential for mitigation.
- They are equivalent in their estimation of savings as they share the same baseline and similar criteria for simulation. In a second stage they will share the use of the Evaluation System Sisevive -Ecocasa.
- They will follow the registration and verification methodology of RUV.
- They will develop a common monitoring system that considers both, GHG Monitoring as detailed monitoring, and the houses that make up the pilot project as baseline housing.
- They will promote the strengthening of the capacities of municipalities based on documents and concerted actions.
- They will develop supporting documentation and knowledge management for sharing the implementation processes of the pilots.
- They will support the development and detailed specification of concepts and mechanisms for financing the NAMA measures (subsidies, credit lines, etc.).
- They will disseminate publicly the results and conclusions of each project.

#### **a) ECOCASA Program of Federal Mortgage Company**

The ECOCASA program, implemented by the SHF and financed by the IDB and KfW, comprises a set of financial incentives and accompanying measures to support developers in the design and implementation of efficient housing construction. This is in order to reduce emissions of CO<sub>2</sub>, according to the reduction targets set in the New Housing NAMA, taking into account measures, bioclimatic design, incorporating ecotechnology and mitigation potential.

The program is designed to last a total period of eight years. During the first two years, the program starts with the collaboration of a group of five large developers who already have experience with energy efficiency projects. From the third year, other developers (small and medium) will also have the opportunity to participate.

The program incorporates performance-based criteria, such as a reduction in the observed energy intake regarding to a NAMA baseline, so developers will be able to innovate in order to find the most competitive ways of achieving energy savings. Accompanying measures are focused on sustainability, through the development of simulation tools, the development and implementation of a monitoring system, capacity developing measures (strengthening of capacities for the housing industry and institutional actors), and awareness of the benefits of energy efficiency technology and renewable energy, and support in the development of comprehensive policies for sustainable housing.<sup>16</sup>

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<sup>16</sup> Mesa transversal de vivienda sustentable en México. June 13, 2012.

Projects consider building approximately 3,570 homes located in four bioclimatic regions (Temperate, Hot Dry, Semi-cold and wet), and of four types (Townhouse, Duplex, Vertical, Isolated), with funds from the Clean Technology Fund (CTF) to be disbursed starting December 2012. Homes are expected to be completed in June 2013 and to obtain credit from FOVISSSTE, Infonavit or SHF for purchase. Developers who participate in this pilot are:

- ARA:1200 housing in Veracruz
- GEO:320 housing in Aguascalientes
- SADASI:850 housing in Ciénega de Flores, Nuevo León
- URBI:1000 housing in Tijuana
- VINTE:200 housing in Tecámac

To simulate the energy and environmental performance of dwellings, the program ECOCASA will share the same baseline and simulation criteria of the Sisevive-Ecocasa system. It also considers the complementation of the program ECOCASA with the rating system for pilot projects scheduled for 2013.

#### **b) NET-ZERO Project of Environment Canada and Building Science**

Retaking the collaboration of Environment Canada and the Mexican government, under which the project Net-Zero was developed in 2010, it was agreed to continue with the support of Environment Canada to achieve the goals that Mexico undertook to design and develop the Housing NAMA. In this sense, it was determined to support the line of action defined by CONAVI in climate financing for sustainable housing, for which it was agreed to implement a preparatory phase for the NAMA Housing Program in Mexico. Therefore, Environment Canada contributes actively in the design, training and implementation of pilot projects to report significant results for Housing NAMA.

In its first stage, the projects include the simulation using the “HOT 2000” tool as well as the detailed monitoring of the dwellings’ overall performance on the concepts of temperature, relative humidity, CO<sub>2</sub> concentration inside the housing, electrical energy intake and punctual temperature in the housing structure. The sites and developers are:

- Aguascalientes, GEO and SADASI.
- Aguascalientes, IVSOP.
- Cancún, Homex.
- Playa del Carmen, SADASI.



The project involves the construction of housing in 2012 which include measures and environmental technologies such as mechanical ventilation systems, solar heating for housing blocks, and measures for indoor air quality. The housing design has been made under the Building Science methodology. For the development of this methodology, training and design workshops for developers and authorities have been carried out and developers have worked together with Canadian experts.

### **c) Pilot Program of the Mexican-German NAMA program of BMU/GIZ <sup>17</sup>**

The GIZ supports CONAVI through a pilot project that aims to test and demonstrate the scope (efficiency standards, financing and MRV) and the potential for new housing NAMA in Mexico.

Specifically, the project aims to support the implementation of measures and activities for the planning, development and construction of about 75 social housing with low energy consumption. These homes will be monitored following the MRV scheme defined by the NAMA. The pilot looks for the housing development with different levels of efficiency:

- *Eco Casa 1/Hipoteca Verde*: Optimize energy efficiency measures with the same incremental cost than the *Hipoteca Verde*.
- *Eco Casa 2*: Increasing energy efficiency and comfort at a more strict level with the ability to replicate this model on a large scale.
- *Passive House*: Show the potential savings and mitigation of a highly efficient housing.

For this purpose, medium homebuilders (Derex and Herso), bioclimatic regions (temperate and hot dry), and different typologies (isolated, semidetached and vertical) were selected, being representative at the national level.

### **B) EXISTING HOUSING NAMA <sup>18</sup>**

A sustainable housing strategy cannot be conceived without designing actions to integrate the existing housing stock to the measures of sustainability, particularly to the efficiency in the consumption of energy and water. These groups of houses is, without doubt, the greatest area of opportunity for reducing emissions and improving the quality of life for families in the housing sector. In Mexico there is a possibility and the challenge of incorporating energy efficiency measures in existing housing as it has a current inventory of 28.5 million units, of which 3.5

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<sup>17</sup> Presentación Piloto CONAVI-BMU/GIZ, Mesa Transversal, August 16, 2012.

<sup>18</sup> GIZ (2012) Presentación NAMA Vivienda Existente, Mesa Transversal de Vivienda Sustentable.

million (12.3%) were acquired through financing and of these, 59.7% were granted by Infonavit, FOVISSSTE or FONHAPO.<sup>19</sup>

Recognizing this great need and potential for modernization of existing housing stock towards energy and environmental efficiency, CONAVI in partnership with GIZ are making the necessary efforts to, in the short term, implement a mechanism similar to the new housing NAMA, allowing the adaptation of a program of energy efficiency for formal existing social and middle class housing. The objective is to present the proposal to the international community at the COP 18.

The existing housing NAMA is being developed on the progress and lessons of the new housing NAMA project in the sense that it takes the same concept of housing as an integral system (Whole-house approach) as well as a similar methodology for monitoring, reporting and verification described in the previous section. It will also use the tools DEEVi and the Evaluation System Sisevive-Ecocasa for its simulation.

The existing housing NAMA will seek to rely on existing finance systems and subsidies that are currently available for the remodeling of homes such as CONAVI's subsidy for "Home Improvement" or the credit products from Infonavit for this sort of housing actions such as "Renovate Your Home" or Infonavit's line IV of credit for expansion and renovation of housing, and the program "Home Improvement" from SHF.

The existing housing NAMA seeks to develop a proposal in the shape of renewal packs with active and passive measures, differentiated by bioclimatic zone, type, and mitigation potential.

### C) URBAN NAMA

CONAVI is currently in the conceptual development of a NAMA at the urban level, understanding that the environmental impact of housing, from a comprehensive view, is not limited to the characteristics of the construction and equipment of housing, but also depends on the conditions of its location and environment, at housing complex and urban level. It considers that the optimization opportunities in urban systems comprise different aspects, such as infrastructure and transport. Therefore, the National Strategy for Sustainable Housing must include mechanisms to promote urban environments that provide a better quality of life and reduce environmental impacts.<sup>20</sup>

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<sup>19</sup> Sociedad Hipotecaria Federal. Estado Actual de la Vivienda en México 2011.

<sup>20</sup> Mesa transversal de vivienda sustentable en México. June 13, 2012. p.7.

Urban NAMA is a proposal of measures that seek to generate a first phase in the construction of efficient complexes with optimal schemes of urban services: distribution of electricity, gas and water at complex level and the optimization of existing urban infrastructure by defining models of novel infrastructure systems.<sup>21</sup> Some of the infrastructure components that are initially considered are:

- Distribution of drinking water.
- Wastewater treatment.
- Street lighting.
- Solid Waste Management.

We propose that the implementation is given by the integration of efficient mechanisms in new housing projects, by strengthening existing infrastructure of housing projects, through optimizing the operation of services and expanding these services to consolidated areas of the city.

The urban NAMA establishes an umbrella structure that will allow simplification of methodologies for quantifying GHG emission reductions and additional benefits. Unlike housing NAMA, it provides the opportunity of reducing the consumption of energy, fuel and water at community level, and therefore, the generation of action at this level of integration.<sup>22</sup>

It also seeks to link the program with additional emerging mechanisms like transport NAMA and integration schemes and financing operation through public-private Urban Services Companies (USCO, for its acronym). The main stakeholders involved in the design and implementation of Urban NAMA are: SEMARNAT, CONAVI, BM, Environment Canada, Point Carbon, and GIZ.

### 7.2.2 CLEAN DEVELOPMENT MECHANISM (MDL) / ACTIVITIES PROGRAM (POA)

The Clean Development Mechanism (MDL, its Spanish acronym) was one of three mechanisms defined in the Kyoto Protocol to help developed countries to mitigate their greenhouse gas emissions globally. The MDL encourages mitigation with international funds for developing countries to generate certified emission reductions to obtain resources through carbon credits.<sup>23</sup> The first MDL program in Mexico will be the one for Sustainable Housing, promoted and coordinated by the CONAVI.<sup>24</sup>

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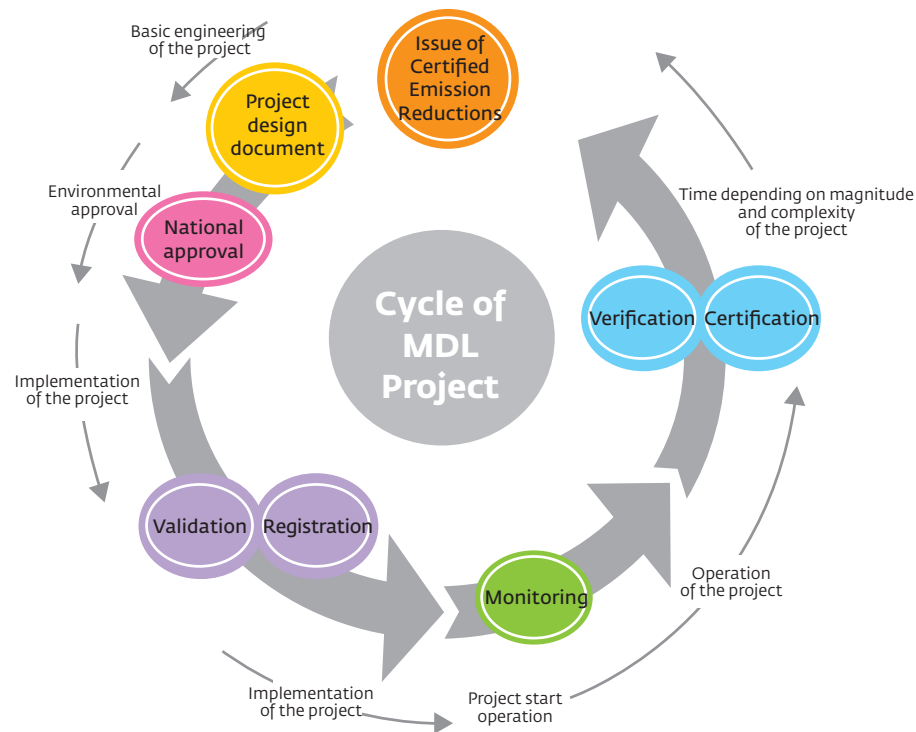
<sup>21</sup> Ibid. pp.7-8.

<sup>22</sup> CONAVI (2012) "Presentación NAMA Urbano, Mesa Transversal de Vivienda Sustentable".

<sup>23</sup> Fundación IDEA, op. cit. p.24

<sup>24</sup> CONAVI. (2009). Desarrollos Habitacionales Sustentables ante el Cambio Climático, CONAVI.

Figure 21. Cycle of MDL project



Source: Desarrollos Habitacionales Sustentables ante el Cambio Climático, CONAVI

The main objectives are: 1) generate MDL funds with the purpose to strengthen existing programs towards using energy more efficiently, and 2) achieve significant reductions of greenhouse gas emissions in the housing sector so that the savings generated, measured in CO<sub>2</sub> can be sold on the international market for carbon credits.<sup>25</sup> However, the requirements to enter the MDL carbon market are complex, stringent and inflexible based on the international standards for mitigation.

In the National Housing Program (PNV) 2007-2012, coordinated by CONAVI, it is stated that in the period 2005-2030 the demand for housing will be 6 million. Therefore, **the Specific Programme for Sustainable Housing Development** to climate change was formulated. This frames the development of a program of activities (PoA), created under the MDL, which gives greater flexibility and access to the attraction of resources from international carbon markets, and helps to strengthen the sustainable and efficient use of energy in the housing sector programs in Mexico.<sup>26</sup>

The PoA proposes the installation of technology and efficiency measures (verifiable) in both existing and new homes. This would be achieved through different lines of action and with the cooperation of major mortgage institutions and international agencies.<sup>27</sup> Additionally, these activities make it easier to buy green homes, meaning homes with technology for efficient use of energy.

<sup>25</sup> *Idem*.

<sup>26</sup> Carpeta de la Mesa Transversal, Tercera Sesión del Grupo Coordinador, Reporte de Avances y Resultados al 13 de Junio de 2012, pp. 4-5.

<sup>27</sup> *Idem*, p. 5.

**Table 3. Examples of sustainable technologies**

	Renewable Energy	Energy Efficiency
New Housing	Photovoltaic solar cells Solar water heaters Wind micro-turbines	Bioclimatic architecture Thermal insulation High efficiency lighting High efficiency appliances High efficiency water heaters
Existing Housing	Solar water heaters	High efficiency lighting High efficiency appliances High efficiency water heaters

Source: Carpeta Mesa Transversal de Vivienda Sustentable.

The PoA consists of mortgage lenders as implementers of financial instruments. The CONAVI manages and coordinates the program, the World Bank acts as the buyer of carbon credits, Det-Norske Veritas (DNV) is the auditor, and Carbonding is the technical consultant.

In the PoA, with an average home 0.95 tons of CO<sub>2</sub> emissions would be saved per year. Taking into account that each house’s reduction depends on the bioclimatic region and the technologies applied as a whole, with a conservative scenario of 400,000 houses per year covered by the PoA, emissions reductions would be:

**Table 4. CO<sub>2</sub> reduction of 400, 000 houses per year**

Year	Total number of houses	tCO <sub>2</sub> e
1	400,000	380,000
2	800,000	760,000
3	1,200,000	1,140,000
4	1,600,000	1,520,000
5	2,000,000	1,900,000
6	2,400,000	2,280,000
7	2,800,000	2,660,000
8	3,200,000	3,040,000
9	3,600,000	3,420,000
10	4,000,000	3,800,000
Total		20,900,000

Source: Carpeta Mesa Transversal de Vivienda Sustentable.

The NAMAs are different from PoA, which is a form of the MDL, as NAMAs parameters are more flexible and seek to align with national development goals of a particular sector so as to achieve a higher level of GHG reduction and expand the institutional capacity of the nation. NAMA is expected to implement the PoA successful elements, such as procedures for monitoring and management.<sup>28</sup>

<sup>28</sup> Castro-Prieto, Emily. “Assessing Sustainability of a NAMA for Energy-Efficient Measures in the Mexican Residential Building Sector” MPhil in Engineering for Sustainable Development, Master’s Thesis.

## 7.3 EVALUATION AND MEASUREMENT ACTIONS

The second set of actions towards a new strategy for housing sustainability refers to programs which evaluate sustainable housing performance. These programs vary according to the results expected from the evaluations and measurements. On the one hand there are tools that increase the house's value before being inhabited in order to give an indicator for environmental performance. On the other hand, there are actions that evaluate and measure inhabited homes in order to obtain information on energy consumption and demands Mexican houses can achieve.

For this set of programs we have sought consensus on the methodology and tools to be used to perform the desired measurements and evaluations. The purpose is to generate transversal results, which means they are comparable and replicable between different actors in the sector.

### 7.3.1 THE EVALUATION SYSTEM OF GREEN HOUSING (Sisevive-Ecocasa)

The Evaluation System of Green Housing, also known as Sisevive-Ecocasa or Sisevive, was originally conceived by Infonavit, and today it has been adopted by other sector's public institutions to complement its efforts in home energy efficiency, like SHF with the program ECOCASA and CONAVI with the program NAMA. It is a tool to comprehensively assess energy efficiency and water consumption in Mexican households in terms of its design and equipment, to give them a rating according to their environmental performance. The Sisevive seeks to be the basis for decisions on financial, tax and normative incentives for more efficient housing and thus redirect the construction of housing in Mexico to an industry with environmental and social responsibility.

The design of Sisevive-Ecocasa took different international practices<sup>29</sup> as reference and discussion workshops with the main public and private national organisms from the housing, energy and environment sectors. The system's design was coordinated and supervised since 2010 by Infonavit, with support from the Federal Ministry for Economic Cooperation and Development of Germany through GIZ and GOPA, as well as with additional support from Fundación IDEA since 2011 (the latter participation was funded by the British Embassy in Mexico).

The Infonavit has promoted the adoption of Sisevive-Ecocasa as a national system for the comprehensive evaluation of energy efficiency and environmental performance of homes that can be used by the various institutions in the housing sector in the country. In that sense, Infonavit and SHF will use the system to evaluate homes participating in the programs Hipoteca Verde and

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<sup>29</sup> See the document "Eficiencia Energética y Ambiental en el Sector Vivienda" and the document "Diagnostico y análisis de Sistemas Internacionales de Certificación Energética en viviendas Julio-2010", Rolf Sielfeld, GOPA-INTEGRATION/GIZ.

ECOCASA, respectively. Furthermore, CONAVI has shown interest in the Rating System, which constitutes a tool to support the simulation of new homes that are part of the NAMA project. Meanwhile, CONAGUA recognizes the tool for the calculation of projected water consumption, and CONUEE joins the activities with the informative calculation of the level of compliance of the NOM-020-ENER-2011 through DEEVi.

The system could also be a first step for Efficient Housing Certification issued by CONUEE pursuant the Program to Promote Certification of Products, Processes and Services, as it allows the comprehensive evaluation of housing energy efficiency, considering both its design (the envelope) and its equipment.

The main objective of Sisevive-Ecocasa is to encourage the development of residential buildings increasingly more sustainable through a flexible combination of strategies that consider both the bioclimatic design and the use of ecotechnologies, favoring those strategies that generate the greatest benefits for the bioclimatic characteristics and water availability in each region. More specifically the objectives are:<sup>30</sup>

**In the short term:**

- Standardize and agree on common criteria on evaluation of energy efficiency and environmental impact in Mexican houses.

**In the medium term:**

- Progressively improve energy and environmental performance in homes in Mexico, thus helping to improve the quality of life of its inhabitants, reducing energy costs and protecting the environment.
- To have relevant information to design new mechanisms of credit allocation criteria or subsidies, focusing resources on the best way to mortgage credits and its results.

Among the benefits to be gained with the Evaluation System, three main areas can be distinguished:

**Social Impact:**

- Improve the quality of life of the population (thermal comfort).
- Provide public and transparent information on each home's level of efficiency to encourage positive competition among real estate developers which will be reflected in more attractive supply of social housing.

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<sup>30</sup> Infonavit (2012). "Modelo del Sistema de Evaluación de la Vivienda Verde".

- Inform the beneficiaries about the: housing's energy level and environmental performance through the labeling of homes.

#### **Environmental Impact:**

- Gradually improve energy and environmental performance of homes.
- Standardize environmental assessment criteria in the industry.

#### **Economic Impact:**

- Reduction in electricity, gas and water costs and savings generation for families.
- Better targeting of incentives for sustainable housing.
- Attracting resources, incentives and subsidies towards sustainable housing.
- Encourage the development of a national industry of efficient and sustainable materials and technologies.

#### **Operation**

To achieve these goals, a system that evaluates the houses according to their type and climate zone was designed. To qualify a dwelling, in a first stage, three household properties are considered: energy demand for cooling and heating the house, the house's projected energy consumption, and projected water consumption. In a second stage, the evaluation system will integrate a fourth component relating to housing development and housing environment.

Each property consists of features described below:

#### **Energy demand for cooling and heating (DE)**

Thermal demand refers to the energy that a home needs to satisfy a suitable thermal comfort level, that means: the amount of energy (electricity and/or gas) which is required for cooling and/or heating, considering the climatic conditions and default housing conditions (building design, construction materials, orientation). The units which are measured with are kWh/m<sup>2</sup>a (Energy/Living area/year).

#### **Projected primary energy consumption (CE)**

It refers to the quantification of all final energy consumption that a standard home will generate based on its equipment. Specifically, it refers to the projected consumption of lighting, water heater, appliances, refrigerators and air conditioning appliances. It also considers the use of energy-saving technologies, such as using solar or photovoltaic panels. The calculation contemplates the preset operating conditions of devices (number of inhabitants, habits, and efficiency of appliances). The units which are measured with are kWh/m<sup>2</sup>a (Energy/Living area/year).



### **Projected water consumption (CA)**

It refers to the quantification of a house's projected water consumption, considering the specifications of the devices and the population's average water consumption habits. Consumption is given by the sanitary artefacts, faucets in bathrooms and kitchens, showers, washing machines and hot water pipes. The units which are measured with are liters/person/day.

### **Sustainable Attributes of Residential Complex (AS):**

This element will consider the housing complex characteristics that have a direct impact on the environmental incidence of the home and its surroundings but, due to its nature, cannot be quantified within the previous sections. Its purpose is to carry out an assessment with the help of a checklist, in which is recorded if the housing development has some of the proposed attributes (e.g. wastewater treatment, solid waste, distance between the city center and the housing complex, etc.).

To calculate the three initial components' values (DE, CE, CA), the system uses two instruments based on spreadsheets: the Energy-Efficient Design of Housing (DEEVi) and the Water Saving Simulator of Housing (SAAVI).

The **Energy Efficient Design of Housing (DEEVi)** is a specially designed spreadsheet by Infonavit, RUV and GIZ / GOPA supported by the Passive House Institute<sup>31</sup> (PHI), to evaluate Mexican households' energy efficiency as a whole system, from vision of the overall housing performance. This method evaluates the overall energy balance of housing, incorporating the effects of architectural design and specification of the envelope, its geographical location and climate, within a defined operational habit.

The spreadsheet estimates the housing's energy demand (DE) and projected energy consumption (CE), after entering all information regarding size, shading, orientation, envelope materials, appliances and ecotechnologies, among others. The tool has been built in accordance with the Mexican reality. DEEVi also incorporates a model for calculating the NOM-020-ENER-2011, thereby allowing to inform the developer about the level of compliance with the standard.

The **Water Saving Simulator of Housing (SAAVI)** is a spreadsheet designed by Fundación IDEA, in collaboration with the GIZ / GOPA<sup>32</sup> and under the supervision of Infonavit. The tool estimates the projected water consumption based on the specifications of the water consuming devices: toilet, faucets, shower, and washing machine.<sup>33</sup> The SAAVI was reviewed and approved by the National Water Commission (CONAGUA) to ensure proper functioning for Mexico.

<sup>31</sup> See: <http://www.passivhaus.de/>.

<sup>32</sup> For its acronym in German; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

<sup>33</sup> See the manual of the Water Saving Simulator of the Housing.

It is important to point out that in SAAVI the official Mexican standards and current Mexican standards were used to estimate the water consumption in the reference case. In this way it is hoped that the information used in the calculator is from devices that meet the regulations in Mexico.

### Global Performance Indicator (IDG)

These three indicators are integrated into a single rating for energy efficiency and environmental impact of housing that is given by the Global Performance Indicator (IDG, its Spanish acronym). Within this classification, each of the components (DE, CE, and CA) has a different weight, which varies depending on the type of housing, climate and water availability in the region. With this, the system favors the design of solutions in the most extreme climates where there is a high demand for energy to provide thermal comfort, the incorporation of technologies in climates where these are the primary source of savings and reduction of emissions, and finally gives a higher value on water saving measures in regions where water pressure<sup>34</sup> is higher and where there is little infrastructure for wastewater treatment.

Based on the IDG, a rating on a scale from A (highly efficient) to G (inefficient) is given. Level F is the baseline level and is the same as that measured for the baseline of new housing NAMA, which was an inter-institutional agreement. Thus, the location within the scale can easily identify the efficiency level of the home and compare it with other homes with the same type and location.<sup>35</sup> In addition to the overall rating of the housing, the system provides information on the following elements:

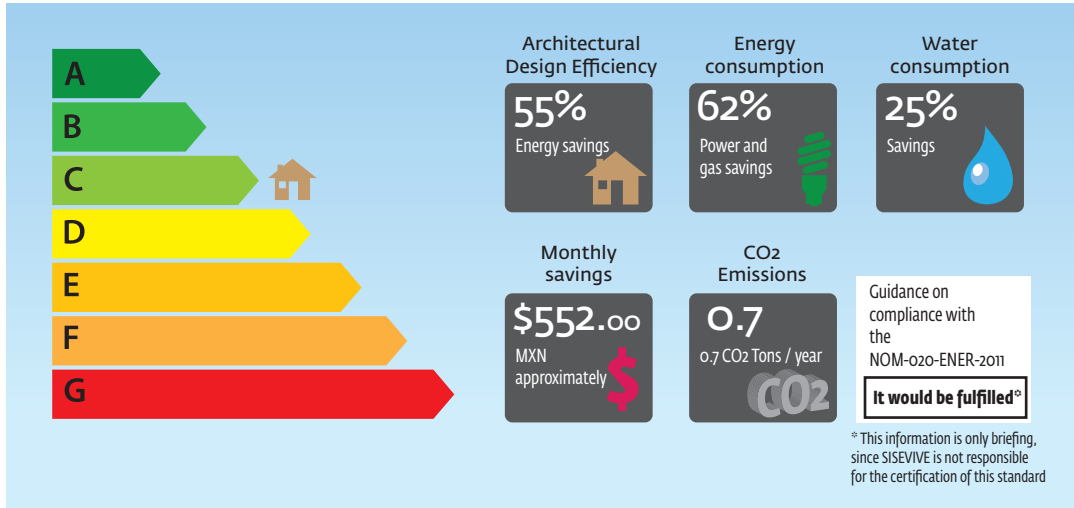
- Percentage of savings in energy and water consumption when compared to a baseline housing case (not efficient).
- Savings percentage on theoretical energy demand for heating or cooling, i.e., the housing envelope's design efficiency.
- CO<sub>2</sub> emissions levels projected in the housing.
- An estimation of the projected savings for families in their spending by electricity, gas and water.
- Level of compliance with the NOM-020-ENER-2011 for informative proposes (unofficial).

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<sup>34</sup> Relationship between hydrological availability and water intake for each hydrological region.

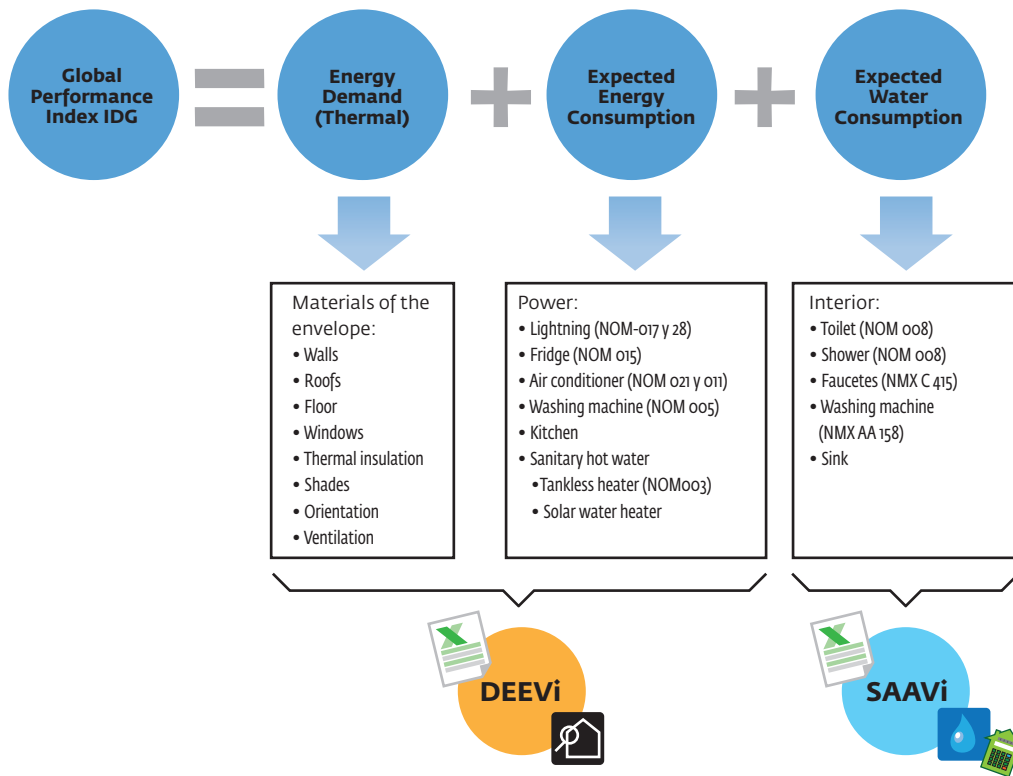
<sup>35</sup> The scales are designed in a specific way for each type/climate combination. Three typologies are considered (isolated, detached and vertical) and four climatic zones, which means there are 12 scales.

**Figure 22. Model of Information Provided by Sisevive-Ecocasa**



Source: Infonavit (2012) "Modelo del Sistema de Evaluación de la Vivienda Verde".

**Figure 23. Sisevive-Ecocasa Components**



Source: Infonavit (2012) "Modelo del Sistema de Evaluación de la Vivienda Verde".

In its first stage, the Sisevive-Ecocasa is designed to evaluate three different types of housing: isolated, semi-detached and vertical housing. Each of these three types can be seen in some of the seven climate zones identified by INEGI for Mexico: Extremely hot humid, Extremely hot sub-humid, Extremely hot dry, Dry and semi-dry, Temperate humid, Temperate sub-humid

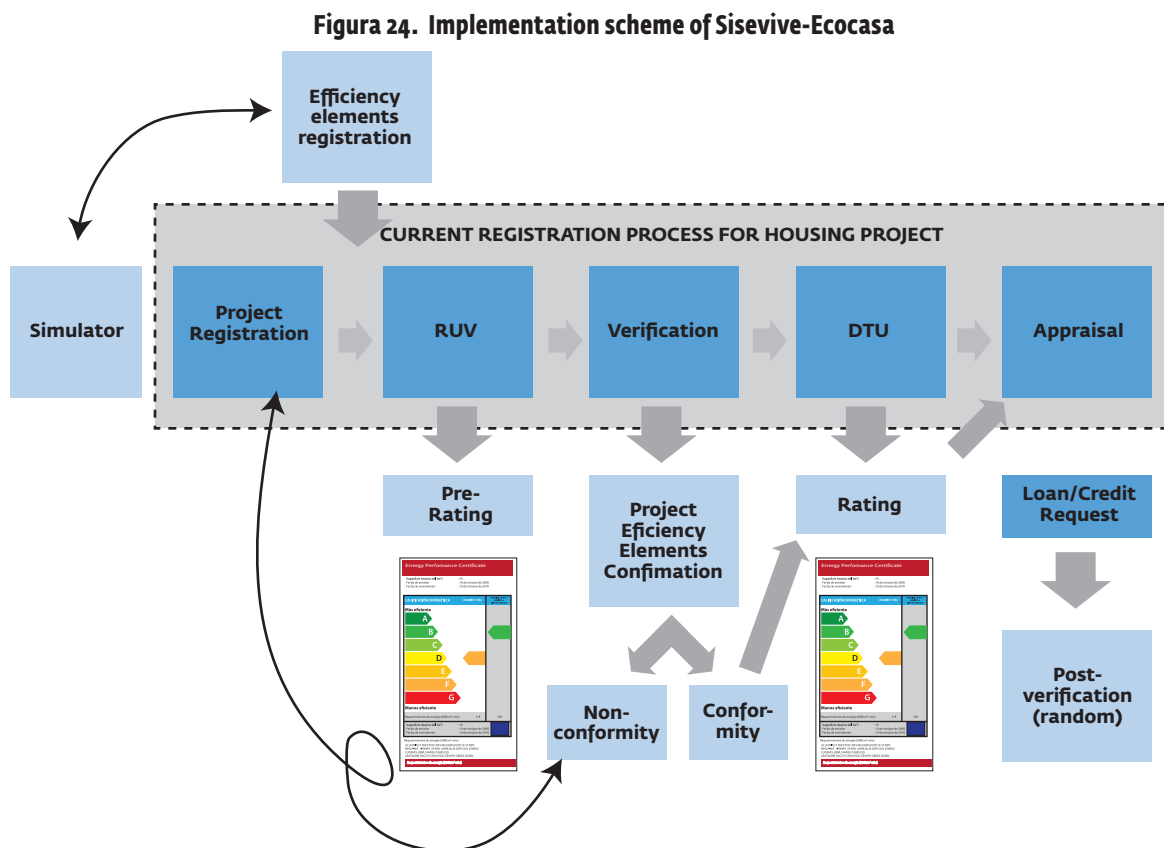
and High mountain cold. The aim is that the Evaluation System has the capacity to cover the entire universe of homes in Mexico.

### Implementation

For housing to be evaluated and receive a rating there must be a process of registration, pre-qualification, verification and final grading. In order to define a simple and inexpensive process to implement the system, it was decided that it would be integrated to existing systems of housing registration and verification that CONAVI and National Housing Entities (ONAVIS) share, held in one common platform of the Unified Housing Registry (RUV).

Therefore, the DEEVi and SAAVI tools will be integrated to RUV's portal for developers to have a simple registration. It also enables any interested user to perform simulations on the environmental performance of housing.

For Sisevive-Ecocasa, Infonavit will implement a pilot program in the first half of 2013. This pilot project is expected to obtain the necessary adjustments so that the evaluation system is implemented nationwide from the second half of 2013.



Source: Infonavit (2012) "Modelo del Sistema de Evaluación de la Vivienda Verde".

### Integration of the Evaluation System in the actions of housing sustainability

As mentioned before, the Sisevive-Ecocasa has been designed with the aim to set up a cross-purpose tool to support the various activities that promote Mexican homes' energy efficiency and environmental performance, as one of its objectives is to standardize the sector's environmental assessment and support the first step toward a national energy certification system for housing. Thus, the system could complement the major efforts in this area to build a housing policy under the comprehensive sustainable housing vision.

Here are some suggestions for specific uses that the evaluation system will have and could have to strengthen various actions in sustainable housing.

#### ***Hipoteca Verde + Sisevive-Ecocasa***

Since its inception, the Sisevive-Ecocasa has been conceived to support the design of a *new Hipoteca Verde scheme* that promotes more decidedly the passive actions on energy efficiency via the measurement of particular elements into the design of a home. As stated, the purpose of this is for *Hipoteca Verde* to promote, besides the use of ecotechnologies, the implementation of bioclimatic design and energy efficient building materials.

The integration of Sisevive-Ecocasa will be made in stages and it is scheduled that rating scales are revised periodically so that they recognize, encourage, and reward the building of housing and housing developments increasingly sustainable.

In the first stage, which will start in 2014, the assessment of housing to meet its environmental performance will be mandatory for homes seeking accreditation by Infonavit. However, at this stage it won't be required that homes meet specific qualifications; housing evaluation will serve only for informational purposes, so residents and housing developers clearly know the home's level of efficiency, specifically on energy and water. It is expected that, as the dwelling is tagged, a process of constructive competition will start that encourages, in the medium term, the definition of higher standards for housing. In a second stage, financial incentives for better rated housing will be incorporated. *Hipoteca Verde* will seek to finance the necessary changes so that the environmental score of a home is the highest possible.

#### ***"Ésta es tu Casa" + Sisevive-Ecocasa***

In section 6.2 the evaluation criteria that currently works with the subsidy program for housing purchase "*Ésta es tu casa*", was presented. These criteria consider four components: location, equipment, re-densification and competitiveness. The competitive component considers the incorporation of environmental technologies as an additional element.

It has been suggested that the evaluation system Sisevive-Ecocasa can support the “*Ésta es tu casa*” subsidy’s program scoring system by incorporating a minimum score of environmental and energy efficiency of housing. Instead of giving the score to the incorporation of isolated environmental technologies, the environmental grade obtained through the evaluation system would translate into points for housing, seen as a system consisting of the design and equipment. The better the environmental performance is (highest rating), the greater the number of points to be granted to the house. Thus, “*Ésta es tu casa*” would reward developers who invest in the best combination of bioclimatic design, efficient materials and water and energy saving devices, and would provide incentives for reproducing such practices within the sector.

### **New Housing NAMA + Sisevive-Ecocasa**

The NAMA program for new housing seeks to attract resources to promote sustainability of homes with energy performance standards increasingly ambitious, as “Ecocasa 1” or “Ecocasa 2”. For these initiatives to be successful, it is necessary to have an energy performance simulation tool as well as specific criteria that evaluate the potential savings and emission reduction of housing. This assessment tool could be transversal among all housing organisms, which means that all organisms would measure with the same parameters.

In this sense, the Sisevive-Ecocasa has been conceptualized and designed as a tool that matches new housing NAMA objectives and requirements. Firstly, both NAMA and Sisevive-Ecocasa share a housing conceptualization, as a comprehensive view of global performance of housing (Whole House Approach). In that sense, both mechanisms share the objective of encouraging and recognizing the combination of passive and active measures that work best in specific types and climates. Secondly, the system’s baseline (rating F) was designed considering the characteristics of the baseline home defined by the NAMA program for each of the housing types (isolated, semidetached and vertical). A third aspect is that the registration and verification processes defined for Sisevive-Ecocasa, match with those for the registration of NAMA projects as both are managed by the RUV. Finally, the information provided by the system for each of the assessed properties is the one required for the project NAMA: projected energy consumption and CO<sub>2</sub> emissions.

### **ECOCASA Program + Sisevive-Ecocasa**

In addition to these initiatives, the Federal Mortgage Company, in conjunction with the Inter-American Development Bank and the German Development Bank, has supported the Sisevive by implementing it into the Program Ecocasa, standardizing the use of the Evaluation System and moving with the rest of the ONAVIS to a housing market with a higher standard in energy efficiency and seen as one of Mexico’s government initiatives that aim to mitigate climate change.

The SHF grants sustainable housing construction loans with a minimum range of specific energy efficiency, considering the bioclimatic design and ecotechnologies. For the definition on this minimum range of efficiency, the program will look for support on the Sisevive-Ecocasa.

### 7.3.2 HOUSING SUSTAINABILITY INDEX

The Housing Sustainability Index (ISV, its Spanish acronym) is an indicator developed by the Centro Mario Molina on behalf of VESAC. It seeks to evaluate models of existing social housing complexes comprising three main areas: environmental, social and economic performance. This instrument will help to quantify progress and identify key opportunities for housing sustainability. Different from and complementary to Sisevive-Ecocasa, the ISV evaluates the housing complex altogether instead of individual houses.<sup>36</sup>

It is expected that this index may impact on the creation of housing projects incorporating improved materials and construction processes, both by public institutions and private companies. It also aims to promote research and development of materials, construction processes, environmental technology, market testing and its long-term impact as well as to establish a development plan for the next 30 years.

It is worth noting that this index is based on the vision of housing complexes of the public-private partnership VESAC. Some of the key actions referred to integral housing are:

- The definition of a new approach to the housing sector in Mexico, aimed at dealing with climate change and global warming.
- The integration of housing policies on issues such as urban, economic and regional development in order to improve the quality of life and create more competitive cities.
- Coordinated participation of public and private agencies in the implementation of projects and activities that strengthen the vision of sustainable policy.
- The use of production processes in the housing sector as an instrument to achieve sustainability and the encouragement of mitigating actions of polluting gases by using efficient eco-technologies.<sup>37</sup>
- The development of incentives to implement international cooperation strategies.

Another feature that distinguishes the ISV is that it considers a complete life cycle approach, a tool that observes the whole life cycle (from cradle to grave) of products and services to assess the

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<sup>36</sup> Currently the ISV is designed for four metropolitan areas: Tijuana, Cancun, Monterrey and the Valley of Mexico.

<sup>37</sup> CONAVI, Vivienda Sustentable, p. 20.

environmental performance resulting from the housing development. This analysis identifies the factors with the greatest impact (negative or positive) on the environment which are generated by social housing and its surroundings.<sup>38</sup>

The ISV is composed of three indexes that can be analyzed separately or together. The table 5 presents the components that make up the Housing Sustainability Index.

**Table 5. Components of the Housing Sustainability Index**

Environmental index	Economic index	Social index
Use of ground	Variation of family spending	Satisfaction in regard to housing
Management of solid waste	Saving due to ecotechnologies implementation	Satisfaction in regard to surroundings
Eco-toxicity and human toxicity	Housing spending relative to family income	Organization and social integration
Photochemical oxidants formation	Transportation spending relative to family income	Social gap index
Water supply	Assets generation	Satisfaction in regard to transportation services
Energy supply	Added value	
Climate change		
Acidification		
Eutrophication		

Source: Elaborated by the authors based upon data from VESAC-Centro Mario Molina, 2012.

## 7.4 DEFINITION OF STANDARDS

Minimum efficiency standards set by the Mexican norms are, at the same time, the starting point of the National Strategy for Sustainable Housing, and an ultimate goal of institutionalization. First, the existing rules define the starting point of the strategy, the minimum levels of energy efficiency and water consumption to be met by housing and new products offered in the market. Second, an objective of the National Strategy should be the impulse for new standards, more modern, integral and demanding, that set new minimum environmental efficiency levels and allow for the generalization of the Strategy's objectives.

In this sense, it is recognized that the regulations development in Mexico is an ongoing process that meets the requirements of the industry and the existing regulatory context in order to promote efficiency in the country in different fields. Efforts made in this area are significant as they have established minimum performance specifications that various of the main sources of energy and water consumption must fulfill. In Mexico there are currently various mandatory or voluntary compliance standards (NOM and NMX respectively, in Spanish) for: the envelope, materials and equipment of energy and water consumption.

<sup>38</sup> VESAC-Centro Mario Molina (2012) Evaluación de la Sustentabilidad de la Vivienda en México. Tercer Informe de Avances.



As part of the regulations on energy, it is important to highlight the role of the official Mexican standards (NOM). The NOM are mandatory compliance technical regulations containing the information, requirements, specifications, procedures and methodologies that enable various government agencies to set measurable parameters for safety, health, energy efficiency, water and environmental protection, among others.

Specifically, the Official Mexican Norms in Energy Efficiency (NOM-ENER) regulate energy consumption and equipment of those devices which, due to their energy demand and number of units required, offer a significant potential for savings to the country and sectors of production and consumption. Similarly, there are NOM for elements and components which regulate water use inside the home (NOM-CONAGUA). Together, these standards seek efficiency of energy and water consumption of the main equipment of housing, such as: refrigerators, water heaters, toilets, water pumps, lighting, showers, washing machines and air conditioners, among others. Table 6 provides a list of existing regulations.<sup>39</sup>

**Table 6. Main regulations on energy efficiency and water consumption related to housing, environment and the construction sector**

Subject	Mexican Official Norm	Description
Energy	NOM-009-ENER-1995	Energy efficiency in industrial thermal insulation.
	NOM-006-ENER-1995	Electromechanical energy efficiency in systems for deep well pump in operation. Limits and test method.
	NOM-018-ENER-1997	Thermal insulation for buildings. Characteristics, limits and test methods.
	NOM-001-ENER-2000	Energy efficiency of vertical turbine pumps with vertical electric external engine. Limits and test method.
	NOM-008-ENER-2001	Energy efficiency in buildings, nonresidential buildings envelope.
	NOM-015-ENER-2002	Energy efficient refrigerators and freezers. Limits, test methods and labeling.
	NOM-007-ENER-2004	Energy efficiency in lighting systems in nonresidential buildings.
	NOM-010-ENER-2004	Energy efficiency of submersible deep well motor pumps. Limits and test method.
	NOM-013-ENER-2004	Energy efficient lighting systems in roads and public outdoor areas.
	NOM-014-ENER-2004	Energy efficiency of AC motors, single-phase, induction, type squirrel cage, air cooling, rated output of 0.180 to 1,500 kW. Limits, test methods and marking.
	NOM-011-ENER-2006	Energy efficiency in central, package or split type air conditioners. Limits, test methods and labeling.
	NOM-004-ENER-2008	Energy efficient pumps and motor pumps for pumping clean water, power rating of 0.187 kW to 0.746 kW. Limits, test methods and labeling.
	NOM-005-ENER-2010	Energy efficiency of household electric washing machines. Limits, test methods and labeling.
	NOM-016-ENER-2010	Energy efficiency of AC motors, three-phase, induction, type squirrel cage, rated output of 0.746 to 373 kW. Limits, test methods and marking.
	NOM-023-ENER-2010	Energy efficiency in air conditioners of free download, air ducts and split type. Limits, test methods and labeling.
	NOM-028-ENER-2010	Energy efficient lamps for general use. Limits and methods of test.
	NOM-020-ENER-2011	Energy efficiency in buildings. Building envelope for housing.
	NOM-003-ENER-2011.	Thermal efficiency of water heaters for residential and commercial use. Limits, test methods and labeling.
	NOM-017-ENER/SCFI-2008	Energy efficiency and security requirements for self-ballast compact fluorescent lamps. Limits and methods of test.
	NOM-021-ENER/SCFI-2008	Energy efficiency, user safety requirements in room air conditioners. Limits, test methods and labeling.
NOM-022-ENER/SCFI-2008	Energy efficiency and user safety requirements for self-contained commercial refrigeration appliances. Limits, test methods and labeling.	
NOM-003-SCFI-2000	Electrical products. Safety specifications.	

<sup>39</sup> For a more detailed review of each of these rules, see the publication “Energy and environmental efficiency in housing” published by Fundación IDEA and funded by the British Embassy in Mexico. (pp. 73-80).

Water	NOM-008-CONAGUA-1998	Showers used for body cleansing. Specifications and test methods.
	NOM-009-CONAGUA-2001	Toilets for domestic use. Specifications and test methods.
	NMX-C415-ONNCE 1999 <sup>2</sup>	Construction industry - valves for domestic water - Specifications and test methods.
	NOM-244-SSA1-2008	Equipment and germicides for domestic water treatment. Sanitary requirements.
	NOM-127-SSA1-1994	Environmental Health. Water for human use and consumption. Permissible limits of quality treatments that must be applied for water purification.
	NOM-230-SSA1-2002	Environmental Health. Water for human use and consumption, health requirements that must be met in the supply systems for public and private water management. Sanitary procedures for sampling.
	NOM-201-SSA1-2002	Products and services. Water and ice for human consumption, packaged and in bulk. Sanitary specifications.
	NOM-010-CONAGUA-2000	Specifications and test methods for toilet valves.
	NOM-001-CONAGUA-2011	Networks for water distribution - Tightness specifications and test methods.
	NOM-007-CONAGUA-1997	Safety requirements for the construction and operation of water tanks.
	NMX-AA-148-SCFI-2008 <sup>2</sup>	Methodology for assessing the quality of drinking water, sewage and sanitation. Guidelines for the evaluation and improvement of the service to users.
	NMX-AA-149/1-SCFI-2008 <sup>2</sup>	Methodology to evaluate the efficiency of the service providers of drinking water, sewage and sanitation. Guidelines for the provision and assessment of wastewater services.
	NMX-AA-149/2-SCFI-2008 <sup>2</sup>	Methodology to evaluate the efficiency of the service providers of drinking water, sewage and sanitation. Guidelines for the provision and assessment of drinking water services.
	NOM-011-CONAGUA-2000	Conservation of water resources. Specifications and method for determining the average annual availability of national waters.
NMX-AA-158-SCFI-2011	Sets the minimum efficiency of washing machines. Requirements to obtain the certification "Grado Ecológico"	
Gas	NOM-007-SECRE-2010	Natural gas transportation, technical specifications and minimum safety requirements to be fulfilled by systems transporting natural gas through pipelines.
	NOM-002-SECRE-2010	Facilities for the utilization of natural gas.
Solar water heaters	Technical Report of Solar Thermal Energy in Housing (DTESTV in Spanish)	Sets the specifications to be fulfilled by water heating systems whose energy source is solar radiation and use as a backup water heater energy source LP gas, natural gas or electricity. It also establishes the test methods for verification and marking and labeling requirements.

Source: Fundación Idea. (2011)

For its impact on the housing sector and the novelty of it, this paper highlights the publication of the NOM-020-ENER-2011. This norm, which came into force in December 2011, specifically refers to buildings for housing, establishing minimum housing envelope efficiency. This standard aims to improve the thermal design in buildings and achieve its occupants' comfort with minimum energy consumption. In that sense, the norm's spirit is fully consistent with the objectives defined by the National Strategy for Sustainable Housing.

The NOM-020-ENER-2011 establishes a methodology for calculating the heat gain of the envelope of a specific house (in other words, the material in walls, ceilings, floors, windows and frames, among others). The heat gain is the result of the sum of the conduction heat gain plus heat gain from solar radiation.

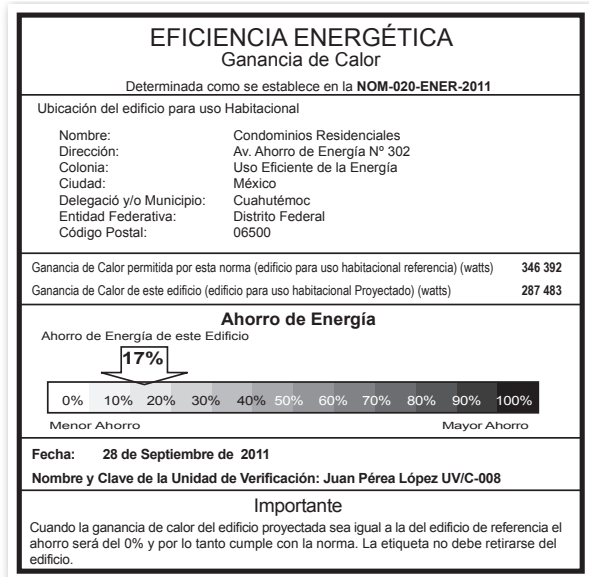
The projected heat gain from residential building is compared to a reference building that has the same characteristics of size and orientation, but fulfills only the minimum conditions of

efficiency in materials and design. The heat gain of the reference building represents the minimum threshold that must be fulfilled by all housing. Thus, the NOM-020-ENER-2011 limits the heat gain of a building by establishing minimum conditions for the house envelope, and therefore contributes to reduce energy demand and, consequently, to lower energy consumption for housing cooling.

Earlier in this text it has been mentioned that the thermal conditioning of buildings in Mexico is greatly affected by the electric system peak demand, with greater impact on northern and coastal areas of the country, where it is more common to use the cooling equipment than the heating equipment. In this sense, the implementation of this standard optimizes the design from the perspective of the thermal behavior of the envelope point of view, obtaining as benefits energy savings by reducing the use and capacity of cooling equipment and consequent reduction in GHG emissions.

The norm applies to both new housing and extensions to existing buildings, and states that they must have a label that provides users with information on heat gain maximum allowed by the standard (for a reference building) and heat gain of the constructed building. The label will show graphically the percentage of savings of the building compared to the reference.

This norm became effective on December 9, 2011. However, some logistical details that are necessary for its implementation still need to be defined. For example: the establishment of verification units, the method by which municipalities must request a certificate in order to issue the building permit and upgrade building regulations, among others.





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# CONCLUSIONS

In conclusion, in recent years the overall housing sector has developed several actions, programs and regulations that have been internationally recognized for their achievements in developing efficient housing in energy and water consumption. It is to be noted that these actions have been focused primarily on social housing and therefore their benefits have supported lower-income families and its impact has become massive. Particularly noteworthy is the contribution of the Infonavit in this area, specifically through the implementation of the program “*Hipoteca Verde*”, and development of “*Sisevive- Ecocasa*”.

More recently, the actions towards housing sustainability have expanded their vision to include not only the building and its interior, but also the social and urban environment that surrounds it, at both housing complex and city levels.

However, and as a natural result of constant innovation and improvement that has characterized the housing sector, it is necessary to set more ambitious goals and strengthen an integral view of sustainable housing. For this, it is necessary to assume a National Strategy for Sustainable Housing that is shared by the main stakeholders in the industry at both federal and local levels. This strategy should allow coordination and create synergies amongst the various efforts that have been taking place to build ever more efficient housing, with higher quality and more integrated into the urban environment.

In this regard, the present document describes the objectives, lines of action and the specific actions and programs that define the national strategy that in the short term seeks to establish funding mechanisms, evaluation and generation of standards to promote more sustainable housing. And in the long run, promotes a profound transformation in the way houses and housing projects are built in the country.

This transformation aims to change the whole sector’s course of action: housing officials, developers, financiers, buyers and residents, to ensure a better quality of life of the latter, without compromising the welfare of future generations.

As shown throughout the text, in the last year, sector coordination, that has been driven by CONAVI and strengthened by the creation of the Transversal Board of Sustainable Housing, has achieved significant progress in the creation and implementation of this national joint strategy. However, it is important to recognize the existence of significant challenges in the short and medium term for sustainable housing in Mexico.

Below are some challenges that are considered critical for the success of the implemented programs and achievement of environmental sustainability of housing in the long term.

**Diversification of information and awareness:** The beneficiaries, developers, planners and the local authorities do not have at their disposal the necessary information to understand the benefits, access and implementation of sustainable buildings. Moreover, the construction pro-

fessions in the country have relatively little information available, and probably the professionals and students will only be willing to invest in upgrading and training on these new technologies if there is clear evidence that green housing is a permanent concept in Mexico.

**Misdirected incentives:** The high subsidies to energy and water consumption are opposed to a strategy that pursues efficient consumption of these essential services, and does not allow giving real value to the actions which reduce consumption without affecting comfort. This leads to distorted information for homeowners about the real value of consumption of electricity, LP gas and water, and therefore, is an inefficient way of assigning prices to non-renewable resources.

**Technical obstacles:** Sometimes the prices of energy efficient equipment are high, as they have to be imported or produced in limited quantities. Service delivery is also insufficient, as there is a lack of qualified personnel to properly install and maintain energy efficient equipment and a shortage of architects who are familiar with bioclimatic designs.

**Regulatory and institutional issues:** There are no general rules for building sustainable housing from an integral view. This effort falls largely in the responsibility of municipalities or states, so it is essential to promote action at those government levels. The Residential Building Code developed by the CONAVI is a very important contribution, but it works only as a model and has no legally-binding character. Existing standards which contain the minimum energy efficiency standards do not cover all aspects of construction and are not yet fully integrated by local building codes.

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# NATIONAL STRATEGY FOR SUSTAINABLE HOUSING

## Environmental Component of Sustainability



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