NAMA for Sustainable Housing Retrofit

Gobierno Federal

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1. Background

The Nationally Appropriate Mitigation Actions (NAMA) are voluntary activities focused at reducing greenhouse gas (GHG) emissions carried out by developing countries under the context of sustainable development and economic growth. Mexico presented the world's first NAMA programme for sustainable new housing during the Conference of the Parties (COP) 16 and 17, which is currently in its first phase of pilot implementation. The NAMA for sustainable housing retrofit, which is currently being developed, is aimed at extending and expanding the scope of these activities, increasing the overall number of existing energy efficient homes, thus contributing to emission reduction.

It is estimated that the Mexican housing sector produces 32% of Mexico's GHG emissions (INE, 2006) which represents 16.2% of the total energy and 26% of total electricity consumption. The residential housing sector in Mexico consists of approximately 28 million inhabited buildings (INEGI, 2010) and it is estimated that one third of these buildings will require a total or partial refurbishment until 2030 (SEMARNAT/GIZ, 2011). Therefore, applying energy efficiency measures to the existing housing stock possesses a huge potential to contribute to energy savings and overall mitigation of GHG emissions. For this reason the Mexican government and its partners[1] are about to design and implement a NAMA programme for sustainable housing retrofit with particular focus on low- and middle-income households.

2. Conceptual Design

Similar to the new housing NAMA, the housing retrofit NAMA will be based on a "whole house approach" where efficiency benchmarks are set for total primary energy demand for each building type taking into account climatic variables. This approach has numerous benefits, including a simple and cost-effective MRV system, and it enables building developers and homeowners to employ a flexible range of interventions to achieve the performance standard desired. It will facilitate a holistic and systematic methodology to energy efficient refurbishment of the building stock. Furthermore, on-going activities and promotional programmes should be coordinated and extended. Based on these approaches, the conceptual design of the NAMA for sustainable housing retrofit will consist of the following steps:

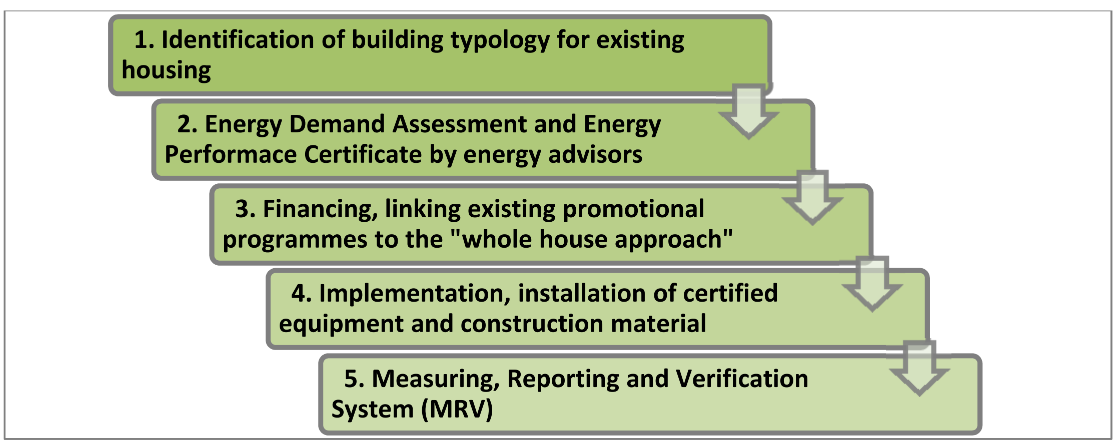

Figure 1: Conceptual Design of the NAMA on existing housing stock

[1] Comisión Nacional de Vivienda (CONAVI) and Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) are supported in the development of this NAMA by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

First, typical buildings and their distribution in different climate zones are identified to serve as a basis for the development of a system of reference typologies (prototypes) to benchmark individual buildings and to identify building clusters for a more systematic approach. For this purpose, a study of the existing housing market has been prepared, concluding that more than 50% of the existing formal social housing stock has been constructed in the last 10 years (CRUZ JIMÉNEZ, 2012). It serves as a base to further identify the correlation of specific housing types and their respective energy consumption values. As one of the main challenges for Mexico is water scarcity, the energy aspect of water consumption will also be included.

Secondly, the energy and water demand of Mexican residential buildings will be calculated. For the purpose of this NAMA, a calculation tool, for example, the Green Housing Evaluation System SISEVIVE[2], – consisting of the DEEVi[3] and SAAVi[4] – designed to evaluate and grade the energy performance and environmental impact of a housing unit, will be used. The DEEVi is a calculation tool for energy demand assessment based on the "whole house approach", contemplating the energy demand of the building and all installed equipment. The energy demand is a calculated value for the energy needed to keep the indoor temperature in a comfort range of 20° to 25°C. It is not be understood as a real demand for energy in economic terms, as most households are not equipped with air conditioners or just accept higher or lower indoor temperatures. The SAAVi is a calculation tool which adds the water aspect to the classification of buildings. Both tools calculate the energy and water need in terms of primary energy and the resulting CO_2 emissions.

Furthermore, a large number of qualified and certified energy advisors need to be trained to approach private households providing recommendations on relevant aspects of energy use, useful energy saving measures and to finally issue an energy performance certificate. This energy certificate will include information on energy demand, consumption and will list suitable retrofit measures for the building, taking into account the cost/benefit ratio, and potential energy and water savings for the user. The qualification of energy advisors can be integrated into the existing system of professional training[5].

The energy performance certificate will be designed according to international standards and adapted to the Mexican conditions. It will classify the buildings according to their energy demand in the categories "A" to "G", where A stands for a building with a very low energy and water need (for example the Eco Casa Max standard/ Mexican Passive House Approach) and G for a building with a very high energy and water need, equivalent to a conventional building without energy efficiency measures. Following, the homeowner uses this energy performance certificate to apply for specific promotional financing (**step 3**), to implement the measures (**step 4**) proposed by the energy advisor.

Current retrofit programmes, which are starting to include environmental aspects and are financially sustainable[6], will serve as basis for the development of appropriate financing products for the improvement of the existing housing stock based on the "whole house approach" (MGM INNOVA, 2012). Such a promotional financing will require energy efficiency measures. To meet the respective energy efficiency standards, the use of certified products shall be fostered. Specific training programmes will be needed for craftsmen, developers and suppliers.

The **final step** consists of the establishment of a "Measuring, Reporting and Verification System" (MRV) which is in line with the MRV system of the new housing NAMA.

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[2] Sistema de Evaluación de Vivienda Verde developed by INFONAVIT in cooperation with GIZ/GOPA-INTEGRATION, Passive House Institute (PHI) y Fundación IDEA, based on PHPP (Passive House Planning Package)
[3] Diseño Energéticamente Eficiente de la Vivienda (energy efficient design for housing)
[4] Simulación del Ahorro de Agua en la Vivienda (simulation of water saving for housing), approved by the Comisión Nacional del Agua (CONAGUA)
[5] Potential partners for professional training and certification are Colegio Nacional de Educación Profesional Técnica (CONALEP) and Consejo Nacional de Normalización y Certificación de Competencias Laborales (CONOCER)
[6] Such as "Línea IV" and "Hipoteca Verde" by INFONAVIT or "Ésta es Tu Casa" by CONAVI

3. Potential savings

This section illustrates the potential savings in terms of energy demand and CO_2 emissions of the NAMA for sustainable housing retrofit. To demonstrate the potential savings, an *Adosada* (row house) building with approx. 40 m^2 of living area (figure 2) has been chosen as an example, which represents approx. 4.8 million houses of the formal social housing stock (CRUZ JIMÉNEZ. 2012).

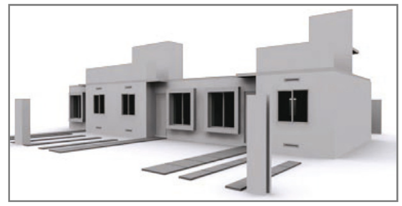

Figure 2: *Adosada* building typology
(CAMPOS/ GIZ-GOPA-INTEGRATION/INFONAVIT)

As a reference to measure energy efficiency improvement, the baseline case for the *Adosada* building type in the four main Mexican climate zones has been calculated (see table 1).

	Guadalajara (temperate)	Puebla (temperate cold)	Hermosillo (hot and dry)	Cancun (hot and humid)
Primary energy demand [kWh/(m^2a)]	> 240	> 340	> 590	> 770
Annual total space cooling demand [kWh/(m^2a)]	> 60	> 30	> 360	> 570
Annual space heating demand [kWh/(m^2a)]	> 10	> 100	> 40	> 0
CO2 equivalent [kg/(m^2a)]	> 55	> 80	> 130	> 170

Table 1: Baseline case (class F) *Adosada* building for main climate zones
(PHI 2012) Estimations based on NAMA 2011 calculated with PHPP, not considering water consumption

Figure 4 shows the estimation of capital and energy efficiency costs in Cancun for different energy efficiency classes, which classify the buildings according to their energy demand in the categories A to G (see figure 3).

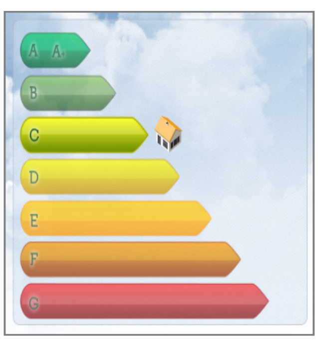

Figure 3: Classification of buildings
Range from A (highest energy efficiency class) to G (lowe)

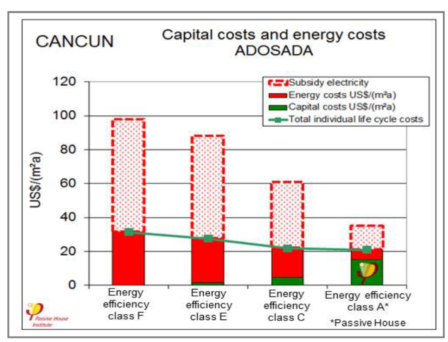

Figure 4: Estimation of capital and energy costs
(PHI 2012)

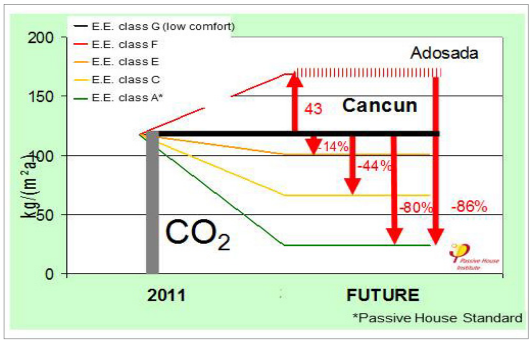

Figure 5: Estimation of CO_2 emission reduction (PHI 2012)

Figure 5 illustrates the difference in CO_2 emission reductions for the different energy efficiency classes mentioned above for the *Adosada* building in Cancun. Whereas the black line represents the low comfort baseline of 18-28°C (class G), the upper dotted line shows the level of CO_2 emissions that the baseline would produce within the comfort range of 20-25°C. With the appropriate energy efficiency measures, up to 90% of the energy demand and the CO_2 emissions can be avoided.

It is important to note that not all existing buildings are conditioned to the ideal comfort range, and the reported savings potential cannot be interpolated to the whole existing building stock, as the resulting energy demand would not reflect the actual consumption of electricity. However, it is likely that the percentage of households using air conditioning will increase as the purchasing power of homeowners rises. Furthermore, homeowners often evolve and expand their building, which can be associated with a higher energy demand. Therefore it can be expected that future consumption comes closer to these estimations. Although the electricity tariffs are highly subsidised, for the households using AC systems a progressive element is already included to provide an incentive to reduce electricity consumption, especially of those households equipped with AC systems.

4. Measures and preliminary cost estimates

Typical Mexican social housing units require a high effort to maintain a comfortable living environment. This is especially challenging in extreme climates such as Cancun or Hermosillo. Energy efficiency refurbishment measures are the more economically viable, the more the respective building component has reached the end of its life cycle. At this stage, the additional investment for more active and passive energy efficiency measures is marginal, providing maximum returns. The implementation of the specific retrofit measures will be defined by the energy advisor and will depend on the specific requirements, such as the building prototype and climate zone. The following measures are needed to reach an optimum retrofit with all its benefits:

Measures towards an economic and energetic optimum	A successful housing retrofit will lead to the following benefits
1. Improved building envelope a. Roof insulation b. Energy-positive windows c. Wall insulation **2. Appropriate shading devices** **3. Efficient building services** (Refurbishment of energy efficiency components) **4. Installation of water saving appliances**	• Comfortable indoor temperatures and living conditions • Constant fresh air supply • Well-tempered surfaces • No air draughts • Sufficient release of humidity • No mould formation (harmful to health) • Substantially lower heating/cooling energy demand • Lower water/energy consumption • Reduction of CO_2-emissions • Energy cost savings • Increased housing value

Table 2: Measures towards optimum with its benefits

Table 3 shows a cost estimate of a possible package of measures for a first pilot implementation of the retrofit NAMA which, similar to the new housing NAMA, would be implemented by large public housing funds of the formal mortgage market (INFONAVIT, SHF, FOVISSSTE) and CONAVI.

Cost of:		Activity	Av. Cost/ Unit (USD)	Units	Total Costs (USD)
1. Refurbishment	**INFONAVIT** (40.000 offered)	Example: Refurbishment offered to homeowners of 100.000 *Adosada* houses, built in 1995-2002. Assumption: 40 % of household participate in the programme with different levels of refurbishment (A-D) and costs.	3.000	16.000	48.000.000
	FOVISSSTE (30.000 offered)		3.000	12.000	36.000.000
	SHF (20.000 offered)		3.000	8.000	24.000.000
	CONAVI (10.000 offered)		3.000	4.000	12.000.000
2. Training for Energy Advisors		Initially 1.000 energy advisors need to be trained. Training includes 40 sessions a 8 hours.	2.500	1.000	2.500.000
3. Energy Performance Certificate		Introduction includes design, application and advertisement, based on the present development of SISEVIVE[7].	-	-	400.000
				Total Financing Need in the first phase:	**122.900.000**

Table 3: Cost estimates for pilot implementation of the NAMA

Refurbishment will be offered to homeowners of representative prototype houses, which were built in different climate zones and in a similar time period. For this purpose energy advisors and energy performance certificates are needed in the first place. Both represent sustainable investments: Energy advisors, once trained and certified, can be appointed repeatedly and energy performance certificates, once designed and advertised, can be used further on.

[7] Sistema de Evaluación Vivienda Verde (SISEVIVE) developed by INFONAVIT in cooperation with GIZ/GOPA-INTEGRATION

5. Conclusion

It is assumed that through an investment of USD 1.000 in energy advice and energy/water efficiency at least 300 kg of CO_2 emissions per year can be avoided. Considering a period of 20 years, this equals a price of up to USD 150 per ton of CO_2 avoided, or accordingly, the (marginal) abatement costs should be less than USD 150/T CO_2. This relation should form a minimum requirement for promotional programmes and be calculated and confirmed by the energy advisor case by case.

At the present time most of the highly efficient technologies, such as efficient windows and ventilation units with heat recovery, are hardly or not yet available on the Mexican market and, thus, are still expensive. However, experience in the European market shows that the introduction of energy efficient building standards leads to the production of more efficient products at lower and more competitive costs. This is also demonstrated in Mexico, for example, through the promotion of solar water collectors under a green mortgage programme[8]. Within 3 years the subsidy scheme brought the price down to a 40% of the original market price.

The NAMA for sustainable housing retrofit aims at coordinating ongoing activities to create synergies towards reducing CO_2 emissions. By combining the various activities in this area, the Mexican government will contribute to accelerate green growth in the Mexican housing sector. The NAMA for sustainable housing retrofit will further strengthen Mexican climate protection leadership.

6. References

CAMPOS/ GIZ-GOPA-INTEGRATION/INFONAVIT (2011) "*Estudio de Optimización de la Eficiencia Energética en Viviendas de Interés Social*"

CRUZ JIMÉNEZ, ROSALBA (2012): "*Estudio de Mercado de la Vivienda Existente*"

INE (2006): "*Inventario Nacional de Emisiones de Gases de Efecto Invernadero 1990-2002*"

INEGI (2010): "*Censo de Población y Vivienda 2010*"

MGM INNOVA, CONAVI and GIZ (2012): "*Análisis de Programas Actuales de Financiamiento de Mejoramiento de Vivienda en México*"

PASSIVE HOUSE INSTITUTE (2012): "NAMA Existente, Mexico: Potentials", based on the NAMA for Sustainable Housing in Mexico 2011

SEMARNAT and GIZ (2011): "*Supported NAMA for Sustainable Housing in Mexico. Mitigation actions and Financing Packages*"

SENER (2012): "*Balance Nacional de Energía 2011*", available at http://www.sener.gob.mx/res/PE_y_DT/pub/2012/BNE_2011.pdf (18.10.2012)

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (German Development Cooperation) has supported the development of this NAMA on behalf of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

Por encargo de:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Ministerio Federal de Medio Ambiente, Protección de la Naturaleza y Seguridad Nuclear

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[8] INFONAVIT's Green Mortgage Programme supported with additional subsidies by the "25,000 Solar Roof Programme" of BMU's "International Climate Initiative"

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