Supported NAMA Design Concept for Energy-Efficiency Measures in the Mexican Residential Building Sector

- Final Draft Working Paper -

Mexico City, 24 November 2010

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The report has been co-funded by the German Federal Environment Ministry (BMU) under the CDM/JI Initiative.

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

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Executive summary

In August 2009, Mexico formulated its Special Climate Change Program (PECC) that defines more than 100 greenhouse gas (GHG) mitigation actions to reduce a total of 51 Mt CO_2e by 2012 across the country. This illustrates a 6% reduction compared to the current GHG trend of Mexico.

The PECC also sets general guidelines to establish an ambitious Mexican GHG emission reduction pathway of -30% with respect to the business as usual scenario by 2020 that Mexico wants to follow, if a multilateral agreement at the UNFCCC is agreed and incorporates provisions for adequate technical and financial support for Mexico from the developed economy.

The PECC includes the “Efficient housing and green mortgages” programme, which has been conceptualised and developed by the National Housing Commission (CONAVI) and is run by the National Workers’ Housing Fund (INFONAVIT). The programme is expected to contribute 2.4% of emissions reductions to the PECC 2012 goal.

Mexico sees the concept of supported Nationally Appropriated Mitigation Actions (NAMAs), as coined during the Bali UN climate negotiations in December 2007 and described within the Copenhagen Accord in December 2009, as an important means for supporting the goals laid out in the PECC.

A NAMA specifies voluntary activities of GHG emissions mitigation in developing countries that are not subject to mitigation commitments and can be supported by industrialised country financing technology or capacity building. In the Copenhagen Accord, industrialised countries have committed to mobilise up to US $100 billion a year by 2020 to address the needs of developing countries for mitigation and adaptation. Generally, three types of NAMAs are differentiated: (i) NAMAs domestically funded and unilaterally implemented (**unilateral NAMAs**), (ii) NAMAs implemented with financial, technological and/or capacity building support from developed countries (**supported NAMAs**), and (iii) NAMAs implemented with funding from carbon offset credits generated for the amount of emission reductions achieved (**credited NAMAs**). The current negotiation does not preclude any of the three types of NAMAs. However, there is a debate on whether NAMAs should be funded through carbon offset credits (UNFCCC, 2010). Under a supported NAMA the support by industrialised countries (e.g. financing) is generally assumed to be given to the more cost-effective programmes and policies supporting up to – but not exceeding – the incremental costs of the policy or action.

The aim of this study is to explore how a supported NAMA that enhances the impact of the “Efficient housing and green mortgages” programme in the PECC could be designed, implemented and operated. The design shall appropriately take into account Mexican development priorities while being attractive for industrialised countries to support the NAMA in final design as well as to finance its implementation and operation.

Although the Copenhagen Accord has laid out the initial concept of NAMAs, the Accord itself does not have a legally binding status in the UNFCCC process. The UNFCCC negotiation is still ongoing and all options for the NAMA design are still widely open. The supported NAMA concept presented in this report could potentially serve as a pilot-NAMA under the UNFCCC. Against the uncertainty surrounding a potential multilateral agreement on the post-2012 climate policy architecture, NAMA design and implementation should be flexible enough to address future developments at the UN level over the next years, including the opportunity to connect the NAMA to the international carbon markets (NAMA crediting). In case no agreement is reached at the UNFCCC level, the NAMA concept can potentially serve as a bilateral mechanism to be linked to (supra-) national emissions trading schemes.

The discussion in this report does not pre-empt any final decisions by Mexico on the NAMA design. It is meant to facilitate discussion with industrialised country representatives on future NAMA support and, in the best case, provide practical solutions for the development of NAMAs on the national and international level.

How can a building sector NAMA be designed? If we consider the residential building sector building codes and appliance standards are the most important policies for energy efficiency improvement in buildings, but their success is entirely dependent on effective enforcement and periodic updates. Hence, there is a high likelihood that NAMAs could set mandatory minimum performance standards and include stringent enforcement mechanisms in order to gain international support. It is vital that any designed NAMA should build on the most important current programmes addressing the residential building sector including the "Ésta es tu casa" and the "Green Mortgages" programme. It should also incorporate the unified building codes (CEV) and existing programme from the Sustainably Integrated Urban Developments (Desarollos Urbanos Integrales Sustentables (DUIS).)).

Under **"Ésta es tu casa"** subsidies are given by CONAVI to the housing developers who could achieve a set of minimum energy efficiency criteria for Greenfield development or refurbishments targeting low-income groups. The **"Green Mortgage"** provides an additional credit line to the approved entitlement of mortgage for INFONAVIT members interested in buying new houses, which incorporate sustainable and energy efficient technologies, such as SWHs, CFLs, water saving faucets, and thermal insulation, among others. The NAMA is aimed to enhance GHG emissions reductions through the "Green Mortgage" and "Ésta es tu casa" . Following steps define the incremental enhancement through NAMA:

- increased penetration (more houses covered during the same time) and/or
- technology up-scaling (more ambitious efficiency standards and/or inclusion of technologies that are currently not covered).

In the medium to long term, a transformation of the voluntary "Green Mortgage" and "Ésta es tu casa" programmes into a holistic urban planning process including mandatory building codes would further increase emissions reductions.

We believe that the NAMA should be coordinated by CONAVI, and a suggested scope is illustrated below:

Table 1: NAMA scope summary

Item	Description
Sector	Building sector
Sub-sector	New residential houses (maximum 4 storeys and 8 units)
NAMA boundary	Entire country
Measures and activities <u>with direct impact</u> on GHG emission reduction	Substantial up-scale of “Green mortgage” and “Ésta es tu casa” schemes through increased subsidies and more ambitious efficiency standards.
Measures and activities <u>with indirect impact</u> on GHG emission reduction	Supportive actions for transformation of the “Green Mortgage” and "Ésta es tu casa" programmes into a holistic urban planning process including building codes - Building code pilot in 1 federal state - Promotion and enforcement of building codes across federal states over time - Capacity building - Extension of urban planning criteria and inclusion in the holistic framework
NAMA timeframe - Preparation - Implementation	 2011-2012 2012-2020
NAMA implementation and operation costs	Full costs of substantial up-scaling of actions until 2020
NAMA type	Supported NAMA (with the possibility of NAMA crediting for parts of the actions)
Type of support required under the NAMA	Financial, technical and capacity building

The baseline annual penetration rate of the “Green Mortgage” and "Ésta es tu casa" programmes amounts to 20% for new houses, i.e. approximately 120,000 houses in 2010. CONAVI’s forecast for 2020 is 121,000 houses under the “Green Mortgage” and 95,000 subsidies for "Ésta es tu casa", i.e. a total of 216,000 houses covering 37% of eligible new houses. Cumulative coverage would reach 2.0 million new houses with 4 million new houses not covered. The up-scaling potential through the NAMA is thus substantial and is highlighted through two scenarios. Scenario 1 assumes that under the NAMA a saturation rate of 100% of green mortgage could be reached by 2020 meaning that every new house by the year 2020 would be built and financed under the criteria of the “Green Mortgage” programme. Scenario 2 reaches a saturation rate of 100% already in 2013.

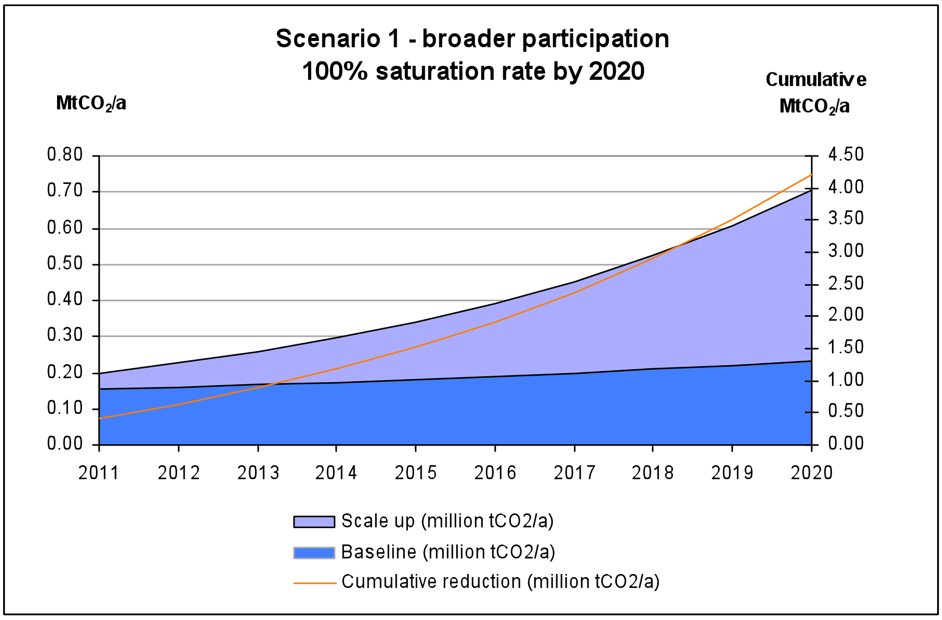
Technology up-scaling in terms of more ambitious requirements and/or the consideration of new technologies currently not covered would mean going beyond the efficient lighting (CFL), the use of solar water heaters (SWH, hybrid solar and gas water heating), efficient gas boiler, thermal insulation (roof and walls) in certain climate zones as well as water saving appliances and reflective coating required under the current programmes. We see energy efficient air conditioners (AC), and efficient refrigerators as critical elements of up-scaling as both technologies have negative abatement costs between -13 and -26 €/t CO_2. Decentralised power generation in the form of solar photovoltaics (PV) in comparison is rather costly, reaching currently 100 €/ t CO_2, but provides a substantial up-scale opportunity.

The technology up-scaling Scenario 3 is based on the baseline roll-out under the “Green Mortgage”, with compulsory energy efficient ACs and refrigerators in the houses. Scenario 4 is the combination of Scenario 1 and 3, i.e. the technology requirements as discussed above are applied to the broader participation roll-out under Scenario 3.

Emission reduction potential for the Scenarios under the NAMA concept

For Scenario 1 the annual emission reduction increment of new houses built during a year reaches 0.5 Mt CO_2 in 2020 compared to the baseline. The cumulated emission reduction of all housing vintages covered by the NAMA reaches 2.1 Mt CO_2/a until 2020, more than twice the emission reductions achieved in the baseline.

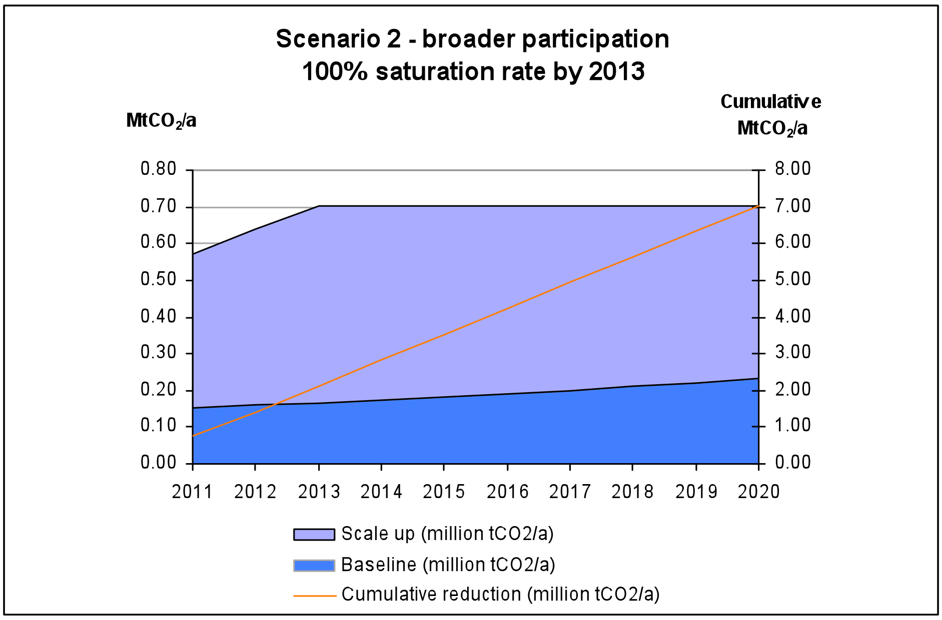
Figure 1: Estimated emission reduction potential under Scenario 1 - 100% saturation rate by 2020



In total, this scenario will create additional emissions reductions of 7.9 $MtCO_2$ between 2011 and 2020.

For Scenario 2 the maximum annual impact reaches 0.54 $MtCO_2$ in 2013 and then converges with Scenario 1. The cumulated additional emission reduction for all housing vintages is 5.0 $MtCO_2$/a until 2020, meaning more than a triplication compared to the baseline.

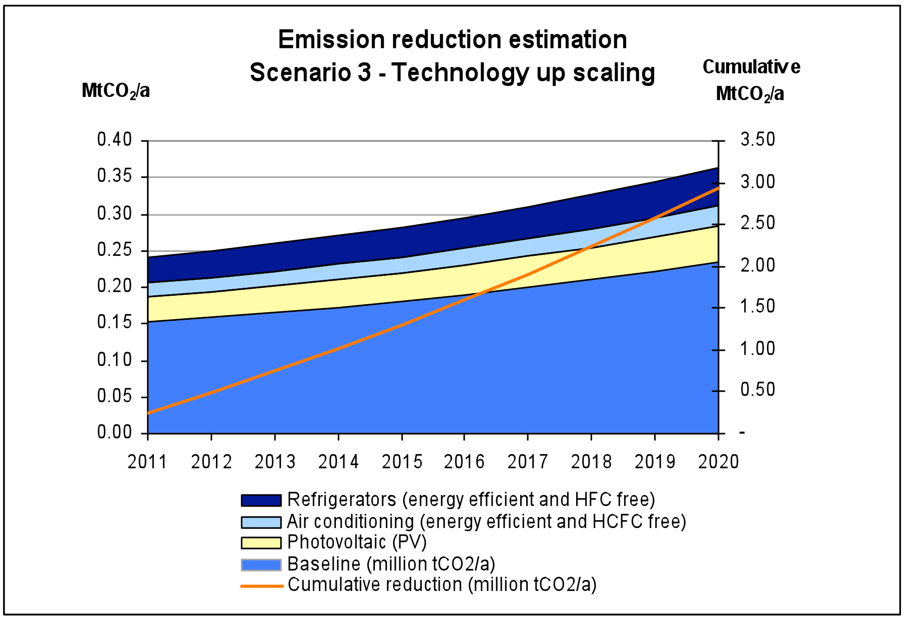
Figure 2: Estimated emission reduction potential under Scenario 2 - 100% saturation rate by 2013



In total, this scenario will create additional emissions reductions of 27.1 Mt CO_2 between 2011 and 2020.

Under the technology up-scaling Scenario 3 the emission reduction impact from each technology over time is illustrated in the figure below. The largest emission reduction potential is expected to be achieved from energy efficient refrigerators and the PV system installation on each house roof. The annual emission reduction potential from PV would be approximately 0.03 $MtCO_2/a$ in 2011 and could increase to 0.05 $MtCO_2/a$ by year 2020. Cumulative the up-scale with PV could end up in 2020 to 0.41 $MtCO_2/a$. Emission reduction from the use of efficient ACs and refrigerators would contribute 0.02 $MtCO_2/a$ and 0.03 $MtCO_2/a$, respectively, in 2011 and would increase to 0.03 $MtCO_2/a$ and 0.05 $MtCO_2/a$, respectively, by 2020. Accumulative these technologies, efficient ACs and refrigerators, would reduce the GHG emission under Scenario 3 by 0.22 $MtCO_2/a$ and 0.42 $MtCO_2/a$, respectively. The aggregated GHG emission reduction potential from Scenario 3 could add additional 0.13 $MtCO_2/a$ to the baseline emission reductions and yield in total 1.05 $MtCO_2/a$ by 2020. Compared to the baseline this is 50% of the emission reductions from the baseline roll-out.

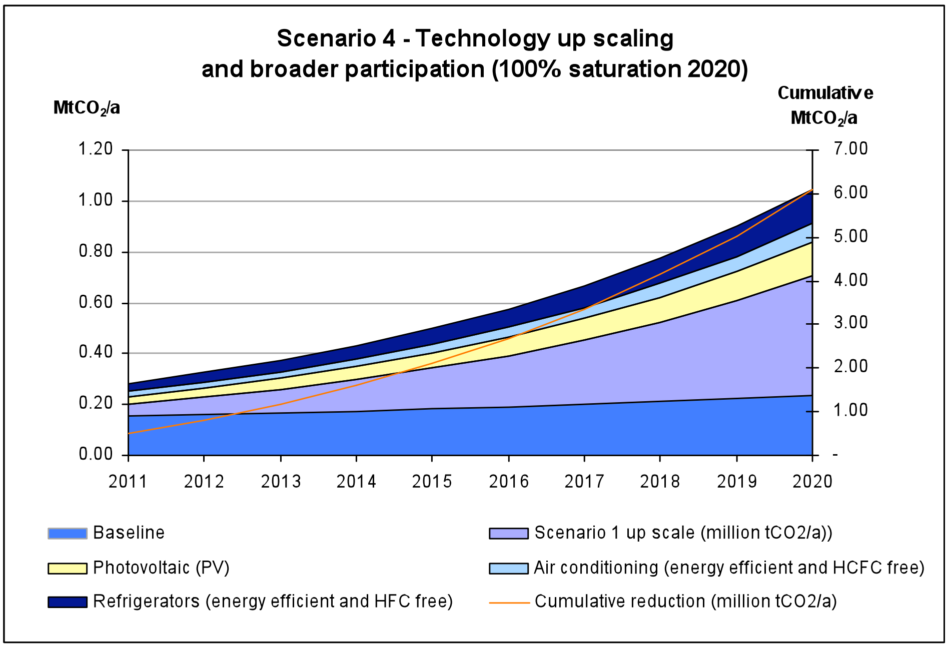
Figure 3: Estimated emission reduction potential under Scenario 3 - Technology up-scaling



In total, this scenario will create additional emissions reductions of 5.4 $MtCO_2$ between 2011 and 2020.It can be observed that most of the emission reductions of the NAMA would in this case be mobilised by the up-scaling of ACs and PV. In how far the potential emission reductions from HC-based refrigerants in ACs and refrigerators could be mobilised under the NAMA will depend on the availability of such products in the Mexican market; which has currently a limited size.

Scenario 4 leads to an accumulation of the emission reduction impacts from scenarios 1 and 3. This means that the technology requirements as discussed above are applied to the broader participation roll-out under Scenario 3. The annual emission reduction from PV would increase from 0.03 $MtCO_2$/a in 2011 to 0.13 $MtCO_2$/a in 2020. Cumulative the up-scaling with PV would add up to 0.73 $MtCO_2$/a by 2020. The emission reduction from efficient ACs and refrigerators would contribute 0.02 $MtCO_2$/a and 0.03 $MtCO_2$/a, respectively, in 2011 and would increase to 0.07 $MtCO_2$/a and 0.14 $MtCO_2$/a, respectively, by 2020. Accumulative these technologies, efficient ACs and refrigerators, would reduce the GHG emission under Scenario 4 by 0.4 $MtCO_2$/a and 0.75 $MtCO_2$/a, respectively.

Figure 4: Estimated emission reduction potential under Scenario 4 - Technology up-scaling under 100% saturation of the "Green Mortgage" by 2020



The aggregated GHG emission reduction potential from Scenario 4 including the emission reduction from broader participation (Scenario 1) could add 4.0 $MtCO_2/a$ additional to the baseline emission reductions. The emission reduction potential would more than triple compared to the baseline by 2020. In total, this scenario will create additional emissions reductions of 15.9 $MtCO_2$ between 2011 and 2020.

All scenarios show substantial emission reduction benefits over time. Scenario 2, due to the rapid inclusion of all new houses under the Green Mortgage by 2013 achieves the highest amount of reductions (27.1 $MtCO_2$ until 2020) that even the Scenario 4, which combines 100% saturation by 2020 and technology up-scaling, cannot achieve (15.9 $MtCO_2$). Among the other two scenarios, Scenario 1 (100% saturation by 2020) achieves higher emission reductions (7.9 $MtCO_2$) than scenario 3 (Technology up-scaling) (5.4 $MtCO_2$). This might point to the conclusion that technology up-scaling is the least effective means of curbing emissions for new residential buildings. However, due to lack of data, our baseline scenario assumed that the same amount of emission reductions of 0.99 tCO_2/house/a can be sustained until 2020 by the "Green Mortgage" in its current design. This assumption cannot be considered realistic. The houses that are going to be built under the current "Green Mortgage" in future years will very likely consume more energy (either due to an increasing number of appliances or by appliances that are not regulated under the "Green Mortgage") and will show less emission reductions per house per year[1]. Therefore, the estimated emission reductions under Scenario 1 and 2 with a very high probability overestimate emission reductions that could be

[1] As discussed, in chapter 5.1.2. in the MRV section, it would therefore be useful to change the current energy cost saving goal for the house owners under the Green Mortgage Programme to energy and CO_2 emission reduction saving goals for the purpose of the NAMA.

achieved through broader participation. If the Green Mortgage programme is not up-scaled by minimum requirements for new technology and is not transformed into a programme where GHG emission reductions are limited following a whole building approach, the trend of rising GHG emissions per house will not be reversed. Therefore, it is suggested that the NAMA should not only rely on broader participation but apply a technology up-scaling at the same time.

In how far the estimated emission reductions associated with the different possible scenarios for actions will materialise under a supported NAMA will depend on (i) the future detailed international rules for baseline setting under such frameworks, (ii) the quality of argumentation that Mexico can provide on why certain technology standards should or should not be part of the baseline, and (iii) the willingness of donors to finance the more expensive components of technology-scale up such as PV. The determination of the precise benchmark level for the supported NAMA and crediting will require further research on the status of the energy efficiency level of Mexican new houses. This would enable to improve the robustness of emission reductions estimates that can be achieved if the NAMA focuses on broader participation in the "Green Mortgage" programme without a technological up-scaling.

Financial requirements for the scenarios under the NAMA concept

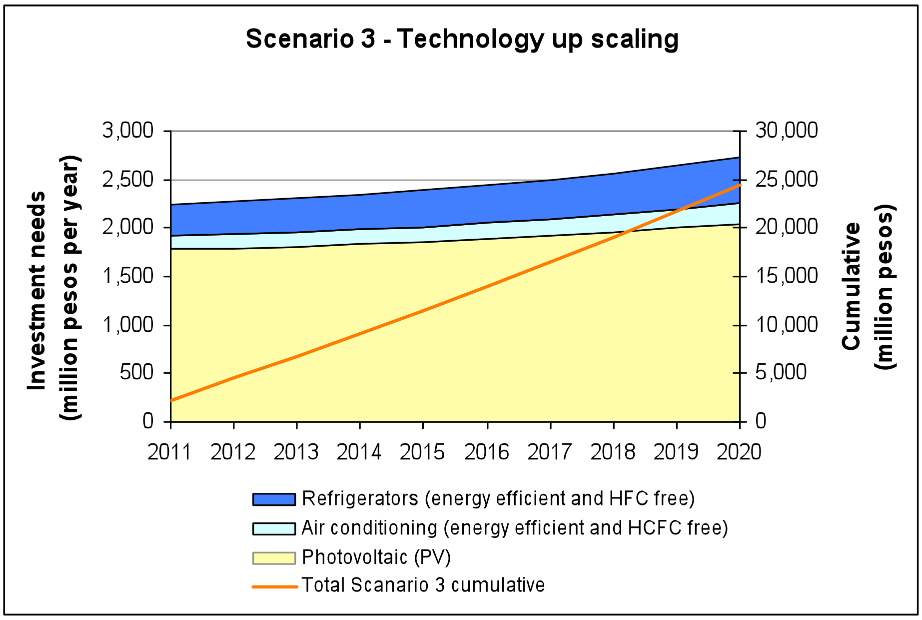
The Scenario 1 with broader participation assuming a 100% saturation rate under the "Green Mortgage" programme until 2020 would require a cumulative incremental subsidy volume for the Green Mortgage of MX$[2] 38 billion until 2020. The annual financial need in 2020 would reach MX$ 8.4 billion.

Under Scenario 2 the broader participation of 100% saturation rate would be reached already in 2013. This scenario would require a subsidy for the "Green Mortgage" of MX$ 89 billion until 2020. The maximum financial need would be reached in 2013, since the additional amount of mortgages would be the highest in this year. In 2013, approximately MX$ 10 billion would be required additionally under the up-scaling. Until 2020, the annual financial requirement is decreasing to MX$ 8.4 billion as the maximum saturation is reached already in 2013 and at the same time the number of houses under the baseline roll-out increases over time.

For the technology up-scaling under Scenario 3, the total incremental financial requirement is in total MX$ 24.4 billion until 2020. The yearly financial need amount to MX$ 2.2 billion in 2011 and would increase until 2020 to MX$ 2.7 billion. The majority of the investment would be required for the installation of the PV systems. During the NAMA operation around 1.76 million PV systems with a total installed capacity of approximately 350 MWp would be installed. The total investment costs for PV only would add up to MX$ 18.9 billion until 2020. The incremental investment needs for AC and refrigerators until 2020 total MX$ 1.7 billion and MX$ 3.9 billion, respectively.

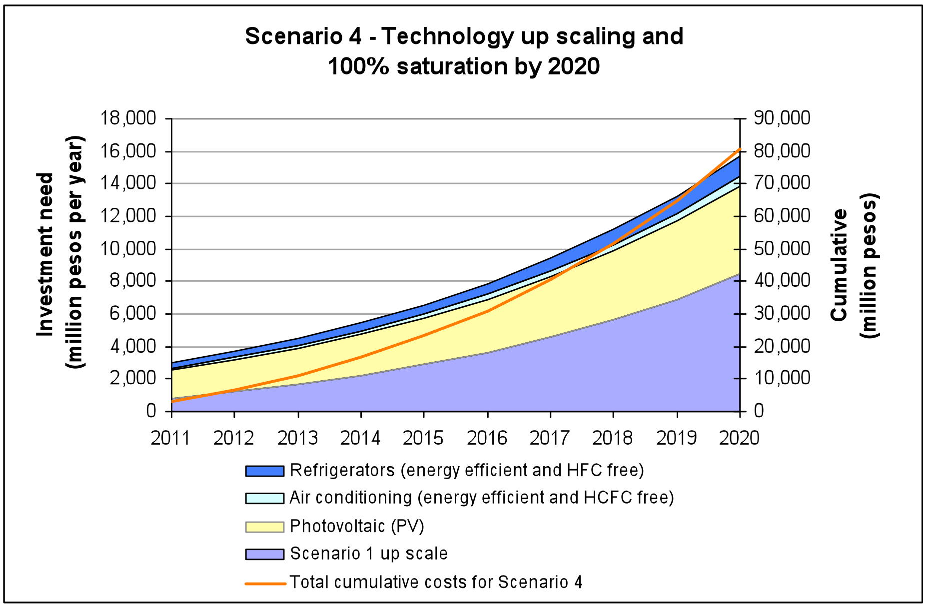
[2] 1 MX$ = 0.06 € as of November 2010

Figure 5: Estimated subsidy needs under Scenario 3 - Technology up-scaling



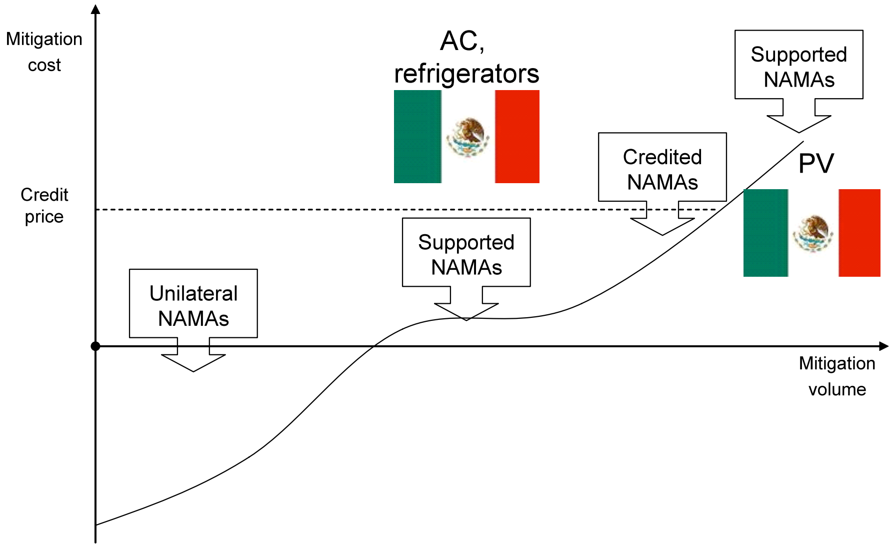
Finally, the combination of technology up-scaling and broader participation with a 100% saturation rate by 2020 will increase and accelerate the financial requirement under the NAMA. The total cumulative investment need until 2020 amount to MX$ 81 billion. 40% or MX$ 33 billion would be necessary for PV and about 47% or MX$ 38 billion for the broader participation related to the costs of the “Green Mortgage” extension plan.

Figure 6: Estimated subsidy needs under Scenario 4 - Technology up-scaling and 100% saturation of the “Green Mortgage” by 2020



Under the scenario the incremental investments for ACs and refrigerators by 2020 would be MX$ 3.0 billion and MX$ 69 billion, respectively. NAMA donors would thus have to consider whether the PV component is worthwhile, which given its high costs would only be the case if a considerable cost reduction would be expected due to the large-scale roll-out.

Figure 7: Marginal cost curve and elements of NAMA in the Mexican building sector



The NAMA implementation and operation would need supplemental financial support for the additional supportive actions and administrative task. The estimation is done to facilitate the implementation phase in 2011 and 2012 and to support the operation due to start in the first half of 2012. The required support is expressed in subsidy volumes. However, some of the actions could also comprise direct support in terms of capacity building and technology transfer. Nevertheless finance is considered most appropriate to enable the implementation of the NAMA, but could be supplemented with direct capacity building and technology.
The financial requirement for the supportive actions are estimated around MX $ 250 million in total until 2010; for the broader participation as well as the technology up-scaling. The budget is considered appropriate for both, as the scope administrative and supportive actions are almost independent of the choice of scenarios discussed in Chapter 4. A major part, however, would be necessary in any case for the implementation phase during 2011 and 2012. The financial need for this period would add up to approximately MX$ 75 million.

The investment in energy efficiency measures and renewable energy encompassed in this NAMA could have a considerable positive impact on the Mexican national economy. Even though the investment in technologies with currently non-competitive costs in the market from a business perspective might be deemed less attractive or even unattractive, e.g. from the point of view of the house owner, there is a long term national economy dimension related to these investments.
The “Green mortgage” programme, also under the proposed NAMA concept, is primarily concerned with the payback of investments in energy efficiency measures and renewable energies from the

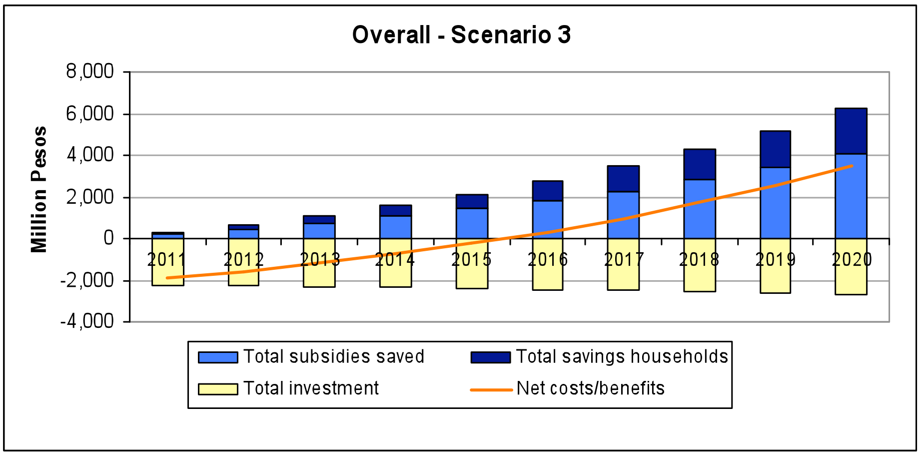
perspective of the house owner; given that the monetary savings are used to refinance the loans from the mortgage.

For this NAMA concept, we have chosen to account the monetary benefits of the proposed actions from a national welfare point of view for Mexico. In the following we undertake a quantitative comparison of the financial requirements for the scale-up technology options (energy efficient ACs and refrigerators) and those monetary benefits in order to analyse and assess the overall economic dimension of the investments to be carried out under the NAMA and how they relate to the financial benefits. Doing so, we account the monetary benefits on two levels only: (i) the house owner (ii) and the Mexican government. We assume that the house owner would be entitled to all the financial benefits from the technology scale-up through energy conservation and generation at his premises (which he will partly use for repayment of the mortgage). The financial benefit for the Mexican government is the avoided financial expenditure for subsidising the energy consumption by the house owner. As currently the price/cost ratio for household electricity tariffs in Mexico is approximately 0.41, this means that every saved MWh of electricity on the household level would save the Mexican Government corresponding subsidies. This refers to a subsidy contribution of 1.64 MX$/kWh saved for each kWh; considering the current average household electricity tariff of 1.14 MX$/kWh in 2010.

How the monetary benefits under the NAMA concept could be shared differently and used to finance the investments should be discussed under the detailed NAMA design and is not part of the scope of this NAMA concept. We assume that in the future design of the financial structure, the monetary benefits will (partly) be used to be refinance the investments over time (e.g. through a fund or the public utility in case it would be involved in the investment under the NAMA). Therefore, in the following comparison of investments and monetary benefits, the financial flows over time are not discounted.

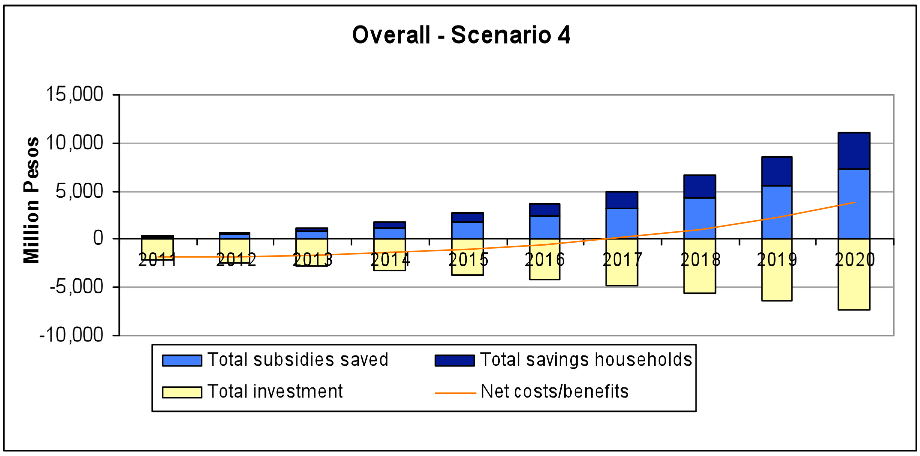
Under Scenario 3 overall there could be a net benefit from the technology up-scaling under Scenario 3 and considerable annual monetary benefits. The benefits would for the first time exceed the newly annual investments in 2016. By 2020 the benefits would amount in total to MX$ 27.8 billion, whereas the accumulated investments would add up to MX$ 24.8 billion.

Figure 8: Associated monetary benefits and investments estimations under Scenario 3



For Scenario 4 considering a broader participation and a technology up-scaling the overall net benefit could reach MX$ 0.8 billion by 2020. The accumulated benefits would amount to approximately MX$ 41.7 billion, whereas the accumulated investments would add up to MX$ 42.5 billion. Figure 8 below is presenting the development of monetary benefits and investments over time until 2020. Compared to Overall - Scenario 3, benefits reach investment levels later, in 2017 due to larger scale of required investments due to broader participation.

Figure 9: Associated monetary benefits and investments under Scenario 4



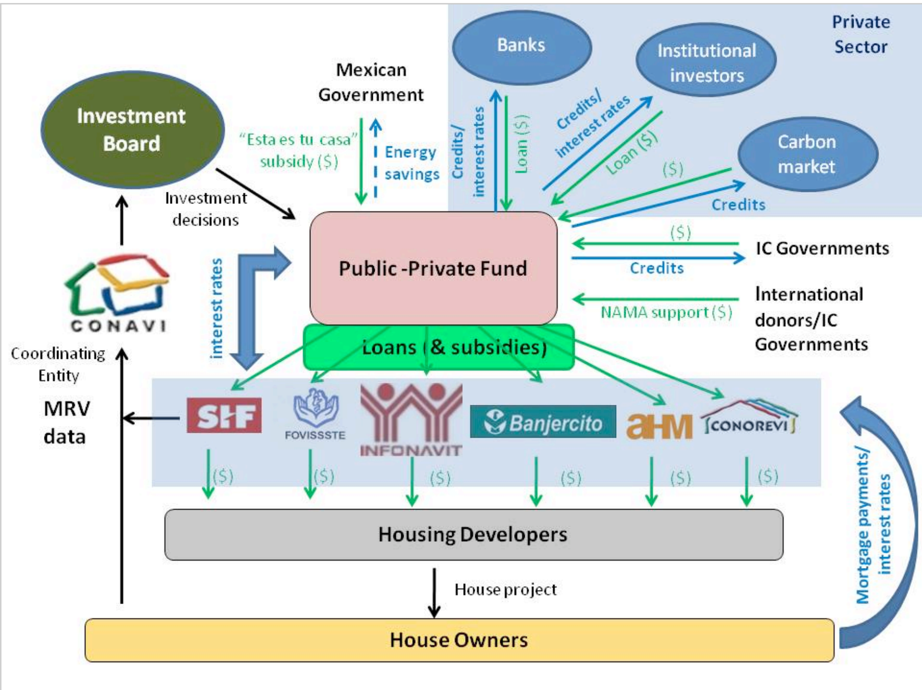
The supported NAMA could help to path the way for a Low Carbon Development Strategy (LCDS) within the Mexican residential building sector. The NAMA would be necessary initially to provide sufficient funds and support to initialise this development and to establish the basis for a sustainable market mechanism.

Financing opportunities

At this stage multilateral financing for the implementation and operation of the NAMA concept presented in this study is rather unlikely due to the vagaries of the negotiation process. Even in case important decisions are made at COP16, the detailed rules and procedures on support for NAMAs and international climate financing (e.g. a possible NAMA registry) will at best need at least another year until COP17 until finally agreed. But given that the international negotiation process puts considerable emphasis on NAMAs and financing for mitigation, with the preparation of this study Mexico has made an important step towards receiving international support for the further implementation of this NAMA concept. Due to the ambitious timeline for NAMA implementation and operation (start 1st half 2012) Mexico should, as long as uncertainty prevails on the multilateral level, seek to finance the next steps for the NAMA implementation through bilateral cooperation. Many bilateral donors are looking for good opportunities to spend their fast-track finance pledges, especially if these entail high visibility.

Under a potential business plan to support the NAMA implementation and operation there are several financing mechanisms and actors involved with different interests. In order to combine the different mechanisms and engage all the participants, we propose the creation of a NAMA fund which will centralize all the financial resources received from donors, the private sector and the Mexican government. In addition, the fund would allocate the resources to the associated financing institutions which are responsible for the distribution of the loans to the housing developers. The model builds up on the current structure already in place between financing institutions, the housing developers and the house owners. An investment board should decide on the allocation of the resources, taking into consideration CONAVI's urban planning and housing policies, and the interest rates provided to each financing institutions (INFONAVIT, FOVISSSTE, SHF, etc). An overview of the NAMA fund is provided in the figure below.

Figure 10: Overview of the NAMA fund



The NAMA fund will provide access to untapped resources from the private sector which will increase the number of loans provided. The large potential to scale up the green mortgage scheme already in place (and projected to reach up to a maximum of 5.6 million new houses by 2020 under the NAMA), will attract private investors interested in low-risk and low-return investments, but which can reach high volumes. Private investors can benefit from the fund structure in two ways: 1) through the repayment of loans and interest rates received from the financial institutions; 2) by receiving CERs in exchange for the investment, in case of a crediting NAMA.

However, a decision on crediting NAMA depends on the Mexico government's position and the international rules on NAMA crediting (especially baseline and MRV). While crediting NAMA represents an effective strategy to attract private sector investment, the requirements for credited NAMAs are likely to be higher than the average CDM project.

The NAMA fund approach combines the participation of the public and private sector in a structure that aims to support existing policies. As a pilot concept, it aims to draw donors' attention to the potential of scaling up *need-based* mitigation actions, based on national circumstances.

Monitoring, reporting and verifying (MRV)

The monitoring, reporting and verifying (MRV) framework for the NAMA should be based on direct GHG emissions monitoring. We propose the introduction of energy performance benchmarks and/or minimum appliance standards based on whole-building energy performance as discussed above. Energy performance improvement due to the up-scaling activities under the NAMA will result in a reduction of the specific energy consumption of new households. Hence, the MRV boundary for the GHG emission reduction for the NAMA framework should be the houses through the whole building approach. The current designs of the aforementioned programmes and the surveys undertaken by INFONAVIT in 2009 and 2010 have already monitored a large number of installations in the target houses. Based on these surveys, reliable MRV concepts would need to be identified and developed for Mexico for the specific proposed NAMA design for up-scaling "Ésta es tu casa" and "Green Mortgage" programmes (see Chapter 4 for the NAMA design and Chapter 5 for proposed MRV). From a MRV point of view a whole building approach would also allow inclusion of renewable energy technologies such as currently already included in the programmes (e.g. solar water heating) into the NAMA.

The analysis in Chapter 5 on the MRV approach revealed that the benchmarking is the most popular approach to the whole-building, large-scale data analysis of the reviewed building efficiency programme evaluation protocols. The approach has a strong advantage in streamlining MRV procedures in that a benchmark can be used to address both baseline and additionality. It is therefore ideally suited to differentiate between BAU measures, supported NAMA efforts and crediting NAMA efforts. Benchmarks can also be made more stringent for the three categories over time. Benchmarking is often a data intensive exercise. Therefore, it is necessary to strike a careful balance between the accuracy and practicability of benchmarking.

If the Mexican NAMA would (only) include activities of transforming the "Green Mortgage" and "Ésta es tu casa" programmes into a country-wide and holistic urban planning and building code framework based on the currently on-going activities within and CEV and DUIS under the NAMA, input and intermediate indicators are deemed adequate, if the NAMA does not include (partial) crediting for the scaling-up of the “Green Mortgage” and "Ésta es tu casa" programmes. If the NAMA were to allow credit generation, possible donors might request that the MRV framework chosen for the NAMA prevents double-counting between emission reductions though supported NAMA elements and the crediting framework.

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1. Background

In August 2009, Mexico has formulated its Special Climate Change Program (PECC) that defines more than 100 GHG mitigation actions to reduce a total of 51 Mt CO_2e by 2012 across the country. This is a 6% reduction compared to the current GHG trend of Mexico.

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The aim of this report is to explore how a supported NAMA that enhances the impact of the “Efficient housing and green mortgages” programme in the PECC could be designed, implemented and operated in such a way that it appropriately takes into account Mexican development priorities while it is attractive for industrialised countries to finance its final design as well as its implementation and operation.

Given the uncertainty surrounding a potential multilateral agreement on the post-2012 climate policy architecture and a possible transition of the Copenhagen Accord text under the UNFCCC framework, especially regarding a fast solution for the framework for NAMAs, the supported NAMA concept presented in this report could potentially serve as a pilot-NAMA under the UNFCCC. In this sense, the further NAMA design and implementation should be flexible enough to address future developments at the UN level over the next years, including the opportunity to connect the NAMA to the international carbon markets (NAMA crediting). In case no agreement is reached at the UNFCCC, the NAMA concept can potentially serve as a bilateral mechanism to be linked to (supra-) national emissions trading schemes.

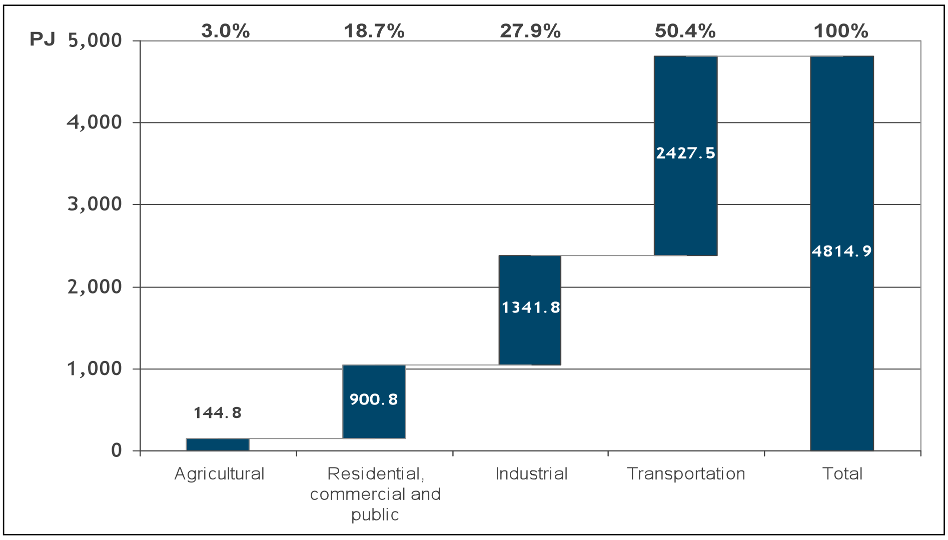
The discussion in this report does not pre-empt any final decisions by Mexico on the NAMA design. It is meant to facilitate discussion with industrialised country representatives on future NAMA support and, in the best case, provide practical solutions for the development of NAMAs on the national and international level.

2. Addressing energy efficiency in the Mexican residential building sector – the relevance of NAMAs

2.1. Status and trends of energy consumption in the Mexican residential building sector and the housing market

The residential sector accounts for a significant share of the energy demand in Mexico. As shown in Figure 10 below, the residential and commercial sector represented almost 19% of the energy consumption in the country in 2008. Of this share, 15.6% comes from the residential sector. The UNEP estimates residential and commercial buildings emissions of close to 75 million tonnes CO_2e in 2006 (Odón de Buen 2009), this means that buildings represented about 12% of total present CO_2e emissions in Mexico in that year. And this number is expected to increase considerably in the next few years due to the population growth and the increasing housing demand in Mexico.

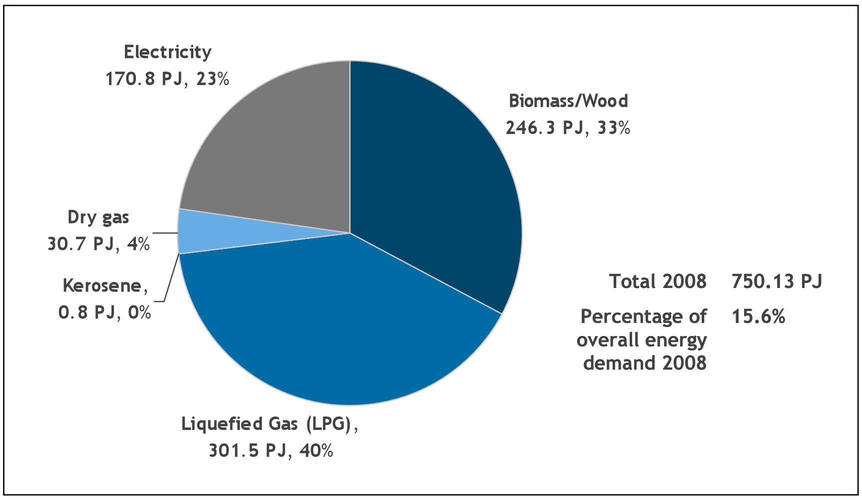
Figure 11: Final energy consumption by sector and type of energy



Source: SENER (2008)

Of all the energy consumed in the residential sector, most comes from liquefied petroleum gas (LPG), accounting for 40% of the energy consumed (see Figure 12). Biomass comes in the second place and it is used mainly by rural households for cooking in traditional open fires. Electricity consumption comes in the third place (23%) and it is mainly driven by the use of air conditioners, refrigerators and other domestic appliances.

Figure 12: Energy consumption in residential sector (buildings)



Source: SENER (2008)

According to Johnson et al. (2010), air-conditioner electricity use in Mexico could increase 10-fold by 2030, reaching a value that is times higher than total residential electricity use in 2005. In comparison the saturation rate of refrigerators at 82% (2006) is already relatively high in Mexico. However, it is assumed to grow further, both in number and storage capacity. With regards to lighting stock, incandescent lamps (ICLs) account for about 85% of the in-use residential light bulbs in Mexico, indicating a large potential for further scaling up the use of compact fluorescent lamps (CFLs), despite CFL promotion programmes starting in the mid-1990s (ILUMEX). Additional CFL dissemination efforts have recently been started (Johnson et al. 2010).

Table 2: Examples of energy efficiency measures and renewable energy supply for the end energy use in Mexico in the residential sector

Activity	Maximum annual emissions reduction (Mt CO_2e/year)	Net cost or benefit of mitigation ($/t CO2e)
Electricity end-use efficiency		
Residential air conditioning	2.6	3.7 (benefit)
Residential lighting	5.7	22.6 (benefit)
Residential refrigeration	3.3	6.7 (benefit)
Renewable heat supply		
Solar water heating	18.9	13.8 (benefit)
Improved cook stoves	19.4	2.3 (benefit)

(Source: Johnson et al. 2010, p. 54)

As can be seen in Table 2, there is a high potential for emission reduction through energy efficiency measures and renewable energy supply in the Mexican residential sector as discussed above.
The Mexican National Housing Commission (CONAVI) estimates the current Mexican’s housing stock at 26.7 million houses. The same institution expects the demand for new houses to reach 20.2 million for the period between now and 2030. Of this total, 11.3 million is the demand for new houses

and 8.9 million is number of houses in inadequate conditions which require partial or total refurbishment.

As shown in Table 3 the majority of new houses are currently built for costs of less than MX$250,000 (38% in 2010) and cost of MX$250,001 - $500.000 (32% in 2010) meeting the demand of low-income families. Both segments of constructions also have the highest growth rates of 30% and 8%, respectively, for 2010 compared to 2009. As of September 2010, the construction level on average exceeds 2008 levels, when the historical record in housing construction was achieved.

Table 3: Mexican housing construction inventory

House price	2008	2009	2010	Var (%)	
				2010/2008	2010/2009
<=$250,000	79,990	102,580	133,063	66.5%	29.7%
$250,0001 to $500,000	95,712	103,641	112,433	17.7%	8.5%
$500,001 to $1,100,000	70,996	69,801	65,183	-8.2%	-6.6%
$1,100,001 to $2,500,000	28,451	27,728	27,114	-4.7%	-2.2%
>$2,500,000	15,916	14,544	15,069	-5.3%	3.6%
TOTAL	**290,975**	**318,294**	**352,862**	**21.3%**	**10.9%**

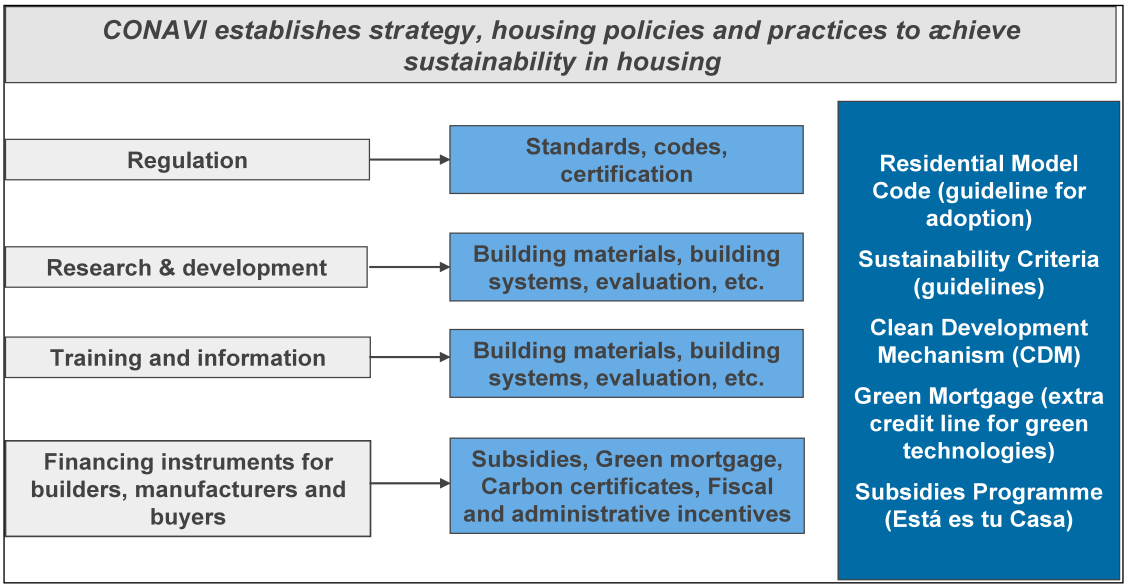
Figures as of September 2010; Source: CONAVI, 2010b)

The expected increase of new housing demand (especially in the low-income segment) highlights the importance of reducing the energy consumption in the residential building sector through dissemination of energy-efficient technology.

2.2. Main on-going and planned programmes for energy efficiency in the residential building sector in Mexico

In a response to the rapidly growing housing demand and the associated projected growth in energy consumption (and related GHG emissions), CONAVI developed several strategic programmes to address the increasing use of energy and enhance energy efficiency in Mexico’s houses. As Figure 13 demonstrates, the package includes: introduction of technical criteria for sustainable housing developments, promotion of Clean Development Mechanism (CDM) projects, development of a methodology for sustainable housing (programmatic CDM), definition of residential building codes (guidance for best practice) and the creation of federal subsidies for new houses and “Green Mortgages as well as enhanced urban planning.

Figure 13: Strategies and activities by CONAVI



Source: CONAVI (2009b)

The following section contains a detailed description of the main support programmes for energy-efficiency in the residential sector in Mexico initiated by CONAVI.

2.2.1. "Ésta es tu casa" programme

The "Ésta es tu casa" ("This is your house") Programme is a subsidy programme created by CONAVI to attend the housing demand of the low-income population and induce uptake of energy efficient technology in the residences. In order to do so, CONAVI has established a set of minimum energy efficiency criteria which has to be followed by the housing developer when designing or refurbishing the house. The programme is focused on the low income population, therefore only workers who receive up to 4 times the minimum wage (approximately MX$6,000) qualify for the subsidy. In addition, the beneficiary should be registered in the social security system or at least have a banking track record and payment capability. These conditions exclude a significant share of the Mexican population as show in Table 4. From the total housing demand, only groups 1 and 2 can benefit from the subsidy. The demand from group 3 (population without payment capability) is not covered by the "Ésta es tu casa" programme.

Table 4: Estimated housing demand in Mexico until 2030

	Demographic Dividend	Housing Backlog	Total
Beneficiary Population (Group 1)	4.4	0.9	5.3
Non-beneficiary population with payment capability (Group 2)	3.0	3.6	6.6
Non beneficiary population without payment capability (Group 3)	3.9	4.4	8.3
Total	11.3	8.9	20.2

Source: CONAVI 2010a

Table 4 illustrates the housing demand divided by population group. Group 1 is composed by workers formally registered in the social security system who are entitled to receive housing credit 6 months after the start date of employment. They are members of different social security institutions (INFONAVIT, FOVISSSTE and BANJERCITO) depending on the economy sector they are part of (private sector, government or army). These workers are known as the "beneficiary population" as they are entitled to the social security benefit. From this group, workers who receive up to 4 times the minimum wage qualify for the subsidy. Group 2 is composed of a section of the population which is not part of the social security system (non-beneficiary), but has a credit history and a banking track record; therefore they are entitled to receive CONAVI's subsidy. The third group is formed by informal workers with very low income and no credit history. Due to their lack of formal affiliations, this share of the population is not reached by any of the housing programmes. However, group 3 represents 41% of housing demand. Currently, this group receives some support from institutions affiliated to CONAVI, but it is not covered by the subsidy.

The subsidies provided under the programme are granted by different executive agencies authorized by the government. The amount of the subsidy varies according to the price of the house the worker wants to acquire. An overview of the amount of subsidy in relation to the housing price is presented in the table below:

Table 5: "Ésta es tu casa" subsidies according to the housing price

Price of the new house	Subsidy
Expressed in multiples of the minimum wage (mw)	
Until 128 mw	33
From 128 to 135	29
From 135 to 147	23
From 147 to 158	20

Source: CONAVI (2009a)

The set of minimum energy efficiency requirements was created by CONAVI and is to be followed by the housing developer when designing the new home. There are different criteria for single family houses and multi-family houses, but the main energy efficient technology requirements are broadly the same: use of CFLs, solar water heaters, water savings appliance and thermal insulation as shown in the table below.

Table 6: Extract from minimum requirement for single family houses under "Ésta es tu casa" programme[3]

Energy Efficiency	Evidence
I. Electrical energy I.1 Light bulb designed for both interior and exterior household illumination in accordance to the requirements in NOM-017-ENER/SCFI-1993, "Energy efficiency and safety required from the self-ballasted compact fluorescent lamp user". Interior: 20W minimum. Exterior: 13W maximum	Certificate and evidence report
II. Hybrid solar and gas water heating system that complies with the "Specifications for determining the saving of liquefied petroleum gas (LPG) emitted by the Comision Nacional para el Uso Eficiente de la Energia (National Energy Efficiency Committee) in the use of L.P.G. and solar hybrid water heating systems" on semi-cold and temperate bioclimatic conditions.	Evidence of accomplishment on DIT backed up by CONUEE (see Definitions on page 1/16), and Evidence Report by Certified Verifiers
III. Gas The heater must be at least instant or quick- recovery type that complies with the requirements in NOM-003-ENER-2000, "Commercial and household thermal efficient water heaters."	Certificate and evidence report
IV. Thermal Insulation **IV.1** Roof insulation in accordance to NOM-018-ENER-1997 "Thermal insulation products for construction", such as boards, foam, formwork, fibreglass and lining that are commercialized as thermo-insulation materials, and that are used in construction systems in semi-cold and temperate bioclimatic conditions.	Certificate and evidence report
IV.2 Wall insulation materials that comply with the requirements specified on NOM-018-ENER-1997 "Thermal insulation products for construction", such as boards, foam, formwork, fibreglass and lining that are commercialized as thermo-insulation materials, and that are used in construction systems in semi-cold and temperate bioclimatic conditions.	Certificate and evidence report
IV.3 Under temperate climate, use reflective coating on smooth slope or flat tiles.	Evidence report and evidence of accomplishment presented by the paint supplier
IV.4 When constructing slope tiles on temperate climate condition, use straw, woven dried palm leaves, mud or wood pieces, among others with similar characteristics.	Evidence report
Water Efficiency	**Evidence**
I. Toilet **I.1** Installed toilet with a certified maximum 6lpf (litre per flush) water consumption, that assures the performance per discharge required in NOM-009-CONAGUA-2001.	Certificate and evidence report
I.2 Installed toilet with a certified maximum 5lpf (litre per flush) water consumption, that assures the performance per discharge required in NOM-009-CONAGUA-2001, and that is recognized as having accomplished "grado ecologico" (ecological label) by CONAGUA.	Ecology label granted by CONAGUA
II. Showerheads **II.1** Low-flow showerheads (compensating flow valve) that comply with NOM-008-CONAGUA-1998.	Evidence report and Evidence of accomplishment
II.2 Low-flow showerheads (compensating flow regulator) that comply with NOM-008-CONAGUA-1998, and that is recognized as having accomplished "grado ecologico" (ecological label) by CONAGUA.	Ecology label granted by CONAGUA
III. Valves for household use certified according with NMX-C-415-ONNCCE-1999.	Evidence report and Evidence of accomplishment
IV. Isolation valves for lavatory faucets, toilets, kitchen sink, water heater, water tank and toilet cistern.	Evidence report
V. Indoor installation hydrostatic test on a pressure rate of 0.75kP (7.5 kgf/cm²) (Kilogram Force) for an hour.	Evidence report
VI. Flow meter that complies with the requirements in NOM-012-SCFI-1994.	Certificate and evidence report
VII. Home water supply that complies with NOM-002-CONAGUA-1995.	Certificate and evidence report

[3] For a full version of the requirements for single and multi-family houses please refer to CONAVI at http://www.conavi.gob.mx/reglas-operacion-paquete-basico

In order to receive the subsidy, the worker should acquire the house from a registered housing developer[4] which incorporates the minimum set energy efficiency requirements defined by CONAVI. Once one of the registered houses is selected by the worker, the subsidy is channelled through one of the agencies associated to CONAVI.

The subsidy programme has been quite successful since its creation in 2007. In 2010, until September 2010, 159,705 housing units had been supported through different institutions. This represents a 20% increase in relation to the same period of the previous year.

2.2.2. Green Mortgage programme

The "Green Mortgage" (Hipoteca Verde) is a programme initiated in 2007, to provide an extra credit line on top of the original mortgage to member of INFONAVIT - which is one of the social security institutions - interested to buy new houses which incorporate sustainable and energy efficient technologies, such as SWHs, CFLs, water saving faucets, and thermal insulation, among others. The programme is targeting state-aided house buyers with low-income. INFONAVIT is by far the largest mortgage provider of the country, with a market share of 80%[5] 400,000 annual mortgages. The Green Mortgage is a credit system based on the savings accumulated in the beneficiary's social security account. When formally employed by a company, the worker is automatically registered in the social security system and receives an social security account number. Thereafter, 5% of his salary every month is deposited on his social security account and can be used to buy a house or as a retirement complement after a certain age. If used to buy a house, INFONAVIT will use the worker's credit to pay the housing developer and gradually deduct the equivalent account from the worker's social security account. In order to qualify for the Green Mortgage the worker should be a "beneficiary" (be a member of INFONAVIT's social security system) and receive up to 7 times the minimum wage. These requirements delimitates Green Mortgages' applicants to group 1 (as group 2 is not part of the social security system and group 3 does not qualify for any of the programmes). The Green Mortgage and CONAVI's "Esta tu casa" subsidy programme are strongly related and most of mortgages provided by INFONAVIT are complemented by the subsidy. In 2010, until September 2010, 100,025 houses had been financed by the Green Mortgage scheme (see Table 7). Of this total, 53% were also granted the CONAVI subsidy. Around 50,000 houses were granted the subsidy without being supported by Green Mortgage.

Table 7: Green mortgages provided by INFONAVIT until September, 2010

2007	2008	2009	2010 ytd
647	1,131	105,104*	100,025*

Source: CONAVI, 2010

[4] Mexico's housing market is relatively concentrated: the ten largest homebuilders build about 25-45% of new homes. The housing developments for low-income families constructed by these developers have usually 100-2500 houses on average. Larger housing developments might contain more than 15,000 units.

[5] The other mortgage provides are: FOVISSSTE, SHF, Banjercito, ahm, and other smaller financial institutions.

*64% of the mortgages provided in 2009 and 53% provided until September 2010 did also benefit from CONAVI's subsidy (Ésta es tu casa).

The Green Mortgage beneficiaries are able to obtain a higher loan from INFONAVIT (approximately MX$ 16,000 more than a traditional loan) due to the monetary savings from water and electricity the energy efficient technologies are expected to generate. Depending on the loan amount provided, the household is expected to generate a certain amount of monetary savings per month. For example, for a standard Green Mortgage credit of MX$17,000, the household is required to achieve minimum savings of MX$ 215 per month. The minimum set of technology requirements for the Green Mortgage programme is the same used for the "Ésta es tu casa" programme. According to the climate zone where the house is located, the housing developer will chose the appropriate package of technologies will be included by the housing developer in the housing design. Once the design is finalized, the developer will register the house project under INFONAVIT's system. At the same time, the housing developer will have a commercial team trying to sell the sustainable house design to one of the interested beneficiaries (future house owners). Once an agreement is reached between the housing developer and the beneficiary, both parties are directed to INFONAVIT for the contracting. A contract is signed between the developer, the beneficiary and INFONAVIT, through which INFONAVIT is committed to pay the developer and deduct the payments and interest rates from the beneficiary's social security account.

2.2.3. Building codes and norms

Mexico has 2,438 municipalities which can self-responsibly design and implement building codes and norms. Due to the dispersed nature of their activities and the decentralized political configuration in Mexico, there are a number of construction regulations and the country lacks a unified building code.

Código de Edificación de Vivienda – Unified building code (CEV)
In 2007, CONAVI developed a unified building code (CEV) to be used as model by local authorities to set minimum building standards for new houses. Since then, CONAVI is working on the CEV with the objective to promote its adoption on municipality and state level:

- 2007: CONAVI publishes the Residential Building Code (Código de Edificación de la Vivienda - CEV) including a chapter on sustainability to set criteria for green residential building. The CEV and sustainable housing developments become a priority in Mexico's Housing Policy.
- 2008: CONAVI starts promoting the CEV for adoption among local governments. Sustainable Construction practices are encouraged.
- 2008 – 2009: The CEV's Sustainability Chapter provides criteria for a rating system for green residential buildings.
- 2010: CEV were updated with enhanced chapters on energy efficiency and sustainability; the nergy efficiency chapter includes a performance path and a prescriptive path.

CONAVI's objective for the building codes is to regulate the home construction process in an urban

context to improve public health, safety and welfare. However, the enforcement of the code should be done at the regional level, which makes it a difficult process to manage and monitor.
In addition to the CEV, CONAVI developed 3 other construction guidelines.

Criterios e indicadores para los desarrollos habitacionales sustentables (Criteria and Indicators for the development of sustainable housing): guideline for the construction of sustainable houses across the different housing programmes developed in the country. At the moment the application of the criteria for sustainable housing is voluntary and it is not supervised.

Guía para la Redensificación Habitacional en la Ciudad Interior – Guide for redefinition of housing density: the guide is directed to local authorities and municipalities and suggests fiscal and normative tools to redefine the utilization of local infrastructure and services.

NOM-020-ENER – Eficiencia Energética en Edificios Residenciales – Energy Efficiency in Residential Buildings: The norm establishes indicators to calculate the heat exchange according to the insulation material used during construction and classifies the buildings according the energy savings achieved in comparison to a reference value. It is currently under revision and therefore it is not enforced.

The application of the building codes and norms should be monitored and verified by designated "Verification Units" (UV). There are 185 UVs in the country, but some states do not have any UV. Due to their low capacity and limited number of UVs and the lack of supervision of their work, the enforcement of building codes and norms in Mexico is very low.

2.2.4. Sustainably Integrated Urban Developments - Desarollos Urbanos Integrales Sustentables (DUIS)

Desarollos Urbanos Integrales Sustentables (DUIS) is an initiative of the Mexican government to promote the integration of urban planning into the context of new housing developments, focusing on the areas where substantial housing developments are planned. The programme aims to coordinate the development of new projects in existing urban areas that plan to increase urban density and to supervise the development of “new” cities with large land extensions through projects that generate served land with infrastructure and sponsored by state governments or urban developers (house & land), aimed to sell big plots to small and medium size house developers.
Sociedad Hipotecaria Federal (SHF) works as the coordinating entity of DUIS and the eligibility criteria for the new regional developments are set up by two independent consultants.

2.2.5. CDM project initiatives in the Mexican building sector

Among the 124 Clean Development Mechanism (CDM) projects that have been registered in Mexico (until September 2010), only 1 project promotes energy efficiency improvement among existing households through the distribution of CFLs under a PoA (Point Carbon, Carbon Project Manager, 22nd September 2010). Only a handful more CDM projects are currently planned in the Mexican building sector of which some are in very early stage of development as shown in Table 8.

Table 8: Overview of CDM activities on EE and RE within the Mexican building sector

UNFCCC ID	Project name	Project type	Summary	Stage
2535	CUIDEMOS Mexico (Campana De Uso Intelegente De Energia Mexico) – Smart Use of Energy Mexico - PoA	ENEF - consumption - power	The programme of activities (PoA) involves the distribution of energy efficient light bulbs to households across Mexico. The goal of the PoA is to transform the energy efficiency of Mexico`s residential lighting stock by distributing up to 30 million compact fluorescent lamps (CFLs) to households. By doing so, the program will abate greenhouse gas emissions through avoided electricity usage, reduce national electricity demand and stress on energy infrastructure.	Project registered
	Distribution of ONIL Stoves - Mexico - PoA (San Felipe Usila 1 - CPA)	ENEF - consumption - heat	The PoA involves the distribution of fuel-efficient stoves to households across Mexico. The goal of the PoA is to transform fuel-efficiency of Mexico’s traditional residential cooking systems by distributing up to 50,000 stoves to households each year. By doing so, the programme will abate greenhouse gas emissions through reduced fuel wood usage. The CPA includes 1000 stoves benefiting 1000 families.	Validation
	Sustainable Housing Programme in Mexico – PoA	Other - Other	The Mexican Housing Commission Sustainable Housing PoA is a small-scale programme of activities to provide subsidies and/or increased loans (“green financing”) for the purchase of residences in Mexico that use energy efficient and/or renewable energy technologies to reduce GHG emissions. The SSC-PoA will be operated and implemented by the Mexican National Housing Commission (Conavi) and will involve the verifiable installation of technological elements and efficiency measures in new affordable housing.	PDD
	Efficient Lighting Project at Residential Sector, Distrito Federal	ENEF - consumption - power		Prospect
	FIDE Program of Refrigerators Substitution in the Metropolitan Area of the Valley of Mexico	ENEF - consumption - power		Prospect
	Mexico Energy Efficient Compact Fluorescent Lamps (CFL) Program	ENEF - consumption - power		Prospect
	Mexican National Housing Commission (CONAVI) project	Other - Unknown		Prospect

Source: Point Carbon’s Carbon Project Manager (22nd September 2010)

In terms of energy efficiency project types, the most advanced planned CDM project is a CDM Programme of Activity (PoAs) which is based on the Green Mortgage and “Ésta es tu casa” programmes and is currently developed by CONAVI.

2.3. “Status and trends” of programmes: evaluation of the impacts

2.3.1. Green Mortgage and Ésta es tu casa

The Green Mortgage programme has been evaluated twice so far, once in 2009 and a broader evaluation conducted in 2010. Both assessments were conducted by an external consulting company. The evaluations aimed to measure the impact of the programme (in terms of monetary and energy savings) and the household’s satisfaction with the energy efficient technologies. In total, 319 phone interviews were conducted and 151 residences were visited to ensure the technologies were installed. Overall, 51% of the sample group interviewed over the phone are very satisfied with the new house and 33% are satisfied. The main complaints from the group of people not satisfied with the new houses are related to construction problems and problems related to water and electricity installations and the size of the house (the new house is considered too small for 13% of the interviewed group).

During the site visits, the following technologies were surveyed: solar water heaters, efficient light bulbs (CFLs), air conditioners (A/A), refrigerators, ventilators, building insulation, and water saving devices. On average, a sustainable house financed by the Green Mortgage scheme has the capacity to reach MX$ 229 in energy savings per month (depending on the climate zone and technologies incorporated in the house).

Most of the houses financed through the Green Mortgage scheme also received the subsidy from CONAVI. Of the total households interviewed over the phone, 70% confirmed they also benefited from the subsidy. There is no separate evaluation for the “Ésta es tu casa” programme, therefore is difficult to measure the impact of the subsidies programme for the households that receive just the subsidy. However, as most of houses under Green Mortgage also benefited from the subsidy, we will use the results from these evaluations to measure the impact of both programmes.

The main differences between the Green Mortgage evaluations conducted in 2009 and 2010 can be seen in the table below. Houses without air conditioning and without ventilation were included on the second evaluation, resulting in higher CO_2 emission reductions. On average, the sustainable houses financed with Green Mortgage are expected to reduce approximately 0.78 tons of CO_2 emissions per year. The summary of the impact of the programmes as presented by INFONAVIT is shown in Table 9.

Table 9: Comparison between Green Mortgage evaluations conducted in 2009 and 2010

Savings Summary 2009		
	Savings MX$	**Emission reductions (tCO_2)**
Hot zones	Monthly savings	Annual reductions
House with A/A	MX$ 360	1.21
Houses without A/A	MX$ 168	0.14
Temperate and cold zones	MX$ 209	1.04
TOTAL	***MX$ 217.5***	***0.6***
Savings Summary 2010		
	Savings MX$	**Emission reductions (tCO_2)**
Hot zones	Monthly savings	Annual reductions
House with A/A	MX$ 354.0	1.2
Houses without A/A	MX$ 178.6	0.63
Houses without A/A and without ventilators	MX$ 72.9	0.26
Temperate and cold zones	MX$ 297.9	1.26
TOTAL	***MX$ 240.5***	***0.96***
Average Summary Savings 2009 and 2010		
TOTAL	***$229***	***0.78***

Source: INFONAVIT (2010b)

The following table shows the resulting energy savings and the achieved CO_2 emission reductions (partly based on own calculations) as surveyed in the INFONAVIT 2010 survey.

Table 10: Annual energy savings and CO_2 emission reductions by Green Mortgage

	Energy savings per house (kWh)		**Avoided T&D losses per house (kWh)**	**Emission reductions (tCO_2)**	
	Electricity	**Gas**	**Electricity**	**per house**	**Total**
Hot zone with A/A	1,788	0	179	1.18	15,016
Hot zone with ventilator	946	0	95	0.62	31,778
Temperate zone	382	4,771	38	1.37	24,758
Cold zone	382	5,423	38	1.53	27,577
TOTAL				**0.99**	**99,129**

Source: INVONAVIT (2010b) and own calculations based on Odón de Buen (2009)

The difference in the emissions reductions compared to Table 9 is due to the fact that we have used UNEP data for the CO_2 emission factor of electricity natural gas used in the Mexican housing sector.

Additionally, we assumed transmission and distribution losses of 15% for Mexico. As the programme reduces electricity consumption, it avoids power generation that is subject to those losses. This leads to a higher amount of electricity generation saved and a higher amount of CO_2 emission reductions per house.

Despite its success in achieving emission reductions in the first years, the programme lacks a monitoring and auditing system which ensures the energy efficiency measures are still correctly installed and working properly after few years of operation. At the moment, the housing construction is verified by one of INFONAVIT's auditors to guarantee the green technologies are incorporated in the house. However, this is no regular inspection to ensure after the appliances are actually operating.

Due to the success of their programmes, both INFONAVIT and CONAVI have plans to scale up the current activities as described in the following section.

Green Mortgage scaling up:

From 2011 onwards, INFONAVIT aims to reach sectors of the population with higher income levels, that will receive a higher loan but that are also expected to achieve higher savings using more energy efficient technologies. A break-down of the planned loan amount per income range is presented below:

Table 11: INFONAVIT's planned loan under Green Mortgage according to income range

Income range (Expressed in multiples of the minimum wage (mw))	Maximum loan (MX$)	Expected Savings (MX$ per month)
Up to 6.99 mw	17,000	215
Between 7 and 10.99 mw	25,000	290
Higher than 11 mw	36,000	400

Source: INFONAVIT (2010a)

The higher savings are expected to be achieved through the incorporation of certain energy efficient technologies, depending on the climate zone where the house is located. INFONAVIT is currently developing a list of preapproved technologies from which the housing developer can flexibly choose to achieve the required cost savings. INFONAVIT's model is expected to provide the housing developer with the following information on the eligible technology types: investment costs, monetary savings, payback period and internal rate of return (IRR) as well as the emission reductions. As the model is still under development, the draft list of technologies could not be assessed. With this expansion plan, INFONAVIT currently aims to achieve an annual increase of green mortgages of 10% from 2011 onwards. INFONAVIT is even considering granting all its mortgages as green mortgages from beginning of 2011 onwards. This would translate into around 400,000 green mortgages to be granted from that year onwards. As this would mean a four-fold increase of the beneficiary number, the current considerations need to be considered as very challenging and ambitious.

"Ésta es tu casa" scaling up:

CONAVI plans to keep the annual number of subsidies to be provided at approximately 95,000 per year. As the programme depends on budgetary approval from the Congress every year, it is not straightforward to forecast how many subsidies will be provided in the next financial years. In 2010, the budget allocated the subsidy programme was MX$ 5.8 billion. For 2011, the senators are suggesting a budget increase to MX$ 12 billion[6], yet to be approved by the Congress. The current budget proposal illustrates the good standing the programme has within the government, but it does not ensure that more resources will be directed to the programme next year.

The annual budgetary approval requirement for "Ésta es tu casa" generates a high political risk for the continuity of the programme. Any changes on the federal government level would risk the continuation of the programme, if the housing policies are not seen as a priority for the new government. However, Mexico will not host general elections until 2012; therefore the scheme is very likely not compromised until then.

Combined scale up of "Green Mortgage" and "Ésta es tu casa":

In terms of the target of houses to be supported by the two programmes, CONAVI and INFONAVIT foresee the following plan to scale up the Green Mortgage programme (see Table 12).

Table 12: CONAVI's projections for the annual number of houses to be supported by INFONAVIT and CONAVI in 2010, 2020 and 2030

	2010	2020	2030
Total of houses	27,294,756	33,061,322	38,053,202
"Ésta es tu casa" subsidy	73,613	95,000	95,000
Green mortgage without subsidy	46,639	120,970	313,764
Total number of "sustainable" houses	120,252	215,970	408,764
Increase of the housing stock	582,076	5,766,506	4,991,880
% sustainable houses in the total number of houses	**0.93%**	**6.12%**	**13.38%**

Source: CONAVI (2010a)

Taking into consideration CONAVI's expansion plan to serve the future housing demand with green mortgages and subsidies, the total number of houses to be supported by CONAVI and INFONAVIT in 2020 would represent 6.1% of the total housing stock in the same year. If we compare the total number of "sustainable houses" with the number of new houses constructed per year (approximately 576,000 houses), it means that approximately 35% of the new housing stock by 2020 will be supported by one of the programmes. This calculation is based on the assumption that the number of subsidies provided by CONAVI will remain the same (approximately 95,000 subsidies per year as

[6] Source: http://www.emedios.com.mx/testigospdfs/20101015/31e6f2-7b2230.pdf

there is no plan to increase the subsidies/budgets) and the number of Green Mortgages will increase by 10% annually, according to CONAVI's projections.

2.3.2. Building codes

A recent assessment of the incorporation of energy efficiency norms in the Mexican construction regulations has identified the following barriers in the Mexican context (Rodriguez and Sielfeld 2010):

- Lack of agreement between the different actors at the federal and state level;
- Resistance from the construction industry;
- Lack of institutional capacity to supervise the establishment and implementation of the proposed norms.

These barriers are identified at different levels and undermine the implementation of different norms and standards. In addition, the study has identified that Mexican norms generally lack a specialized chapter on energy efficiency and the use of renewable technologies in buildings. This could be done for example through the incorporation of a Technical Complementary Norm for each one of the four climate zones. Another main barrier for the implementation of building codes and energy efficiency norms in Mexico is the lack of resources from the local authorities to ensure compliance and review of the building codes.

The enforcement of building codes and incorporation of energy efficiency norms are crucial for the development of an integrated approach towards sustainable housing in Mexico. They are an integral part of the urban development, ensuring the new residences comply with minimum safety and energy efficiency standards.

2.3.3. Sustainably Integrated Urban Developments - Desarollos Urbanos Integrales Sustentables (DUIS)

So far, 4 DUIS projects have been approved representing a total investment of MX$ 77 billion for the construction of 250,500 houses (SHF, 2010). DUIS' projects will be monitored periodically by the same consultants in order to evaluate its evolution and to ensure that sponsors and each Government agency comply with their commitments.

2.3.4. CDM project initiatives in the Mexican building sector

The only fairly advanced planned CDM project for new housing is the CDM PoAs of CONAVI based on the Green Mortgage and "Ésta es tu casa" programmes. The way the PoA is currently organised, it does not contribute to the financing of funds granted under the Green Mortgage and "Ésta es tu casa" programmes. Both programmes were developed and are currently financed without considering carbon credits from the PoA and will need to do so for the foreseeable future. Given the current lead times of CDM PoAs and the stage of development of the PoA, the programme can realistically be expected to be registered in 2012 only (if it passes validation and registration at the UNFCCC) and it will then earn CERs earliest in 2013. The CER revenues could then potentially be used to contribute to the refinancing of the two programmes from 2013 onwards.

2.4. NAMA as an opportunity to scale-up the programmes and enhance GHG emission reductions

As illustrated above, the current roll-out plan of the “Green Mortgage” and "Ésta es tu casa" programmes will only address approximately 35% of the new houses built until 2020. At the same time, the current CONAVI catalogue of minimum energy-efficiency requirements would allow significant potential of technological up-scale. This could be achieved for example by more ambitious minimum efficiencies for technologies included in the current catalogue as well as by mandating technologies that are currently not covered in the list (e.g. air-conditioning or PV).
This is especially important as it must be assumed the emissions per house are going to rise further with increased household wealth alongside the economic growth in Mexico. For example according to the Global Environment Facility (2010) the average annual growth rate of air-conditioner sales in the residential sector during the last 10 years period is 15 %, but it exceeded 30 % in the last three years of the period (GEF 2010).

The goal of the NAMA could therefore be to upscale the existing expansion plan of the programmes in terms of:

- increased penetration (more houses covered during the same time) and/or
- technology up-scaling (more ambitious efficiency standards or inclusion of technologies that are currently not covered).

Ideally those measures would also be supplemented by a transformation of the “Green Mortgage” and "Ésta es tu casa" programmes into a holistic urban planning process including building codes.

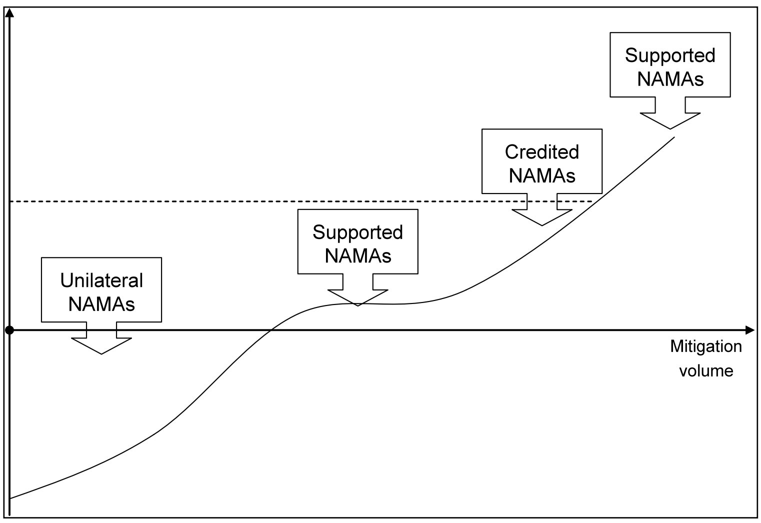
3. NAMA requirements and relation to carbon markets

This chapter lays the conceptual basis for parts of the detailed NAMA framework design discussion following the specific scope of the NAMA as presented in chapter 4 (see Chapter 5 “Procedures for MRV and additionality demonstration” and Chapter 8.2 “Financing opportunities”).

3.1. Status of international climate negotiation on NAMAs

The concept of NAMAs was first introduced at the Conference of the Parties’ (COP) held in 2007 in Bali, Indonesia. Generally three types of NAMAs are differentiated: (i) NAMAs domestically funded and unilaterally implemented (**unilateral NAMAs**), (ii) NAMAs implemented with financial, technological and/or capacity building support from developed countries (**supported NAMAs**), and (iii) NAMAs implemented with funding from carbon offset credits generated for the amount of emission reductions achieved (**credited NAMAs**). The current negotiation does not preclude any of the three types of NAMAs. However, there is a debate on whether NAMAs should be funded through carbon offset credits (UNFCCC 2010b). Under a supported NAMA the support by industrialised countries (e.g. financing) is generally assumed to be given to programmes and policies supporting up to – but not exceeding – the incremental costs of the policy or action . It is generally assumed that unilateral NAMAs should target those emission reductions with negative GHG abatement costs and that credited NAMAs would target the emission reduction potential that has higher GHG abatement costs while supported NAMAs could either have low positive or very high costs (see Figure 14). Such an approach would ensure that the “low-hanging fruit” emission reductions are not sold to industrialised countries (but remain for the developing country to abate once they might face a future emission reduction target) and that the credits sold to the industrialised countries are “additional” emission reductions following the current concept of additionality applied under the CDM framework.

Figure 14: Different tiers of NAMAs



The most contentious issue for NAMAs in the international negotiation process has been how to design a framework for monitoring, verification and reporting (MRV) for NAMAs implemented in developing countries. Developing countries generally prefer a voluntary, domestic MRV scheme, while developed countries insist on MRV by international experts. In 2009 in Copenhagen, Denmark, the COP took note of the Copenhagen Accord that specifies the following aspects of MRV of NAMAs by developing countries (UNFCCC 2009):

- NAMAs by developing countries shall be communicated every two years through National Communications to UNFCCC.
- NAMAs implemented without international support (unilateral NAMAs) will only be subject to domestic MRV.
- NAMAs seeking international support (supported NAMAs) will be recorded in a registry along with relevant technology, finance and capacity building support. They will be subject to international MRV in accordance with guidelines adopted by the Conference of the Parties (COP).

Although the Copenhagen Accord has laid out the initial concept of NAMAs, the Accord itself does not have a legally binding status in the UNFCCC process. The UNFCCC negotiation is still ongoing and all options for the NAMA design are still widely open. The key issues can be summarized as follows:

- What to record in a registry of NAMAs, e.g.:
    - A description of the mitigation action.
    - The estimate of full or increment costs of NAMA implementation.[7]
    - An indication of type of support required.
    - An estimate of mitigation benefits.
    - The anticipated timeframe for NAMA implementation.
- What should be the nature of MRV:
    - Whether NAMAs should be subject to international MRV, regardless of the use of international support or carbon offset credits.
    - For domestic MRV, whether there needs to be certain qualification requirements for domestic reviewers of MRV of NAMAs, or whether international consultation and analysis need to be implemented.

The first issue, what to record in a registry of NAMAs, provides a preliminary indication of what NAMAs need to specify in order to receive international support. The most contentious issue seems to be whether NAMAs should be funded for their full implementation costs or only for the costs incremental to the mitigation action that would happen in the business-as-usual scenario. The second issue on the nature of MRV shows that developed countries are keen on having international MRV or at least some degree of international intervention in domestic MRV. On the other hand, developing countries have been trying to avoid international MRV of even supported NAMAs, as opposed to what the Copenhagen Accord has stipulated.

[7] It is undecided whether NAMAs should be funded for their full implementation costs or only incremental costs compared to the mitigation action that would happen anyway.

Even though the rules and procedures for NAMAs will need to be detailed over the coming years, countries hosting NAMAs have the possibility to build pilot NAMAs and propose them to international donors for support. Such NAMAs, if well conceptualised, will very likely have a good probability to be supported by national or international donor agencies which are aware that practical NAMA experience will help to define the NAMA rules and procedures on the multilateral level.

3.2. Towards a NAMA framework for residential building efficiency improvement

As shown above, the negotiation on NAMAs is still ongoing and does not provide much detail on what the NAMA framework could look like. In this section, a general concept is developed based on Point Carbon Global Advisory Services' own expert judgement, for a possible NAMA framework for residential building efficiency improvement (RBEI) programmes. The key issues assessed are MRV and additionality demonstration of NAMAs as well as the relation of NAMAs with carbon markets. Point Carbon Global Advisory Services has given expert consideration on how those key issues would need to be best addressed in order for the NAMA concept to be supported by donor countries.

3.2.1. Measurement, reporting and verification

Type of MRV indicator

MRV of a NAMA could be done in terms of the qualitative or quantitative input to mitigation actions (e.g., funding, establishment of energy efficiency regulations), intermediate output (e.g. number of energy efficiency appliances installed), and/or the GHG mitigation outcome of such actions (Vine and Sathaye 1999). In general MRV indicators in the building sector should be able to demonstrate changes in the sector and the effects of various programmes under a NAMA framework (Cheng and Zhu 2009). Following this typology, possible examples of MRV indicators for residential building efficiency programmes are given below.

Table 13: Examples of MRV indicators for residential building efficiency programmes

	Quantitative	Qualitative
Input	• Amount of funding provided • Number of staff allocated	• Building code introduced and adopted • Responsible institutions appointed
Intermediate output	• Number of houses built and related floor area according to minimum performance standards (building codes) • Energy performance / demand of houses (according to type and climate zone) • Investment in green housing leveraged (total amount of loans, subsidies, tax breaks) • Number of capacity building workshops conducted • Number of professionals in the building sector trained (e.g. with certification)	• Implementation system of the building code in place • Information material published and distributed
GHG mitigation outcome	• Amount of emission reductions	• N/A

Donors of supported NAMAs are likely to require an estimation of the expected amount of GHG emission reductions because the emission-based metric enables a straightforward assessment of climate benefits of the NAMAs. For instance, the European Union (EU) states that “the allocation of support to developing countries should move towards a performance-based system, strongly incentivising the promotion of actions which maximize climate value for climate money” (EU 2009).
On the other hand, unless NAMAs are to generate carbon offset credits (credited NAMAs), MRV does not necessarily have to be based on GHG outcome (Jung et al. 2010). A NAMA does not necessarily result in direct emission reductions but can create enabling conditions for businesses and individuals to undertake mitigation activities (Cheng and Zhu, 2010). Non-emissions-based MRV can be instrumental in cases where quantification of emission reductions is difficult (e.g., complex MRV is required) and/or for actions with indirect GHG impacts (e.g., capacity building, R&D). Thus, the appropriate choice of indicators is very important for successful MRV of a NAMA.

MRV methods

This section focuses on the analysis of possible methods for MRV of emission reductions. The emission-based MRV will likely be the first preference of NAMA donors, thus it warrants a detailed analysis. There is no “one size fits all” approach to quantify the GHG outcome of residential building efficiency improvement (RBEI) programmes. The size and complexity of the programme determines the MRV approaches. The following three broad categories of MRV approaches are available for

RBEI programmes: (i) deemed savings approach, (ii) large-scale data analysis approach,[8] and (iii) measurement and verification (M&V) approach. The methodological choice has important implications for the programme design (Hayashi et al. 2009). Therefore, the three options and suitable activity types are briefly summarized below (NAPEE 2007).

- **The deemed savings approach** is most commonly used for programmes that involve simple energy-efficiency measures with well-defined applications. Examples might be T-8 fluorescent lamp retrofits in office building or give-away of compact fluorescent lamps (CFLs) for households. With the use of deemed savings, there are no or very limited measurement activities and only the installation and operation of measures is verified. This approach is only valid for projects with fixed operating conditions and well-known, documented stipulation values.
- **The large-scale data analysis approach** is most commonly used for programmes that involve large-scale building efficiency programmes with many participants. It is primarily used for residential programmes with relatively homogeneous participants and measures, when project-specific analyses are not required or practical. A typical example is a residential customer weatherization programme with thousands of homes being retrofitted with a variety of measures such as insulation, weather stripping, low-flow showerheads, and CFLs.
- **The M&V approach** is used for almost any type of programmes that involves retrofit projects. It is generally applied only to a sample of projects in a programme because it is more expensive on a per-project basis than the other two approaches. It is the most common approach used for programmes involving non-residential facilities, in which a wide variety of factors determine energy savings. In general, the M&V approach is applied when the other approaches are not applicable or when per-project results are needed. An example is a performance-contracting programme[9] with multiple contractors.

There are two types of approaches to building efficiency improvement: (i) system-specific approach, and (ii) whole-building approach. The system-specific approach is used for the implementation of specific mitigation measures (e.g., efficient lighting, better insulation). Based on this approach, MRV of a combination of mitigation measures is possible only if there is no interaction between the implemented measures or the impact of such interactive effects on the overall emission reductions can be clearly estimated. The whole-building approach is to assess emission performance of the entire building (e.g., in tCO_2/m^2). Such an approach would provide three main benefits over the system-specific approach (adapted from Hayashi et al. 2010):

- **It readily allows a combination of measures.** The combination of measures would increase the amount of emission reductions per building and so improves the effectiveness and efficiency of a building efficiency project.
- **It gives wider flexibility in technology choice**. Flexible technology choice is important because building efficiency improvement typically requires a range of different, small

[8] Large-scale data analysis approach conducts statistical analyses on the energy usage data (typically collected from the meter data reported on utility bills) for all or most of the participants and possibly non-participants in the programme.
[9] Through performance contracting, participating agencies can hire the prequalified contractors for energy efficiency upgrades and pay for them with energy savings.

measures suitable for specific local circumstances. Also, additional measures could be installed over time (UNEP 2008).

- **It streamlines monitoring requirements**. By using the performance-based methodology, monitoring of emission reductions will be performed at a building level, but not at an equipment level. The monitoring of whole-building emission performance inherently accommodates a complex interaction of measures, and thus avoids the challenging monitoring of the emission impact of each such interaction. In addition, the holistic monitoring approach is especially helpful for residential buildings since they usually do not have centralised control systems for appliances (e.g., lighting in a corridor) or cooling/heating devices. Hence, it is not practical to require monitoring of each measure (UNEP 2008).

The large-scale data analysis and M&V approaches can be used for both system-specific and whole-building approaches. However, the deemed savings approach is only possible on a system-specific level. This is because the energy consumption level of an entire building is influenced by numerous factors and the use of a fixed value for the whole-building energy performance would likely be a too simplistic assumption.

3.2.2. Additionality demonstration

There are neither guidelines available on additionality of NAMAs nor Parties' positions expressed at climate negotiation meetings. This issue has also not been explored widely in the literature. One of the few analyses is Okubo et al. (2009), which discusses additionality demonstration of NAMAs generating carbon offset credits (credited NAMAs). NAMAs can be designed to address specific mitigation measures and/or policies for reducing GHG emissions (mitigation policies). In the former case, additionality demonstration of NAMAs can well build on the experience of the existing carbon offset mechanisms such as the CDM.[10] In the latter case, however, new challenges will arise as there is so far no carbon offset mechanism that allows mitigation policies to generate carbon offset credits. Therefore, policy-based NAMAs need to devise their own approaches to additionality demonstration.
In general, impact evaluation of a mitigation policy or programme is much more difficult than one of a mitigation project. This is because a mitigation policy per se does not result in direct emission reductions, but it is to regulate or incentivise companies and/or individuals to undertake mitigation actions. Since mitigation actions are not always driven solely by policy implementation but also by many other factors, it is difficult to establish a clear causality between the policy implementation and emission reductions achieved. This is the prime reason why there is no carbon offset mechanism for mitigation policies so far. According to Okubo et al. (2009), key issues in additionality demonstration of mitigation policies are as follows:

- **The conventional additionality test for CDM projects needs a careful adjustment for additionality demonstration of mitigation policies.** While costs of policy implementation

[10] Additionality of a CDM project can be demonstrated by proving that the project is not a financially most attractive course (investment analysis) and/or the project faces too significant barrier to be implemented (barrier analysis), and complemented by an assessment of whether the project is considered common practice in the relevant geographical area (common practice analysis).

are usually borne by a government, costs of actual mitigation actions are frequently borne by the private sector. When assessing additionality of a mitigation policy, it is necessary to consider both cost components. However, the exact number of mitigation actions to be undertaken in response to the policy implementation is rarely known ex ante. In addition, the barrier and common practice analyses may become problematic in some cases since the proposed policy may achieve other objectives than emission reductions and can be introduced for a variety of reasons.[11]

- **The baseline needs to be updated over time to avoid non-additional emission reductions.** A baseline that may be stringent at the time of introduction of a policy may become a common practice over time. Therefore, it needs to be adjusted to take into account autonomous technological improvement over time (Kartha et al., 2005).
- **A suitable timeframe for policy impact evaluation needs to be decided.** Policies usually have longer-term effects than projects do. Accounting for possible time lag between the policy implementation and visible impacts would become a challenge (Bosi and Ellis, 2005). Additionality of policies that have longer time lag (e.g., R&D) would be more difficult to demonstrate than ones with short-term impacts. For mitigation policies implemented as NAMAs, a suitable timeframe for policy impact evaluation needs to be decided in advance. Suitable timeframe depends on policy type and design, and local circumstances.

3.2.3. Relation of NAMAs to carbon markets

NAMAs are very likely to target sectors in which CDM projects are already registered or are currently planned. It is therefore an important question, how CDM projects, and especially the crediting of emissions reductions from these projects, should be dealt with within a future NAMA framework.

Generally speaking, NAMAs can lead to double-counting of emission reductions, if they exist at the same time as CDM projects and address the same emissions. But as revenues from sales of emissions credits are an important source of private investment in mitigation actions, it is advisable to work with CDM projects rather than to displace them entirely from the sector. Existing CDM projects can be excluded from the calculation of a GHG baseline of a NAMA by subtracting the amount of CERs issued for the CDM projects from the amount of emission reductions achieved by the NAMA. However, it is more difficult to determine the impact of a NAMA on the future CDM baseline in the sector. Namely, broadly defined, policy-based actions are likely to change CDM baselines in a way which make CDM projects in the sector less attractive (Jung et al. 2010). This gives rise to the question, how MRV and additionality requirements for credited NAMAs would possibly differ from those of supported NAMAs and how CDM projects would fit in under both NAMA types.

[11] For instance, policies for rural electrification are primarily to improve energy access of non-electrified areas and consequently improve the quality of the people living in these areas. If the electricity supplied to the areas is less carbon intensive than the fuels currently used, the policy implementation would result in emission reductions as well.

Credited NAMAs and impact on stringency of MRV and additionality requirements

It is generally assumed that a credited NAMA under the UNFCCC will need to be subject to a more stringent MRV and additionality framework than it will be the case for supported NAMAs (CCAP 2009, Sterk 2010). The rationale is that the credits will be eligible for compliance with emission reduction targets of developed countries (or entities with a cap under an emission trading scheme). The developing country hosting the credited NAMA would receive additional financial resources from the sale of credits for the domestic abatement measures. MRV for credited NAMAs would thus necessarily need to be based on GHG emissions outcome. In this sense, it can be assumed that the requirements for MRV and additionality within a credited NAMA might not differ conceptually to a large extent from the current requirements under CDM. So far, most authors see NAMA crediting as an add-on to unilateral and supported NAMAs (Butzengeiger et al. 2009, CCAP 2009, Sterk 2010). This could for example be achieved through a sector-wide emission reduction baseline set by the developing country under a unilateral and supported NAMA where an overachievement of the baseline would allow carbon credit generation. Another possibility could be the implementation of a policy with economic incentives for emission reduction projects (e.g. a renewable feed-in tariff) under a unilateral and supported NAMA where those projects which still would not be economically viable with the economic incentives, could generate credits. Very likely, the abatement costs of credited NAMAs will be therefore higher than that of the average CDM project so far.

Coexistence of credited NAMAs and CDM

As credited NAMAs would generate credits for developed countries just as the current project-based and programmatic CDM activities do, credited NAMAs as well as CDM in principal follow the rationale of a baseline-and-credit approach. However, the practical suitability of incorporating CDM activities within the credited NAMA will depend on the exact scope of the credited NAMA, its MRV and additionality framework as well as on the approach of the relevant CDM methodology underlying the CDM project. Most of the approved CDM methodologies currently assume a business-as-usual (BAU) baseline from which GHG emissions are reduced at a single project-level. As credited NAMAs will require ambitious baselines (see above), significant conceptual challenges for a coexistence of CDM projects based on BAU baselines and credited NAMAs in the same sector (e.g. power generation) need to be expected. A possible solution could be an MRV methodology within the credited NAMA which is based on an ambitious benchmarking approach for establishing the baseline. This approach has the advantage in that a benchmark can be used to address both baseline emissions and additionality determination for the credited NAMA as well as for single CDM projects. CDM project development could then theoretically be utilised within the credited NAMA framework to generate emission reductions for the NAMA. However, such CDM methodologies do currently not exist (as a benchmarking approach for CDM projects has so far been not supported by the CDM Executive Board) and would need to be developed and approved for such purpose.

Another important question to address is how the private sector could be incentivised to develop CDM projects within a credited NAMA framework, as the developing country hosting the credited NAMA would be entitled to the emission reduction credits from the NAMA, and not the single CDM project developer. A possible solution could be that the host country commits to pass on the credits to the CDM project developers that bring about the reductions.

In a situation where a country chooses that a credited NAMA and CDM projects should exist alongside each other in the same sector (e.g. to pass incentives for GHG abatement directly to the private sector), a possibility could be to restrict CDM activities to those sub-sectors or activities where additionality can be established relatively straightforward ex-ante. In the power generation sector, this could for example the development of projects such as PV or Concentrated Solar Power. As CDM Programme of Activities (PoAs) are more related to the NAMA concept in terms of sector coverage, it seems advisable, when CDM activities are allowed under NAMA crediting, that those activities are being carried out as CDM PoAs.

Coexistence of supported NAMAs and CDM

As shown in chapter 3.2.1, a supported NAMA MRV and additionality framework can potentially be less stringent than for credited NAMAs and/or CDM projects. This is especially the case, if the supported NAMA entails measures for which the GHG emission reduction benefit cannot be directly monitored and only input-based and intermediate output-based MRV indicators are applied under the NAMA (e.g. for development and enforcement of mandatory standards (e.g. building codes) or certain capacity building measures). For instance, introduction of a mandatory regulation on building energy performance would lead to a reduction of emissions from buildings. As stipulated in several approved CDM methodologies, such a mandatory regulation will need to be taken into account in the baseline determination and may significantly reduce the potential of energy-efficiency projects under CDM.

If under a supported NAMA framework feed-in tariffs for renewable energy technologies were to be introduced with the financial assistance of donor countries and the underlying MRV framework would require a GHG emission output indicator, the NAMA donors might not want CDM projects to take place in the renewable power sector (or only under very stringent rules). The reason is that this bears the risk of double-counting as it means developed countries would pay twice for the same emission reductions (once through financial support of the feed-in tariff and for the purchase of CERs). Thus, it seems advisable to prevent double-counting between emissions reductions mobilised by donor support and by CDM projects in the early design phase of the supported NAMA (as much as possible). It would be straightforward to argue that no new CDM projects shall be registered in the sector in which a country decides to implement a sector-wide NAMA. However, such treatment can significantly reduce the CDM attractiveness of the host country. A possible solution is to use a NAMA-financed emission level as the baseline for future CDM projects or to follow a similar approach as proposed for the relation between credited NAMAs and CDM projects.

3.3. Implications for the Mexican NAMA

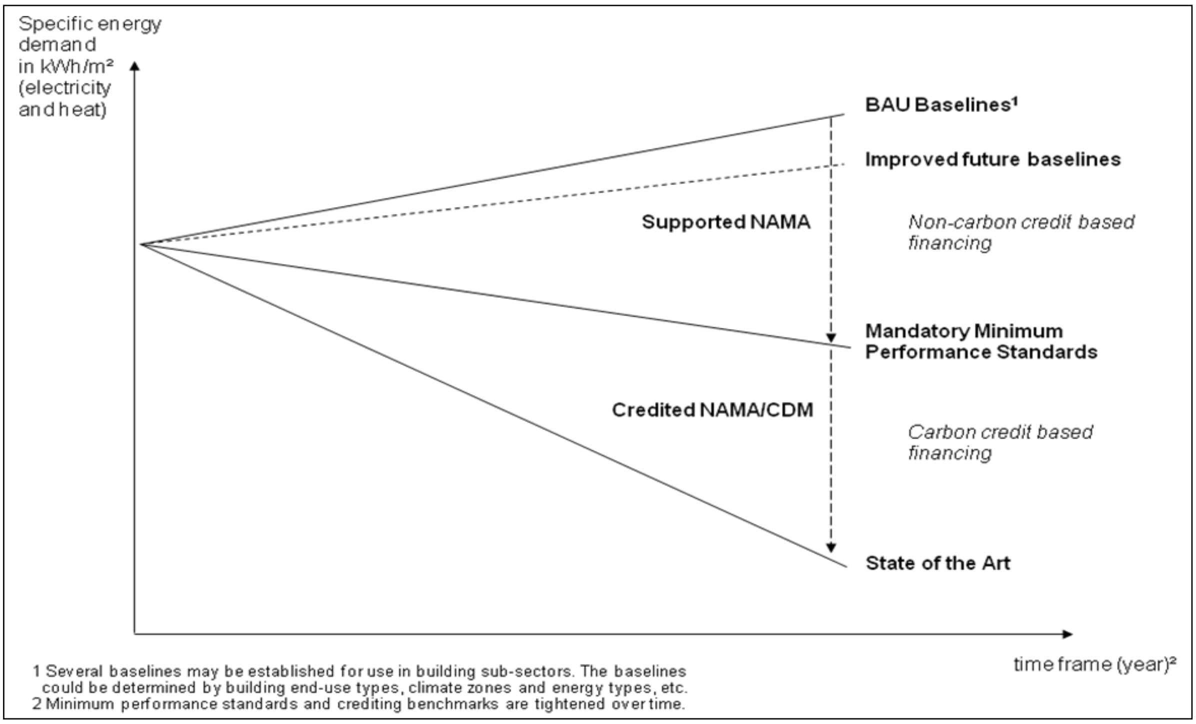
Building codes and appliance standards are the most important policies for energy efficiency improvement in buildings, but their success depends on effective enforcement and periodic updates (Cheng and Zhu 2009). Hence, there is a high likelihood that NAMAs that set mandatory minimum performance standards and include stringent enforcement mechanisms could gain international support.

Potential up-scaling of “Ésta es tu casa” and “Green Mortgage”

Taking into consideration that one of the objectives of the NAMA, with the support of large-scale financial support from donors and/or crediting, could be to upscale the existing expansion plan of the “Ésta es tu casa” and “Green Mortgage” programmes towards a higher number of beneficiary houses and/or more ambitious efficiency standards or inclusion of technologies, the MRV framework for the NAMA should be based on direct GHG emissions monitoring. A suitable approach could be the introduction of energy performance benchmarks and/or minimum appliance standards based on whole-building energy performance as discussed above. Energy performance improvement due to the up-scaling activities under the NAMA will result in a reduction of the specific energy consumption of new households. Hence, the MRV boundary for the GHG emission reduction for the NAMA framework should be the houses through the whole building approach. The current designs of the aforementioned programmes and the surveys undertaken by INFONAVIT in 2009 and 2010 have already monitored a large number of installations in the target houses. Based on these surveys, reliable MRV concepts would need to be identified and developed for Mexico for the specific proposed NAMA design for up-scaling “Ésta es tu casa” and “Green Mortgage” programmes (see Chapter 4 for the NAMA design and Chapter 5 for proposed MRV). From a MRV point of view a whole building approach would also allow inclusion of renewable energy technologies such as currently already included in the programmes (e.g. solar water heating) into the NAMA. This would for example also be the case for PV, if energy exports from the building are accounted under the MRV framework for the NAMA.

If CDM project developers would decide to develop projects involving energy-efficient buildings or appliances beyond the mandatory minimum performance standards, the additional energy savings could generate carbon credits and receive carbon revenues. The similar rationale applies when Mexico would want to receive credits under the NAMA. As mentioned above, another possibility could be to design crediting only for those technologies that are clearly additional ex-ante (e.g. PV) whereas other technologies would be implemented under a supported NAMA approach. The relation between BAU baseline, Supported NAMA and Credited NAMA for the Mexican NAMA in terms of GHG emission reduction ambition is illustrated in Figure 15 for the case of minimum energy performance standards for buildings.

Figure 15: Minimum performance standards and their effect on the baseline of buildings[12]



Source: According to Cheng, C.-C.; Zhu X (2009)

Another option to avoid overlapping of emission reductions is the definition of eligibility criteria for the NAMA and CDM projects based on, e.g. geographical boundary, housing type and/or vintage, or participation in housing support programmes.

If the Mexican NAMA should involve crediting alongside NAMA support, it seems reasonable to assume that the MRV and additionality approach would need to be very stringent or that a separate and more stringent MRV and additionality framework would need to be developed for the credited part of the NAMA.

Transformation of the “Green Mortgage” and "Ésta es tu casa" programmes into a holistic urban planning process including building codes

If the Mexican NAMA would (only) include activities of transforming the “Green Mortgage” and "Ésta es tu casa" programmes into a country-wide and holistic urban planning and building code framework based on the currently on-going activities with CEV and DUIS under the NAMA, the input and intermediate indicators are deemed adequate, if the NAMA does not include (partial) crediting for the scaling-up of the “Green Mortgage” and "Ésta es tu casa" programmes. If the NAMA were to allow credit generation, possible donors might request that the MRV framework chosen for the NAMA prevents double-counting between emission reductions though supported NAMA elements and the crediting framework.

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12 The BAU baseline is expected to increase as there is a documented evidence of a correlation between the income level and household energy consumption, including both electricity and fuel. Especially, the penetration and saturation rate of applications, e.g. for AC, is expected to grow in Mexico.

Details of NAMA design need to be further investigated in this project. As summarized in the table below, the above analysis has revealed some key design aspects of NAMAs that need to be taken into account in the formulation of a NAMA in Mexico.

Table 14: Catalogue of issues for NAMA design

Issue	Necessary consideration	Judgement basis
"Minimum" information requirement	• A description of the mitigation action. • An estimate of NAMA implementation costs. It has not been decided whether full or incremental costs need to be estimated, so a NAMA should be ready to provide both estimates. • An indication of type of support required. • An indication, if crediting should be part of the NAMA. • An estimate of mitigation benefits. • The anticipated timeframe for NAMA implementation.	International climate negotiation texts
MRV	• Supported NAMAs should assume international MRV. • Choose appropriate indicators for MRV. An emission-based indicator is the preferred option, but the indicators can also be based on input or intermediate output parameters. • Credited NAMAs should assume stringent MRV based on GHG emission reduction output (maybe similar to MRV requirements under CDM). • Given the potentially large number of residential buildings to be built under the NAMA and the whole-building approach to building efficiency improvement anticipated, the large-scale data analysis approach should be the first choice. • The whole-building approach is recommended because of its advantages of the combination of measures, flexible technology choice and streamlined monitoring requirements.	Own judgment based on literature survey
Additionality demonstration	• Additionality demonstration of a policy-based NAMA needs a careful adjustment of the procedure used so far for project-based mechanisms. • The baseline needs to be updated over time to avoid non-additional emission reductions. • A suitable timeframe for policy impact evaluation needs to be decided.	Own judgment based on literature survey
Double-counting with the CDM	• Avoid double-counting with the CDM by using a NAMA-financed emission level as the baseline for future CDM projects, or by clearly establishing eligibility criteria for participation in NAMAs and the CDM.	Own judgment based on literature survey

4. Definition of the NAMA

4.1. Rationale for the NAMA

The “Green Mortgage” programme is expected to grant approximately 120,000 additional loans for investments into sustainable technologies for new housing in 2010. It can be expected that the scheme will not easily reach the ambitious goal of 800,000 houses supported by the end of 2012 and the goal of 1.2 million t CO_2e reductions as stipulated in the PECC. As of September 2010, 206,907 “Green Mortgages” had been granted since the start of the programme in 2007 of which 100,025 mortgages were awarded in 2010 (which is a slight increase compared to 2009: 105,104 in total. This means that within the remaining two years almost 600,000 “Green Mortgages” would need to be granted. As the current plan roll-out plan from CONAVI includes 146,000 for 2011 and 151,000 for 2012, the objective of 800,000 mortgages by 2012 is deemed unlikely to be reached without a considerable acceleration of the programme. However, INFONAVIT is now considering granting all its’ mortgages as “Green Mortgages” from beginning of 2011 onwards. This would translate into around 400,000 “Green Mortgages” to be granted from that year onwards and a four-fold increase of the beneficiary number.

The objective of the NAMA would be the amplification and enhancement of the impact of the existing “Green Mortgage” and "Ésta es tu casa" programmes in order to achieve long-term GHG emission reductions additional to the level of reductions that the programmes would not achieve without the NAMA. In this sense the NAMA would enhance the impact of the “Efficient housing and green mortgages” programme in the PECC. As shown in Chapter 2.4, this could be achieved by upscaling the existing expansion plan of the programmes and including more ambitious efficiency standards and/or inclusion of technologies that are currently not covered. Furthermore, a transformation of the “Green Mortgage” and "Ésta es tu casa" programmes into a holistic urban planning process including building codes could be envisaged. Currently, in both programmes participation is on a voluntary basis and house owners and developers receive economic incentives to implement energy efficient and sustainable technologies (see Chapter 2 for details). The NAMA and its underlying measures could be used to convert the structure of the “Green Mortgage” and "Ésta es tu casa" programmes from avoluntary, incentive based programme to a mandatory scheme to fulfil binding standards and codes in the long run. CONAVI would need to be the political institution in Mexico driving this transition. Lack of financial resources and technical expertise currently prevent CONAVI from reaching a higher impact in terms of energy savings and GHG emission reductions of new residential buildings through the “Green Mortgage” and "Ésta es tu casa" programmes than what is currently planned.

4.2. Scope of the NAMA

The NAMA scope focuses on the Mexican residential building sector and the sub-sector of new residential houses. The boundary for the NAMA is therefore new residential houses which are single family houses and multi-family houses. The houses will have a maximum of 4 storeys and will include maximum 8 units. The following Table 15 gives an indication of the indicative scope of the NAMA.

Table 15: NAMA scope summary

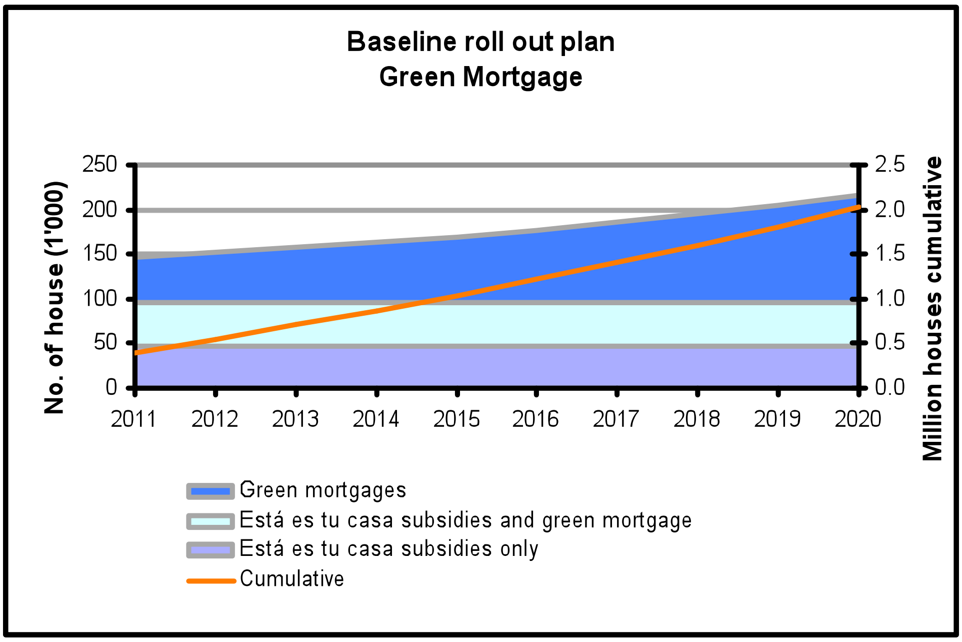
Characteristic	**Dimension**
Sector	Building sector
Sub-sector	New residential houses (maximum 4 storeys and 8 units)
NAMA boundary	New residential houses nation-wide
Measures and activities with direct impact on GHG emission reduction	Substantial up-scale of “Green mortgage” and “Ésta es tu casa” schemes - Broader participation - Technology up-scaling (more ambitious efficiency standards and/or inclusion of new technologies)
Measures and activities with indirect impact on GHG emission reduction	Supportive actions for transformation of the “Green Mortgage” and "Ésta es tu casa" programmes into a holistic urban planning process including building codes - Building code pilot in 1 federal state - Promotion and enforcement of building codes across federal states over time - Capacity building - Extension of urban planning criteria and inclusion in the holistic framework
NAMA timeframe - Implementation - Operation	 2011-2012 2012-2020
NAMA implementation and operation costs	Full costs of substantial up-scaling of actions until 2020
NAMA type	Supported NAMA (with the possibility of NAMA crediting for parts of the actions)
Type of support required under the NAMA	Financial, technical and capacity building

The up-scaling options and the supportive actions are described and discussed in detail in the following chapters.

4.3. Up-Scaling option: Broader participation

The first option for scaling up the current programme with a direct impact on future GHG emission reductions would be the expansion beyond the current CONAVI roll-out plan for “Green Mortgage” and "Ésta es tu casa" programmes. The basis for scaling-up in terms of broader participation is the overall housing demand for eligible Groups 1 and 2 given in Table 11 of 5.95 million houses until 2020 (derived from 11.9 million houses until 2030). With current expectations by CONAVI until 2020 the number of “Green Mortgage” are going to reach approximately 120,970 per year corresponding to a 10% annual growth, where as the total amount of expected subsidies granted under the “Ésta es tu casa” programme are going to be stable (see Table 12) with 95,000 subsidies per year (partly combined with subsidies). In total 215,970 houses are projected to be built in 2020 meeting the programmes requirements. This relates to 37% of new houses by in 2020 under the conditions and requirements of the “Green Mortgage” and "Ésta es tu casa" programmes.[13] Altogether approximately 2.0 million new houses under the programmes would be built by 2020, representing 6.1% of the overall housing stock. These figures demonstrate the potential for up-scaling. At the current roll-out rate there is still more than 62% of the annual new housing market not covered under the green mortgage until 2020. It can be expected that these houses would not be built following ambitious energy efficiency standards and sustainable criteria. Figure 16 illustrates the baseline roll-out plan for the “Green Mortgage” and the “Ésta es tu casa” programmes.

Figure 16: Baseline roll out plan for the “Green Mortgage” and “Ésta es tu casa” programme



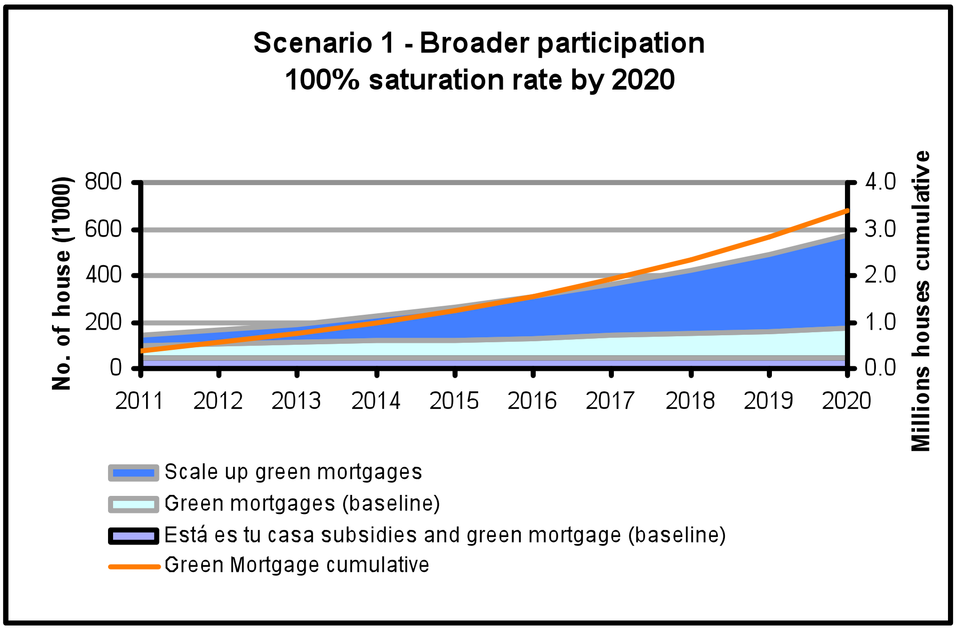
Source: CONAVI (2010a)

In the following two scenarios are presented for increased penetration. Scenario 1 assumes that under the NAMA a saturation rate of 100% of green mortgage could be reached by 2020 meaning that every new house by the year 2020 would be built and financed under the criteria of the green mortgage programme. The second scenario (Scenario 2) presumes already a saturation rate of 100% reached by the year 2013.

[13] See Table 11: CONAVI’s projections for the annual number of houses to be supported by INFONAVIT and CONAVI in 2010, 2020 and 2030

Under Scenario 1 it is presumed that the green mortgage reach a 100% saturation rate by 2020, meaning 0.58 million houses covered by the programme. Subsidies under the "Ésta es tu casa" programme would be granted additionally for low income families that would need additional support. The amount of green mortgages would have to increase by an average of 17% per year between 2011 and 2020. Altogether, almost 3.4 million houses would be built under the programme until 2020. The scale up from the NAMA would therefore add an additional 1-8 million new houses (cumulative) under the green mortgage programme until 2020. Figure 17 below presents the baseline and the potential scale up.

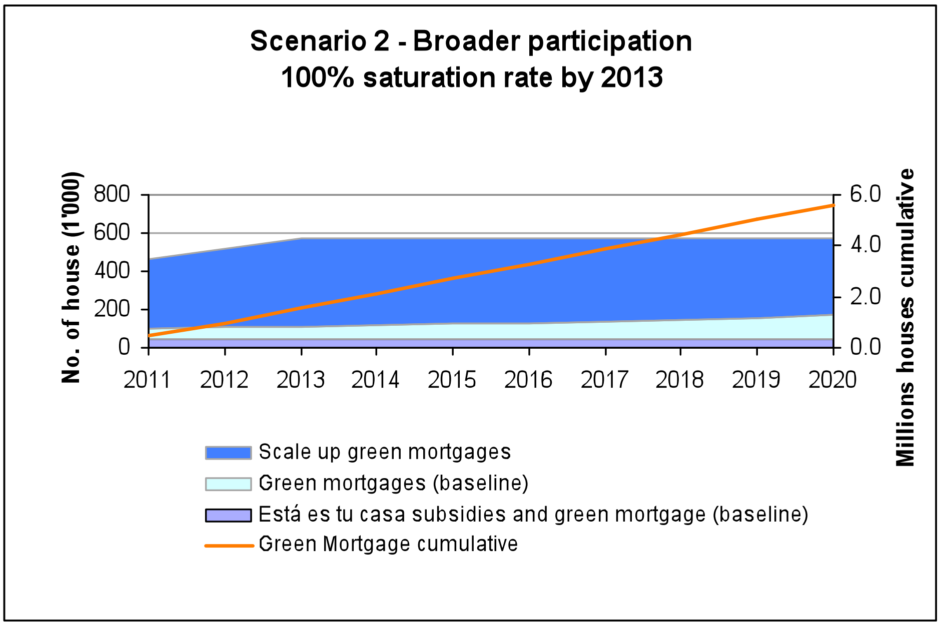
Figure 17: Scenario 1: Broader participation with 100% saturation by 2020



Scenario 2 considers a 100% saturation rate of the housing demand financed with green mortgages already reached by 2013, i.e. 0.58 million houses from then onwards. The year 2013 is assumed since as of today not all financial institution providing mortgages have a green credit line in place and hence could not easily offer green mortgage by 2011 or 2012.

As a result the cumulative amount of houses built under green mortgage could reach up to approximately 5.6 million houses. Compared to the baseline this is an extension of 4.3 million houses. The following figure pictures the development over time until 2020.

Figure 18: Scenario 2 - Broader participation with 100% saturation by 2013



The financial requirements and the potential emission reductions for Scenarios 1 and 2 are discussed in Chapter 6 and 7.

4.4. Up-Scaling option: Technology up-scaling

The second option represents a technology up-scaling in terms of more ambitious requirements and/or the consideration of new technologies currently not covered under the minimum requirements. The housing sector is providing manifold technological opportunities for energy savings and GHG emission reduction. Currently the minimum requirements for the "Ésta es tu casa" and "Green Mortgage" programmes, respectively, currently only require efficient lighting (CFL), the use of solar water heaters (SWH, hybrid solar and gas water heating system), efficient gas boiler, thermal insulation (roof and walls) in certain climate zones as well as water saving appliances and reflectance coating. Besides tightening the existing requirements, especially the incorporation of new technologies is deemed as a promising approach for technological up-scaling under the NAMA. In the following the technology options and the additional GHG reduction that could be induced under the NAMA are described in detail. The potential is discussed based on the current technological requirements and the results achieved so far under the "Green Mortgage" programme, as future minimum standards are not defined yet.

4.4.1. Warm water supply

The energy efficiency measures for warm water supply in households are well addressed under the current minimum requirements for the green mortgage programme. Standards and requirements are included for the use of SWH in medium- and cold climate zones (hybrid solar and gas water heating system), efficient gas boiler and water saving appliances. Since SWH required are required already for medium- and cold climate zones limited potential for up-scaling is given. In hot climate zones usually no additional warm water supply is necessary, as supply is sufficient without SWH due to the climate conditions. In medium to cold climate zones more efficient boilers are only relevant for high-income households where SWH cannot satisfy the total hot water demand of the household (currently SWH satisfies around 80% of the demand). The INFONAVIT surveys from 2009/10 have shown that the low-income families have amended their warm water demand to the supply from the installed SWH. 97% of the surveyed household eventually even do not use additional gas boiler for heating up the water (INFONAVIT/Enervalia (2010). Some households even disconnected from the gas supply for warm water generation.

For houses that still use gas boiler for preparing warm water, efficiency standards for the hot water boilers are already included in the minimum requirements under the green mortgage scheme to date. Hence, the further up-scaling potential under the programme is deemed limited.

Additional requirements already apply for efficient water use appliances under the green mortgage requirements. These appliances have direct impact on the warm water use. As described above most warm water is already carbon neutral due to the SWH installation requirement in medium to cold climate zones. Therefore, the up-scaling potential of more efficiency water use appliances is considered as low.

4.4.2. Lighting

The current version of the minimum requirements of the green mortgage mandates the installation and use of efficient light bulbs (CFLs). Light bulbs applied for both, interior and exterior household, have to be in accordance to the requirements of NOM-017-ENER/SCFI-1993, "Energy efficiency and safety required from the self-ballasted compact fluorescent lamp user". The maximum wattage for interior use is 20 W minimum and for exterior use 13 W. Hence the potential for further enhancement is limited as the use of CFLs is already required. A technology change to LED lighting is currently not deemed appropriate, since LED applications for household lighting is not market ready world-wide. As a result the potential for up-scaling with more efficient lighting appliances is limited.

4.4.3. Cooling demand

The cooling demand of houses and therefore the cooling load supplied by air conditioners (AC) depend on the climate zone and the quality of thermal insulation. The green mortgage minimum requirements already involve certain insulation material requirements. Roof and wall insulations in semi-cold and temperate bioclimatic conditions have to be in accordance to NOM-018-ENER-1997, "Thermal insulation products for construction", and have to make use of materials such as plates, formwork, foams, fibres and coatings that are commercialized as thermo-insulation materials, and that are used in construction systems.

The minimum requirements of the green mortgage do currently not involve efficiency standards for ACs. The NAMA could therefore enforce the application of energy efficient ACs (in case additional cooling demand is necessary in houses located in hot zones) under the green mortgage programme. The use of air-conditioning equipment alone accounts for about 6.6% of the energy use of residential buildings. In 2008, about 32 TWh of electricity consumption was due to air-conditioning in residential buildings (PRONASE 2009). According to GEF (2010) the household market penetration of room and mini-split air-conditioners in Mexico is estimated to be less than 25%, or approximately 6 million households. Air conditioner sales grew rapidly over time in Mexico from about 160,000 in 1994 reaching 568,000 in 2004. The average annual growth rate during this 10 years period is 15 %, but it exceeded 30 % in the last three years of the period (GEF 2010). One recent study projects that air-conditioner electricity use in Mexico could increase 10-fold by 2030, reaching a value that is higher than total residential electricity use in 2005 (Johnson et al. 2010). Currently, used and energy intensive ACs from the US are often bought in the second-hand market and applied in Mexican houses, especially in hot states bordering the US.

The demand for ACs is mainly driven by houses located in hot climate zones. The recent INFONAVIT surveys show that about 64% of the houses under the green mortgage programme were in hot zones of Mexico (INFONAVIT 2009). About 45% of the houses had still the need for ACs, even though thermal insulation as required under the programme was implemented. In consequence, only 18% of households do not have AC because users achieve an acceptable degree of comfort due to the thermal insulation and methods such as cross ventilation.

Table 16: Houses with Green Mortgages in hot climate zones with and with using ACs

Home with insulation w/o AC	18%
Homes with insulation w/ AC	45%
Home with insulation w ventilators	37%

Source: INFONAVIT (2010)

Under the NAMA enhanced requirements for participation in the green mortgage programme could mandate the installation of advanced energy efficient devices exceeding the current Mexican norm for ACs (NOM-021-ENER/SCFI/ECOL-2008). The following calculations on associated costs and GHG benefits are based on an assumed 25% energy reduction compared to the current energy consumption for ACs (assuming an average energy consumption for AC per household in hot climate of 1,515 kWh/a according to INFONAVIT (2010) and assuming that households would otherwise buy ACs that meet the norm). The associated energy savings and GHG emission reductions can be determined based on data from the recent INFONAVIT surveys and own calculations. For the calculation of energy savings, we also include the avoided generation that would need to be generated to offset the transmission and distribution (T&D) losses[14].

[14] The current T&D losses in Mexico amount to 15%. Source: World Development Indicators database: (http://www.nationmaster.com/time.php?stat=ene_ele_pow_tra_and_dis_los_of_out-power-transmission-distribution-losses-output&country=mx-mexico)

Additionally, the NAMA could mandate the households to install only new ACs using a refrigerant with considerably less global warming potential so that GHG emissions due to refrigerant leakage during the operational lifetime would be significantly reduced (i.e. change from Chlorodifluoromethane (HCFC-22) to hydro carbonate (HC)). We assume a GHG emission reduction of approximately 0.05 tCO_2/a per AC due to this measure.

Table 17: Assumptions on costs and GHG emission reductions from ACs

	Unit	Value
Initial investment per unit (Baseline)	(MX$/unit)	3,849
Initial investment per unit (NAMA)	(MX$/unit)	6,158
Incremental investment per unit	(MX$/unit)	2,309
Cost of capital p	%	8%
Lifetime	Years	10
Average electricity tariff for households (2010)	(MX$/kWh)	1.14
Net present value	(MX$/units)	1,134
Energy consumption (Baseline)	MWh/a per unit	1.52
Energy consumption (NAMA)	MWh/a per unit	1.14
Energy savings	MWh/a per unit	0.38
Avoided T&D losses	MWh/a per unit	0.06
Refrigerant change	tCO_2/a per unit	0.05
Grid emission factor Mexico	tCO_2/MWh	0.60
Abatement cost **with** refrigerant consideration		
CO_2e abatement annual	tCO_2/a	0.31
CO_2e abatement over lifetime	tCO_2	3.1
Abatement cost	**MX$/$tCO_2$**	**- $366**
Abatement cost	**€/tCO_2**	**- €22**
Abatement cost **without** refrigerant consideration		
CO_2e abatement annual	tCO_2/a	0.26
CO_2e abatement over lifetime	tCO_2	2.6
Abatement cost	**MX$/$tCO_2$**	**- $436**
Abatement cost	**€/tCO_2**	**- €26**

Source: Own estimation based on GEF (2010), Odón de Buen (2009), INFONAVIT (2010), Riviere et al. (2010), Attali et al. (2009)

As summarised in Table 17 above the electricity savings from more efficient AC and avoided T&D losses amount to 0.44 MWh/a per unit. Considering a grid emission factor of 0.6 tCO_2/MWh (Odon de Buen 2009) the GHG emission reduction results in 0.26 tCO_2/a per unit, which is an up-scale potential of approximately 27% compared to the current green mortgage impact of about 0.96 tCO_2/a following the current requirements. If the GHG emission abatement from refrigerant change of modern ACs are taken into account, the total GHG emission reduction adds up to 0.31 tCO_2/a per

unit (approximately 32% compared to the current green mortgage impact). Assuming incremental cost of MX$ 2,309 per unit, a current electricity price of MX$ 1.14/kWh and an electricity tariff increase of 5% over time the CO_2 abatement cost amount to a benefit of -366 MX$/$CO_2$e with refrigerant consideration and -436 MX$/$CO_2$e without refrigerant consideration, respectively.
A potential limitation for the mandating of HC-based ACs in Mexico could be that currently the market share of HC units is around 2% (GEF 2010). Hence the devices have to be imported or the Mexican production capacity would need to be increased considerably.
As mentioned above, GHG emission reductions through avoided AC use could under the NAMA also be induced by more stringent requirements for building insulation. However, as a modelling of a further increase in insulation requirements and its effect on AC use requires more detailed data and investigation, this option is not further investigated but warrants further research in the future.

4.4.4. Refrigeration

State-of-the-art refrigerators can provide a significant potential for energy conservation and GHG reductions in households. Under the current status of the green mortgage programme minimum standards for energy efficient refrigerators are not applied. The survey carried out by INFONAVIT among the beneficiaries of the green mortgage showed that the house owners only use 17% of new refrigerators (INFONAVIT 2010). 31% of the devices were old and 52% moderately aged. The NAMA could therefore mandate the application of more energy efficient refrigerators.

Table 18: Assumptions on energy efficiency gains per refrigerator

	Energy consumption	Share of surveyed households
Energy consumption of refrigerators surveyed under the “Green Mortgage”	kWh/a	%
New appliances	360	17%
Moderate aged appliances	456	31%
Old models	552	52%
Weighted average (Baseline)	490	
Assumed minimum standard under NAMA (equivalent to energy efficiency category of A+/A++[15]	196	
Energy efficiency gains (NAMA vs. baseline)	60%	

Source: Own estimation based on INFONAVIT (2010) and Attali et al. (2009)

As presented in Table 18 the baseline for the NAMA and the energy efficiency gains are based on the penetration rate of refrigerator standards in households covered under the current green mortgage scheme. According to this approach the baseline energy demand of an average refrigerator

[15] According to European labelling, please refer to Attali et al. (2009)

is assumed to be 490 kWh/a[16]. New appliances should at least reach the consumption level of currently new models which is about 26% below the weighted average baseline. For the NAMA an additional energy efficient increase is assumed through the use of high energy efficient refrigerators (energy efficiency category of A+/A++[17]) with a potential energy savings of 60% compared to the baseline. Besides energy savings, the following calculation also considers avoided T&D losses of 15%[18]. Additionally, under the NAMA only new devices could be allow that apply a refrigerant with a considerably reduced global warming potential, i.e. by changing using the refrigerant HC instead of the conventional HFC-134a (Tetrafluoroethane) to reduce GHG emissions from refrigerant leakage during operation. The change of the refrigerant with a less global warming potential results in a GHG emission reduction of approximately 0.036 tCO_2/a per refrigerator.

Table 19: Assumptions on costs and GHG emission reductions from refrigerators

	Unit	Value
Initial investment per unit (Baseline)	(MX$/units)	4,373
Initial investment per unit (NAMA)	(MX$/units)	6,559
Incremental investment per unit	(MX$/units)	2,186
Cost of capital p	%	8%
Lifetime	Years	10
Average electricity tariff for households (2010)	(MX$/kWh)	1.14
Net present value	(MX$/units)	$514
Energy consumption (Baseline)	MWh/a	0.490
Energy consumption (NAMA)	MWh/a	0.196
Energy savings	MWh/a	0.294
Avoided T&D losses	MWh/a	0.044
Refrigerant change	tCO_2/units per a	0.036
Grid emission factor Mexico	tCO_2/MWh	0.60
Abatement cost **with** refrigerant consideration		
CO_2e abatement annual	tCO_2/a	0.24
CO_2e abatement over lifetime	tCO_2	2.4
Abatement cost	**MX$/$tCO_2$**	**-$216**
Abatement cost	**€/tCO_2**	**-€13**
Abatement cost **without** refrigerant consideration		
CO_2e abatement annual	tCO_2/a	0.20
CO_2e abatement over lifetime	tCO_2	2.02
Abatement cost	**MX$/$tCO_2$**	**-$254**
Abatement cost	**€/tCO_2**	**-€15**

Source: Own estimation based on GEF (2010), OdóBun de en (2009), INFONAVIT (2010), Attali et al. (2009)

[16] Refrigerators should at least meet the requirements of NOM-015-ENER-2002, which should be the baseline under the NAMA for each category of refrigerator following the norm.
[17] According to European labelling, please refer to Attali,et al. (2009)
[18] The current T&D losses in Mexico amount to 15%. Source: World Development Indicators database: (http://www.nationmaster.com/time.php?stat=ene_ele_pow_tra_and_dis_los_of_out-power-transmission-distribution-losses-output&country=mx-mexico)

The incremental cost of a more energy efficient and HFC free refrigerator are assumed to approximately MX$ 2,190, or about 50% compared to a conventional model.

A potential imitation for the mandating of HC-based refrigerators in Mexico could be that currently the market share of HC units is around 2% (GEF, 2010). Hence the devices have to be imported or the Mexican production capacity would need to be increased considerably.

Table 19 above illustrates the assumption for the abatement cost calculation: the electricity savings per more efficient refrigerators and the corresponding avoided T&D losses amount to 0.34 MWh/a. Applying the Mexican grid emission factor of 0.6 tCO_2/MWh the GHG emission reduction results in 0.20 tCO_2/a per refrigerator and house[19]. Compared to the current impact of the green mortgage programme of 0.96 tCO_2/a this equals to an upscale potential of more than 20% in terms of emission reductions per house. If the GHG emission abatement from the refrigerant change is considered, the total GHG emission reduction increases up to 0.24 tCO_2/a per device (25% of the current green mortgage emission reduction impact per house). With the current electricity price of MX$ 1.14/kWh and an electricity tariff increase of 5% over time the CO_2 abatement cost amount to of -216 MX$/$CO_2$e with refrigerant leakage consideration and -254 MX$/$CO_2$e without refrigerant leakage consideration, respectively.

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4.4.5. Decentralised power generation (Photovoltaics)

Mexico is one of the countries in the world with the highest solar radiation and available solar energy. The average daily solar insolation in Mexico amount to approximately 5.3 kWh/m² in average which is about twice the radiation of Germany, a major market for solar energy technologies (PV and SWH). Besides SWH which is already addressed under the minimum requirements for the green mortgage, programme solar photovoltaic (PV) offers a high potential for decentralised power generation at buildings. The current installed capacity of PV in Mexico is about 22 MWp (2008) with a new installation of about 1 MWp per year (2008). About 80% of the market are installed off-grid for rural electrification and self-supply and only 20% are grid connected (Eckermann, A. (2010)).

Newly built houses provide the opportunity to integrated and install PV systems in the building design. Under the NAMA the programme requirements for the green mortgage programme could be extended to mandate the installation and use of PV on houses' roofs. Depending on the size and geographical location of the houses (roof area), the installed capacity could vary. In the following an average installed capacity of 0.2 kWp is estimated to be installed per house as a roof-top system. Even though space competition on the roofs with the SWH has to be considered, this size is deemed reasonable and conservative.

Such small-scale PV systems should be connected to the local electricity grids and be operated under net metering. However, to meet MRV requirements under the NAMA the systems would require their own electricity meter additional to the obligatory power demand meter in order to monitor the electricity generated by the PV systems. In Table 20 below the main assumption for the potential scale up of the green mortgage with PV systems are summarised.

[19] Assuming a 100% saturation rate

Table 20: Assumptions on costs and GHG emission reductions from photovoltaic systems

	Unit	Value
Installed Capacity	kWp	0.5
Capital cost	€/kWp	3,570
Capital cost	MX$/kWp	60,900
Cost of capital p	%	8%
Lifetime	Years	20
Insolation (horizontal area)	kWh/m²a	1930
Insolation (horizontal area)	kWh/m²d	5.3
Performance Ratio (System yield)	%	80%
Cost for O&M, insurance etc.	(% of capital cost per kWp/a)	1.5%
Energy yield per year (optimal tilt)	kWh/a	337
Avoided T&D losses	kWh/a	50
Average electricity tariff for households (2010)	(MX$/kWh)	1.14
Net present value	€	- € 460
Net present value	MX$	- $ 7.840
CO_2e abatement annual	tCO_2/a	0.23
CO_2e abatement over lifetime	tCO_2	4.6
Abatement cost	**MX$/$tCO_2$**	**$1,694**
Abatement cost	**€/tCO_2**	**€ 99**

Source: Own estimation based on GEF (2010), Odón de Buen (2009), INFONAVIT (2010)

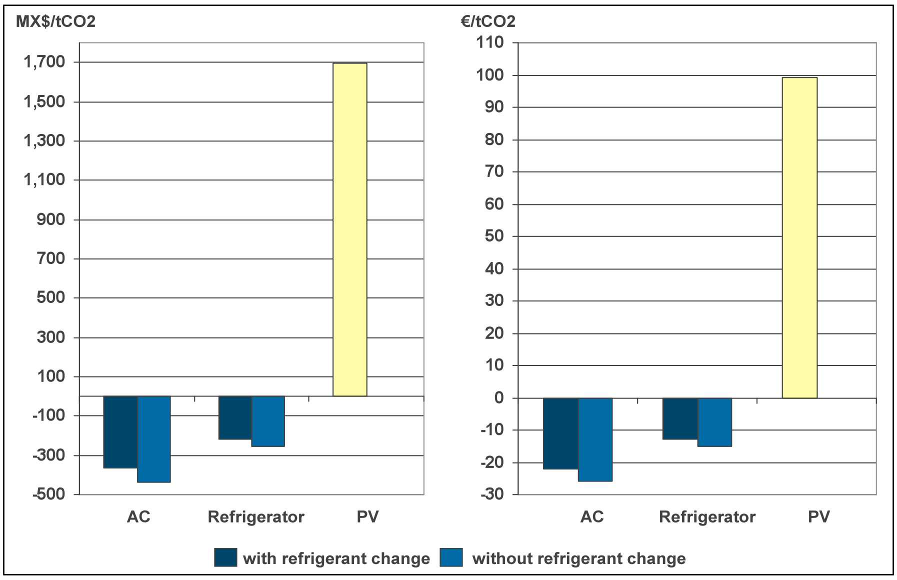
The power generated by PV can be deemed as electricity saving at the house level, since the demand for electricity from the grid is replaced. Given the high solar radiation in Mexico the average energy yield per installation of 0.2 kWp per house is estimated to be 337 kWh/a. Additionally, the decentralised power generation avoids T&D losses. For the PV system of one house these are additional 50 kWh/a. Considering the current grid emission factor of the Mexican power generation mix of 0.6 tCO_2/MWh, the annual CO_2e abatement per system and house is calculated to 0.23 tCO_2/a. This is equivalent to about 24% of the annual impact of the current green mortgage programme and would mean an corresponding upscale on the potential GHG emission reduction per house. Over the lifetime of minimum 20 years the PV systems could avoid accumulated up to 4.6 tCO_2 each. Taken into account current electricity price of MX$ 1.14/kWh and an electricity tariff increase of 5% over time the CO_2 abatement cost for the described PV systems would amount to of 1,694 MX$/$CO_2$e.

4.4.6. Discussion of technology up-scaling options

As can be seen in Figure 19, the technology options differ significantly from each other in terms of abatement costs. The application of energy efficient ACs and refrigerators have negative abatement costs from -22 €/tCO_2 to -26 €/tCO_2 (depending on coverage of HFC emission) and -13 €/tCO_2 to -15

€/tCO_2 respectively. PV by far has the highest abatement costs with around 100 €/tCO_2.

Figure 19: Comparison of abatement costs for technology scale-up options



From a pure economic point of view and assuming limited volumes of NAMA financing available, the technologies AC and refrigeration (especially with HC-based refrigerant) should therefore be preferred over the application of PV. Only if a donor is really interested to mobilize PV due to the hope to accelerate the progress towards achieving full competitiveness of PV compared to conventional energy technologies, PV would come to the fore given its high technical potential.

4.5. Supportive and administrative actions

As defined in Chapter 4.2, the NAMA should also include supportive actions to facilitate the transformation of the “Green Mortgage” and "Ésta es tu casa" programmes into a holistic urban planning process including building codes. Supportive and administrative actions are required during the implementation phase (2011-2012) and during the operation of the NAMA (2012-2020).

In the implementation phase the institutional set-up and NAMA administration has to be designed and set up. Until the start of the operation, the final design of the final scope of the NAMA and the associated business model has to be laid out. This also requires the designing of the final legislative framework to support the underlying GHG reduction programme (i.e. up-scaled “Green Mortgage” and integration of urban planning process and building codes), the designing of the detailed finance structure and plan (involving the private sector), the design of a fund for administration and the investment of the financial resources (incl. legal agreements) and the design, establishment and operation of a "NAMA Programme Office Unit".

The design of the baseline, MRV and additionality framework will also be a main task until 2012. The framework should encompass a data-collection system to accurately measure, report and verify emissions. For that reason a set up and operation of a comprehensive data base (baseline and MRV) of houses and energy consumption and demand is proposed. On this basis a professional and specialized inspection and supervision system should be established that ensures a comprehensive household monitoring and conducts auditing surveys (i.e. simulation using data base and detailed surveys). Such a system should allow to MRV the energy savings and the GHG emission reductions achieved by the up-scaling as part of the NAMA. This might warrant a transformation of the incentive and MRV approach of the "Green Mortgage" programme which currently requires monetary savings from the households instead of energy consumption targets or even GHG emission reduction targets. Even though the monetary savings might be a useful tool to incentivise the households to save energy, the system could be complex to operate in the long-run as it should take into account variations in the energy price for electricity and gas over time. In a context of increasing electricity prices in Mexico[20], the amount of energy savings (in kWh) required by the households will decrease with time. This might have negative effects on the technology change induced for housing developers and house owners, if such a system is not properly designed.

As main supportive action the enforcement of mandatory building codes is proposed. CONAVI has already developed comprehensive building codes (CEV) including an energy efficiency and sustainability section for the residential sector. These requirements are beyond the current minimum criteria under "Ésta es tu casa" and green mortgage programme and are going to be updated regularly. However, the codes are only a model code at present, since CONAVI cannot enforce the adoption and implementation on a federal level as building standards or codes are established locally on state level by local authorities. Therefore, the NAMA should support and promote the adaption of CONAVI's existing CEV by the administration of each state over the time of operation of the NAMA.

To date there is a very low rate of adoption of standards and building codes on state and municipality level. And in case codes exist, monitoring and enforcement systems are missing. Hence, CONAVI expects the NAMA to facilitate the enforcement of CEV at the level of federal states, starting with a "pilot" state to demonstrate the feasibility and the advantages of CEV enforcement in order to incentivise other states to follow the example. The introduction of mandatory advanced building codes over time would additionally support the up-scaling activities under the NAMA.

The NAMA's long term objective of transforming the green mortgage programme into a country-wide holistic urban planning process should be supported by several means. Firstly, a holistic approach for sustainable urban planning requires the consideration of additional criteria. For example, it includes the selection of possible locations for new housing developments. A quick-win could be to mandate the site selection criteria from the DUIS programme into the green mortgage programme. The integration of urban planning criteria would have an indirect positive impact on the potential emission reduction under the NAMA, e.g. through avoided transportation needs. In the long-term an integral approach under the building codes following sustainable urban planning and housing should be the goal. The NAMA could pave the way for this process by providing support for investigating possibilities to integrate urban planning (e.g. DUIS criteria) and the green mortgage programme into a single holistic urban planning and sustainable housing concept for Mexico.

[20] In January 2010, the Federal Electricity Commission (Comisión Federal de Electricidad or CFE) announced monthly electricity price increases of 0.33%, resulting in an overall increase of 4% in electricity prices throughout the year. Source: http://eleconomista.com.mx/sistema-financiero/2010/01/04/cfe-se-estrena-sube-tarifas-electricas and http://www.cfe.gob.mx/casa/ConocerTarifa/Paginas/Conocetutarifa.aspx

Table 21: Supportive and administrative actions under the NAMA

No	Activity
1	**Institutional set-up and NAMA administration**
1.1	Designing the final scope of the NAMA and the associated business model
1.2	Designing final legislative framework to support underlying GHG reduction programme
1.3	Designing the finance plan
1.4	Designing fund for financial resources, incl. legal agreements
1.5	Designing, establishment and operation of "NAMA Programme Office Unit"
1.6	Baseline, MRV and additionality framework
1.6.1	Design of final baseline, MRV and additionality framework
1.6.2	Development of data-collection systems to accurately measure, report and verify emissions: Set up and operation of a comprehensive data base (baseline and MRV) of houses and energy consumption and demand
1.6.3	Capacity building and capacity build-up for monitoring and auditing - Establishment of a professional and specialized inspection and supervision system
1.6.4	Comprehensive household monitoring and auditing surveys (i.e. simulation using data base and detailed surveys)
2	**Enforcement of mandatory Building Codes**
	Provision of capacity building and information campaigns to state administrations - Provide information and training to local governments and organizations - Implement pilot programmes in municipalities with high housing development - Identify necessary changes in standards
2.1	Show case in an advanced federal state for introduction, implementation and enforcement of building codes; Necessary consulting and internal resource support for adoption
2.2	Up-scaling of promotion activities for adoption and adaption CEV and standards - CB for federal government and local administration
3	**Transformation of "Green Mortgage" programme into a country-wide holistic urban planning and building code framework**
	Enhancement of CEV and standards/criteria of subsidies and mortgages, i.e. SD/EE part , including enhanced urban planning considerations
3.1	External support for initial update and consolidation
3.2	Regular supervision and update (internal) with enhancement of urban planning criteria; development and update of NOM/NMX Establish committees made of certified professionals to develop and update existing codes Capacity building and resource for tests of new appliances in laboratories for norm testing/certification
3.3	Supportive dialogue between federal administration, NAMA stakeholders and donors on future process of federal policies relevant for the housing sector and the NAMA; basis for the general long term strategy and continuity towards a general and supportive policy for the housing sector.
4	**Capacity building**
	Outreach to stakeholders, workshops series etc.
4.1	Training of architects, engineers, constructors, installers
4.2	Scaling up of university / commercial school curricula on EE buildings and RE in buildings with focus on supporting for the NAMA implementation and operation
4.3	Preparation of an exhaustive study demonstrating the detailed potential in the housing sector; establishing a comprehensive data base and continuous update Survey and investigation on building codes penetration among municipalities
5	**Marketing and advertisement**
	“Internal” marketing strategy in Mexico through several channels
5.1	Website
	Website development
	Website maintenance
5.2	Mass media campaign (TV, radio, newspaper)
5.3	Promotion for the participation (Brochures and marketing material)

In order to reach a considerable up-scale of the green mortgage and a broader participation in the scheme under the NAMA framework capacity building and information campaigns would be necessary. Capacity building could comprise the outreach to stakeholders and participants, e.g. through workshops series and trainings for architects, engineers, constructors and equipment installers as well as local authorities.

An extension of current university and/or commercial school curricula on energy efficient buildings and renewable energies could support the wider objectives of the NAMA. A first measure could be the preparation of a comprehensive study investigating and demonstrating the technological and economical potential in the housing sector which facilitates the establishing of a comprehensive data base including continuous updates for the NAMA data requirements and technology evaluations. This could be supplement with a survey study and investigation on building codes penetration among municipalities and states in Mexico. Currently, there is none comprehensive overview given on which kind of building code standards is in force on single state level.[21] An analysis of existing codes and deficits in the enforcement would help identifying the areas where enhancement and enforcement is mostly needed.

Capacity building activities do not generate GHG emission reductions directly under the NAMA but they can be a crucial element for delivering the anticipated reductions. Capacity building is vital to achieve accurate MRV and assist in the creation of enforcement procedures. Additionally, it encourages the development of human and technical capacity to manage the required institutional and regulatory infrastructure. However, capacity building activities under the NAMA can only be effective if they are integrated in the domestic regulatory and institutional processes.

Finally, an “internal” marketing strategy in Mexico using several communication channels could be launched in order to raise general awareness and obtain broader participation. This could be done through mass media campaigns on TV, radio and newspapers as well as the distribution of information brochures and marketing material. In addition, we suggest the creation of a website to explain and promote the benefits of the NAMA

5. Procedures for MRV and additionality demonstration

This chapter presents possible approaches for MRV and additionality demonstration for the actions under the potential NAMA defined in Chapter 4. Following the discussion in Chapter 3.3, possible frameworks will be presented for the scaling-up options and the supportive actions separately.

[21] The GTZ and CONUEE investigate the current status for 10 cities in Mexico in 2010 and found that only few energy efficiency standards are enforced (Rodriguez and Sielfeld 2010).

5.1. Scaling-up options

5.1.1. Review of building programme evaluation protocols

Apart from PV, all technology up-scale options included in the package of measures incorporated in the NAMA (see Chapter 4.3) will reduce energy consumption in the house. The PV installation will partially lead to a physical reduction of the electricity demand of the house (drawn from the grid), if the house can consume all the power generated, but would at times when the house does not require (all) electricity export power to the distribution grid ("net metering"). We propose that from an MRV point of view, electricity generation by the PV set should be treated in the NAMA as an equivalent energy saving[22].

The following are identified as most prominent protocols for building programme evaluation including energy efficiency and renewable energy measures as well as measures to reduce leakage from refrigerators and air-conditioners (AC) based on the whole-building, large-scale data analysis approach that was deemed most appropriate in Chapter 3.3.. The protocols represent carbon offsetting programmes both on the compliance and voluntary markets, as well as voluntary initiatives for building energy or emission performance comparison.

- CDM: AMS-III.AE "Energy efficiency and renewable energy measures in new residential buildings" (version 01).[23]
- CDM: NM0328 "Energy efficiency and fuel switching measures in new buildings" (version 02).[24]
- Voluntary Carbon Standard (VCS): "Weatherization of single and multi-family buildings" (version 3.2).[25]
- United Nations Environment Programme (UNEP): "Common carbon metric for measuring energy use & reporting GHG emissions from building operations".[26]
- United States Environment Protection Agency (US EPA): "Energy Star® - Energy performance rating system".[27]

The reviewed protocols are categorized into three groups of MRV approaches: (i) regression analysis on energy savings, (ii) benchmarking on energy or emission performance, and (iii) energy consumption adjustment approach. Key aspects of these approaches are summarised below.

The regression analysis on energy savings is used in one of the reviewed protocols (CDM AMS-III.AE). The amount of energy savings is estimated based on energy consumption of sample

[22] This approach is for example in line with the CDM methodology AMS-III.AE, which is one of the most robust approved methodologies for energy-efficiency and renewable energy generation measures for new residential buildings (see 6.1.1.)

[23] http://cdm.unfccc.int/methodologies/DB/AWRS1U9S13QBGT2FX236Z2CVTMH44A/view.html.

[24] http://cdm.unfccc.int/methodologies/PAmethodologies/pnm/byref/NM0328.

[25] http://www.v-c-s.org/methodology_mwsmfb.html.

[26] http://www.unep.org/sbci/pdfs/UNEPSBCICarbonMetric.pdf.

[27] http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

buildings participating in the programme (project buildings) and ones outside the programme (baseline buildings). The approach statistically adjusts the energy savings for factors influence building energy performance (e.g., climate conditions, building size, occupancy, etc.).

In case of AMS-III.AE, baseline buildings need to be selected from ones in the similar location, climate and socio-economic conditions, with comparable building type, size, and vintage. Thus, the level of disaggregation is relatively high.

AMS-III.AE sets the baseline as the average of energy performance the baseline buildings built in the recent five years. Additionality demonstration needs to be carried out following the barrier and/or investment analysis. It requires the energy consumption and climate condition data to be updated annually, while other building characteristics can be updated every third year.

The benchmarking approach is applied in three protocols (CDM NM0328, UNEP and US EPA), making it the most popular approach among the reviewed protocols. Benchmarking is generally defined as a performance comparison against peers. In case of building efficiency programmes, a benchmark is commonly expressed in GHG emissions or energy consumption per gross floor area of a building. The benchmark is established based on actual energy consumption data obtained from a sample of buildings.

As there are numerous factors that influence building efficiency levels, it is commonly required to disaggregate building stocks into several sub-categories so that the performance level of buildings in the sub-category becomes more homogeneous. The most commonly applied dimensions for disaggregation are building type and occupancy, followed by climate condition, building size and vintage.

CDM's NM0328 applies a benchmark to baseline and additionality. For both baseline and additionality, the stringency level of the benchmark is set as the average emission performance of building units built in the recent five years, and with the top 20% highest emission performance. UNEP and US EPA protocols do not specify benchmark stringency levels.

A benchmark is commonly established on historical one-year data. Energy consumption and climate conditions are usually based on actual data, while default emission factors of the consumed energy are available in non-offset protocols (UNEP and US EPA). NM0328 is the only protocol that specifies updating frequency. It applies updating frequencies differentiated by data source. Energy consumption needs to be updated annually, but other factors may be updated every three years so as not to inflate the monitoring costs.

The energy consumption adjustment approach is applied in one protocol (VCS). It monitors actual energy consumption of a sample of buildings prior to the project implementation for an ex-ante determination of a building energy performance level. Update monitoring of the energy performance level is not required. But the level will be adjusted over time by climate conditions (heating degree days (HDD), and cooling degree days (CDD)) and the historical trend in building electrical efficiency.

The approach establishes a common energy performance level for buildings in a similar location, with a similar building type and occupants with a similar income level. The baseline stringency is set as the average energy performance of all buildings. Additionality is demonstrated if energy load reduction of the project exceeds the sample-error-adjusted historical average level of energy load reduction measured in the comparable building stock over the last three years.

For baseline determination, one-year historical data is required on energy consumption, HDD and CDD. In addition, an electricity correction factor needs to be applied to the project electricity consumption based on the historical data on building electrical efficiency trend over the recent 10 years. Additionality demonstration requires data on the average energy load reduction in comparable buildings over the recent three years. Data updating is required for HDD, CDD and the electricity correction factor.

5.1.2. MRV and additionality framework for the NAMA based on the whole building approach

The analysis in the previous section revealed that the benchmarking is the most popular approach to the whole-building, large-scale data analysis of the reviewed building efficiency programme evaluation protocols. The approach has a strong advantage in streamlining MRV procedures in that a benchmark can be used to address both baseline and additionality (as in NM0328 and VCS) [28]. It is therefore ideally suited to differentiate between BAU measures, Supported NAMA efforts and crediting NAMA efforts. Benchmarks can also be made more stringent for the three categories over time. Benchmarking is often a data intensive exercise. Therefore, it is necessary to strike a careful balance between the accuracy and practicability of benchmarking (Hayashi et al., 2010). The section below elaborates a MRV framework for the Mexican NAMA on the key technical aspects of benchmarking identified in Hayashi et al. (2010): (i) system boundary, (ii) key performance indicator, (iii) aggregation level, (iv) stringency, (v) data requirements, and (vi) updating procedures.

System boundary

In consideration of a system boundary, it is necessary to distinguish two possible units of analysis for the building efficiency performance: the entire building or a building unit. A building unit is a distinct space within a building allotted to a specific user. For instance, a single-family home is one residential building unit while a building with ten apartments has ten residential building units. The use of building unit is recommended as it helps homogenise emission performance of a building category, especially in regions where mixed-use buildings are dominant (Hayashi et al., 2010).

Emission sources for the operation of a building unit include emissions from energy consumption and refrigerant leakage. The former is related to the consumption of electricity, fuels (e.g., LPG, natural gas), and central building/district energy (e.g., steam, hot water, chilled water). The latter is associated with the use of air conditioners and refrigerators. Furthermore, renewable-energy

[28] The regression analysis approach is suitable for emission reduction calculation. It could also be applied to additionality demonstration by, e.g., deeming a project is additional, if its emission reductions exceed the historical trend in building emission performance improvement. However, it would require a long-trend historical data on building emission performance. Such data is rarely available in developing countries, and so it is excluded from further consideration.

generating systems (e.g., a photovoltaic system) can be included as negative emission sources if the energy is supplied to other users (Hayashi et al. 2010).

Key performance indicator

A key performance indicator (KPI) is a common metric used for performance comparison. As the amount of emission reductions is the concern of a NAMA, the KPI should be expressed in GHG emissions per gross floor area (tCO_2e/m^2). It would therefore be useful to change the current energy cost saving goal for the house owners under the Green Mortgage Programme to energy and CO_2 emission reduction saving goals for the purpose of the NAMA.

Aggregation level

The grouping of various types of potential projects into a single category with a corresponding single baseline is the defining aspect of benchmarking. The more disaggregated a benchmark is, the higher the number of benchmarks need to be. Thus, it is essential to keep benchmarking aggregation as high complex as necessary, but as simple as possible. Based on the review in the previous section, the following aggregation is recommended for the Mexican NAMA:

- Building type: Distinguish between single-family and multi-family residence units.
- Building occupancy: Choose only residence units used as a primary, year-round residence.
- Climate condition: Differentiate into three key climate zones in Mexico: hot, temperate, and cold climate.
- Building size: Categorise residence units into appropriate building size groups that justify differences in building energy performance level.
- Building vintage: Consider only residence units built in the recent five years, as the target of the NAMA is new construction of residential buildings.

Stringency

The choice of benchmark stringency is the most controversial aspect of benchmarking. For the baseline determination, we argue that the average of residence units built in the last five years would represent the most reasonable estimate. It is the level of stringency at which the risks of over- and under-estimation of emission reductions are most likely offset with each other.

The use of additionality benchmark could address the three issues on additionality demonstration of a policy-based NAMA. First, the additionality benchmark can substitute the barrier, investment, and common practice analyses as currently required under CDM. It builds on the rational that the more stringent the additionality benchmark is, the more likely that the project faces greater barriers, requires larger investments, and goes beyond the common practice in the host country. The complex institutional setup of the building sector and multiple layers of decision making processes involved in the implementation of a mitigation policy warrant the more streamlined way of additionality demonstration by benchmarking. Second, the additionality benchmark can be updated to avoid non-additional emissions reductions, in line with the proposed NAMA design to make the minimum standards under the Green Mortgage programme gradually more stringent over time. Third, the additionality benchmark does not require a decision on a suitable timeframe for policy impact evaluation. It does not require an ex-ante evaluation of additionality prior to the NAMA implementation. Instead, additionality of the NAMA is assessed when emission reductions are achieved.

With regards to the selection of the benchmark value, it should be considered, if the NAMA should be a supported NAMA or a credited NAMA. As for the additionality demonstration, the best available practice is the average of top 20% performers used in the CDM. Although it has no technical underpinning, the number could be politically an acceptable option for credited NAMAs. Therefore, unless other evidence is available in Mexico, we would recommend the use of the average of top 20% performers for NAMA crediting. A minimum benchmark for a supported NAMA would then be below the top 20% performers. The determination of the precise benchmark should be subject to further research on the status of energy efficiency in the Mexican housing sector for the last five years as well as future trends.

Data requirements

The benchmarking approach requires following data to be collected from a sample of residence units (adapted from Hayashi et al., 2010):

Table 22: Key data requirements for the Mexican NAMA

Data to monitor	Type of monitoring
Electricity consumption Emission factor of the grid electricity Transmission & distribution loss	Direct and continuous metering of electricity consumption (including generation from PV). If available, utility billing records can be used. As per CDM Tool to calculate emission factor for an electricity system[29], or use published data. Data from utility or an official government body.
Fuel consumption Net calorific value of the fuel CO_2 emission factor of the fuel	Direct and continuous metering of fuel consumption. If available, utility billing records or fuel purchase invoices can be used. Values provided by the fuel supplier in invoices, own measurement, or regional or national default value. Values provided by the fuel supplier in invoices, own measurement, or regional or national default value.
Refrigerant leakage from refrigerators and air-conditioners	IPCC default value or manufacturer specifications.
Gross floor area of a building unit	Building plan, or onsite measurement.

[29] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf.

Updating procedures

Building energy consumption levels change greatly over time. Climate conditions have particularly strong impacts on energy consumption levels, so actual climate conditions need to be taken into account. This requires annual monitoring of the energy consumption data. Such annual monitoring can also incorporate autonomous improvement of the building energy performance (e.g., by adoption of efficient appliances over time).

Alternatively, a procedure similar to the adjusted energy consumption approach could be applied to update the benchmark. Namely, the building energy consumption monitored prior to the NAMA implementation could be adjusted annually by the change in the number of HDD and CDD (see the VCS methodology for details). In new residence buildings in Mexico, space cooling is supplied solely by electricity and there is no need for space heating. Fuels (mostly LPG, with minor share of natural gas) are used for hot water supply and cooking, whose demand is not strongly influenced by variations in climate conditions over time. Thus, it is reasonable to consider that the number of CDD plays a decisive role in determining the electricity consumption. Consequently, the electricity consumption measured ex-ante could be adjusted by a correction factor for CDD. Even with the CDD adjustment, it is necessary to update the benchmark at a certain interval in order to reflect the autonomous emission performance improvement.

Other data (refrigerant leakage, gross floor area, emission factor of energy consumed) are much more predictable, thus it is not necessary to require frequent updating of these parameters.

5.1.3. Alternative MRV and additionality framework for the NAMA

The discussion in this chapter so far focused on the whole building approach combined with benchmarking for the MRV and additionality framework for the NAMA. One of the reasons is that this approach allows a combination of support and crediting in one holistic NAMA MRV framework. An alternative option could be to choose a less data intensive approach for establishing MRV and additionality (for example the energy consumption adjustment approach as applied under VCS). If at all, such an approach would very likely only be expected under a supported NAMA framework. In the context of the Mexican NAMA, this could practically mean that the scale-up of technologies (apart from PV) could take place under a supported NAMA whereas PV dissemination under the Green Mortgage programme could be (partly) financed by NAMA crediting. In terms of MRV and additionality determination the credited NAMA could then be operated similar to a CDM PoA using the approved CDM methodology AMS-I.D. “Grid connected renewable electricity generation”.

5.2. Supportive actions

As the direct GHG emission reduction benefit of the supportive actions under the potential NAMA can at best be estimated, we suggest to follow an input- and intermediate output-based approach for MRV for those actions. Following some example of MRV indicators mentioned in Table 23, the following indicators could complement the NAMA.

Table 23: Possible MRV indicators for supportive actions under the NAMA

Supportive Action	MRV Indicator
1: Institutional set-up and NAMA administration	- Development of data collection system for MRV (database) - Establishment of inspection and supervision system of new houses built under the NAMA - Survey of house of realised GHG emission reductions (annually)
2: Enforcement of mandatory building codes	- Number of federal states adapting and enforcing mandatory building codes - Performance of the Verification Units (VUs)
3: Transformation of Green Mortgage programme into a country-wide holistic urban planning and building code framework	- Number of developments and updates of norms and standards for enhanced building codes by CONAVI (including urban planning process integration in building codes/programme requirements) - Number of supportive dialogues towards a policy for sustainable housing for Mexico
4: Capacity building	- Number of certified architects, engineers, constructors and installers for sustainable housing design and technology - University Curriculum: Number of professors, Number of studies and reports, Number of graduated students (Master and PhD) - Development of technology database for the housing sector and updates
5: Marketing & Advertisement	- Implementation and operation of webpage - Number of TV spots, radio spots and newspaper advertisements

During the implementation and operation of the NAMA the financial funds allocated to the different support actions and their implementations steps should be subject to a transparent and robust MRV framework.

6. Estimation of GHG emission reductions

This chapter provides a preliminary estimate of GHG emission reductions expected from the NAMA. The currently available data does not allow us to conduct a detailed benchmarking analysis as proposed in Chapter 5.1.2. Our estimation is based on the empirical data of the “Green Mortgage” programme from the INFONAVIT surveys 2009/10 and supplemented by own research and assumptions. We consider our estimations to be a good proxy for the emission reductions that could be achieved under the NAMA in the different scale-up options.

6.1. Baseline roll-out

We establish the baseline emission reductions from which emission reductions will additionally achieved by the NAMA based on the current roll-out plan and the impact of the “Green Mortgage” and “Ésta es tu casa” programmes so far.

As shown in Table 6 in Chapter 2.2.1, the “Green Mortgage” and “Ésta es tu casa” programmes, set the minimum requirement of green technologies, customised for three different climate zones in Mexico. Based on the above sets of green technologies, INFONAVIT (2010) estimated energy savings and emission reductions achieved in the “Green Mortgage” programme for the whole house. The estimation combines the temperate and cold climate zones for electricity because similar green technologies are used in both climate zones.

Table 24: Cumulative energy savings achieved by “Green Mortgage programme”

Data referenced by housing / year		Without measures	With measures	Difference	CO_2 emission reduction
		kWh/a	kWh/a	kWh/a	tCO_2/a
Electricity	**Hot zones with A/C**	4,963	3,175	1,788	1.20
	Hot zones without A/C	3,309	2,363	946	0.63
	Other zones	2,042	1,660	382	0.26
Gas	**Temperate climate zone**	6,512	1,741	4,771	1.20
	Semi cold climate zone	7,480	2,057	5,423	1.32

Source: INFONAVIT (2010)

The results of the survey were used to estimate the energy savings and emission reductions. Avoided T&D losses were additionally considered and incorporated in the emission reduction impact. Using an assumed grid emission factor of 0.6 tCO_2/MWh and an average emission factor for gas (LPG and NG) of 0.24 tCO_2/MWh the overall impact from the “Green Mortgage” is estimated to be 0.99 (tCO_2/a). This emission reduction per house is applied for our emission reduction estimation for the baseline.

Table 25: Annual energy savings and CO_2 emission reductions by “Green Mortgage“ (BASELINE)

	Number of houses (%)	**Energy savings per house (kWh)**		**Avoided T&D losses per house (kWh)**	**Emission reductions (tCO_2/a)**	
		Electricity	**Gas**	**Electricity**	**per house**	**Total**
Hot zones with A/C	13%	1,788	0	179	1.18	15,016
Hot zones without A/C	51%	946	0	95	0.62	31,778
Temperate climate zone	18%	382	4,771	38	1.37	24,758
Semi cold climate zone	18%	382	5,423	38	1.53	27,577
Total	100%				0.99	99,129

Source: Own calculation and assumption based on INFONAVIT (2010b)

It is assumed that the low-income house will achieve at least this emission reduction in the baseline.

As the current extension plan for the “Green mortgage” already considers the incorporation of higher income ranges in the future, the increased mandated saving target was applied for the emission reduction estimations under the baseline roll-out scenario.

Table 26: Planned loan under and expected emission reduction impact of “Green Mortgage” according to income range

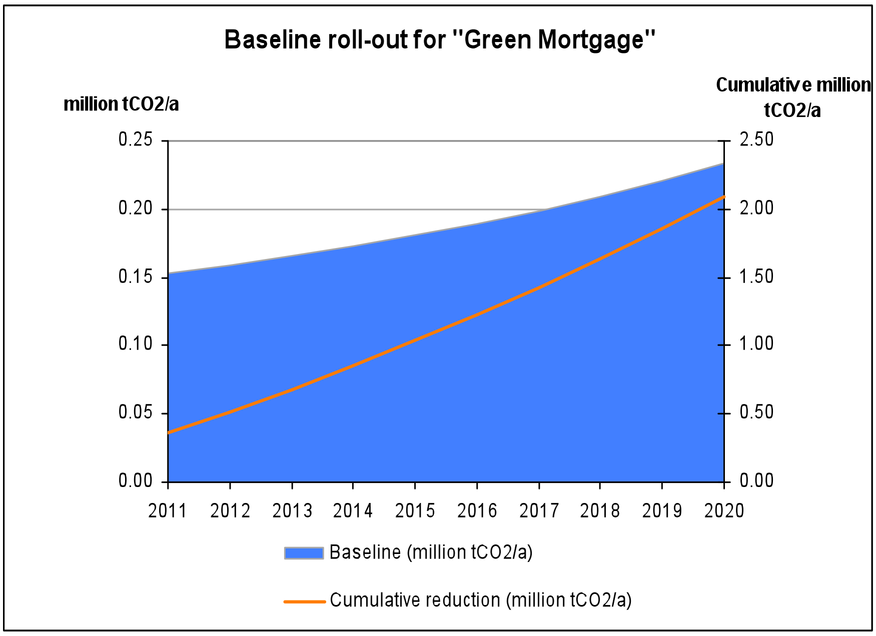
Income range (Expressed in multiples of the minimum wage (mw))	Maximum loan (MX$)	Expected savings (MX$ per month)	Assumed emission reduction impact (tCO_2/a)
Up to 6.99 mw	17,000	215	**0.99**
Between 7 and 10.99 mw	25,000	290	**1.34**
Higher than 11 mw	36,000	400	**1.84**

Source: INFONAVIT (2010b) and own assumption

This approach implicitly assumes that the households will not consume more energy in the future (e.g. due to the penetration of more energy consumers into the houses). Realistically, it must be assumed the emissions in the baseline are going to rise further with increased household wealth alongside the economic growth in Mexico. This is for example illustrated by the high growth rates of AC use in the residential sector as discussed in chapter 4.4.3.. However, due to the lack of readily available data on the total energy consumption of residential houses (over time), it was not possible to build a dynamic baseline of GHG emissions of the houses under the Green Mortgage programme over time until 2020.

Under the currently planned baseline roll-up of the “Green mortgage” and the “Ésta es tu casa” programmes, the annual emission reduction would increase from about 0.153 $MtCO_2/a$ in 2011 to 0.234 $MtCO_2/a$ in the year 2020. The accumulated emission reduction potential is estimated to reach 2.09 $MtCO_2/a$.

Figure 20: Estimation of baseline emission reductions

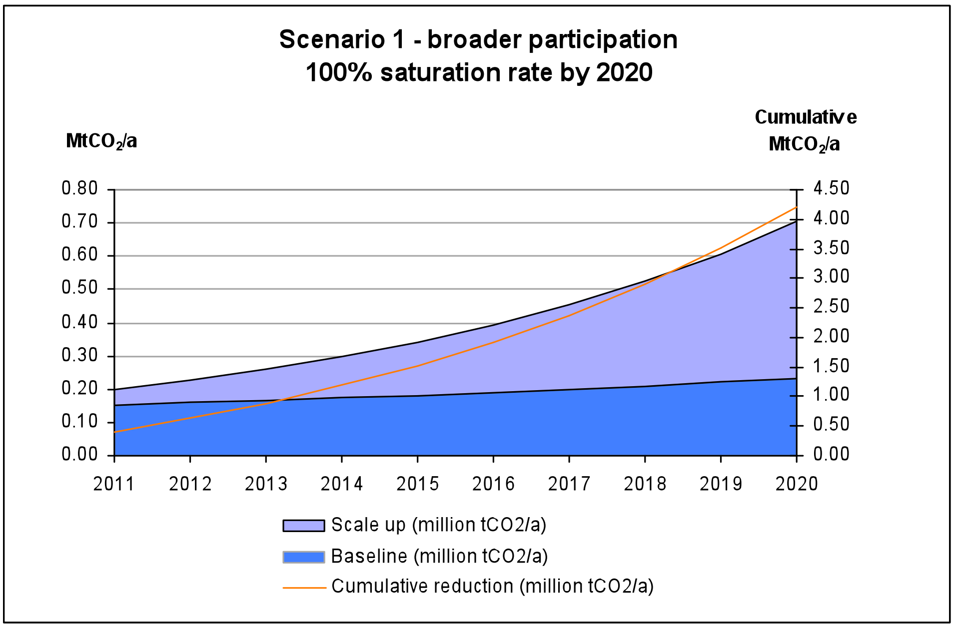


In total, the baseline scenario will create emissions reductions of 11.7 $MtCO_2$ between 2011 and 2020.

6.2. Scenario 1: Broader participation - 100% saturation by 2020

For Scenario 1 a saturation rate of 100% of green mortgage of the annual housing demand by 2020 is assumed (see chapter 4.3). The additional impact of the participation of the much larger number of houses would be 0.47 $MtCO_2$/a by 2020. The accumulated emission reduction potential resulting from the broader participation amounts to 2.12 $MtCO_2$/a until 2020, which is more than a doubling of emission reductions compared to the baseline.

Figure 21: Estimated emission reduction potential under Scenario 1 - 100% saturation rate by 2020

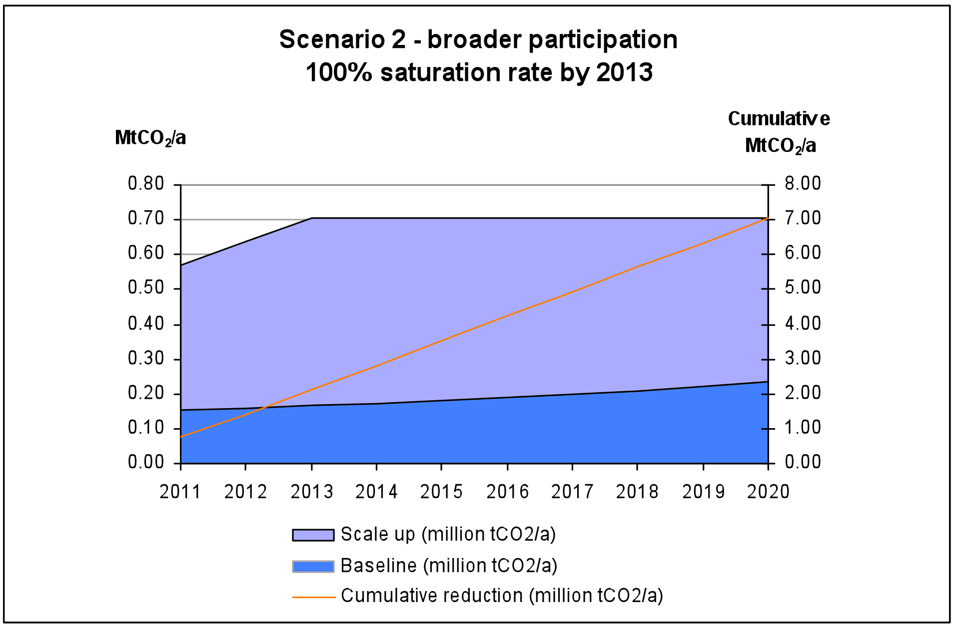


In total, this scenario will create additional emissions reductions of 7.9 $MtCO_2$ between 2011 and 2020.

6.3. Scenario 2: Broader participation - 100% saturation rate by 2013

For Scenario 2 the saturation rate of 100% of the housing market being financed and built according to the “Green Mortgage” is assumed to be reached by 2013 (see chapter 4.3). The additional impact from the broader participation under this scenario through the increased number of houses would be at a maximum of 0.54 $MtCO_2$/a in 2013 and amount to 0.47 $MtCO_2$/a by 2020. The accumulated additional emission reduction from the increased saturation is 4.95 $MtCO_2$/a until 2020, meaning more than a triplication compared to the baseline.

Figure 22: Estimated emission reduction potential under Scenario 2 - 100% saturation rate by 2013



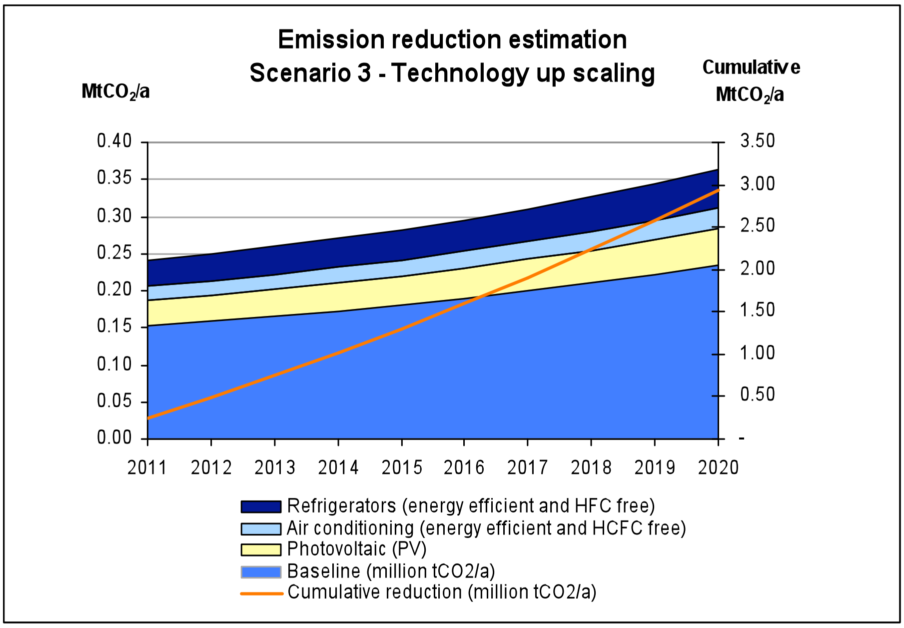
In total, this scenario will create additional emissions reductions of 27.1 $MtCO_2$ between 2011 and 2020.

6.4. Scenario 3: Technology up-scaling

The technology up-scaling Scenario 3 is based on the baseline roll-out under the "Green Mortgage". Additionally, it considers the employment of energy efficient ACs, refrigerators and solar PV in the houses compulsory for receiving the "Green Mortgage". The assumptions for the technologies apply as described in Chapter 4.3. The emission reduction impact from each technology over time is illustrated in Figure 23 below. The largest emission reduction potential is expected to be achieved from energy efficient refrigerators and the PV system installation on each house roof. The annual emission reduction potential from PV would be approximately 0.03 $MtCO_2/a$ in 2011 and could increase to 0.05 $MtCO_2/a$ by year 2020. Cumulative the up-scale with PV could end up in 2020 to 0.41 $MtCO_2/a$. Emission reduction from the use of efficient ACs and refrigerators would contribute 0.02 $MtCO_2/a$ and 0.03 $MtCO_2/a$, respectively, in 2011 and would increase to 0.03 $MtCO_2/a$ and 0.05 $MtCO_2/a$, respectively, by 2020. Accumulative these technologies, efficient ACs and refrigerators, would reduce the GHG emission under Scenario 3 by 0.22 $MtCO_2/a$ and 0.42 $MtCO_2/a$, respectively.

The aggregated GHG emission reduction potential from Scenario 3 could add additional 0.13 $MtCO_2/a$ to the baseline emission reductions and yield in total 1.05 $MtCO_2/a$ by 2020. Compared to the baseline this is 50% of the emission reductions from the baseline roll-out.

Figure 23: Estimated emission reduction potential under Scenario 3 - Technology up-scaling

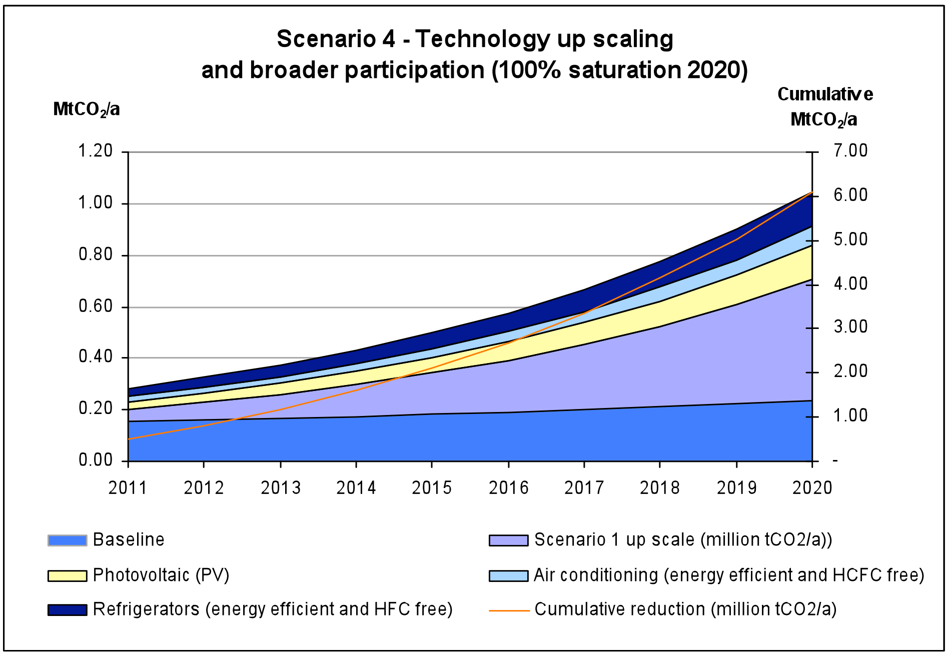


In total, this scenario will create additional emissions reductions of 5.4 $MtCO_2$ between 2011 and 2020.It can be observed, that most of the emission reductions of the NAMA would in this case be mobilised by the up-scaling of ACs and PV. In how far the potential emission reductions from HC-based refrigerants in ACs and refrigerators could be mobilised under the NAMA will depend on the availability of such products in the Mexican market; which has currently a limited size.

6.5. Scenario 4: Technology up-scaling and 100% saturation

Scenario 4 is the combination of Scenario 1 and 3 which lead to a potentialisation of the emission reduction impact from each scenario. This means that the technology requirements as discussed above are applied to the broader participation roll-out under Scenario 3.
The annual emission reduction from PV would increase from 0.03 $MtCO_2/a$ in 2011 to 0.13 $MtCO_2/a$ in 2020. Cumulative the up-scaling with PV would add up to 0.73 $MtCO_2/a$ by 2020. The emission reduction from efficient ACs and refrigerators would contribute 0.02 $MtCO_2/a$ and 0.03 $MtCO_2/a$, respectively, in 2011 and would increase to 0.07 $MtCO_2/a$ and 0.14 $MtCO_2/a$, respectively, by 2020. Accumulative these technologies, efficient ACs and refrigerators, would reduce the GHG emission under Scenario 4 by 0.4 $MtCO_2/a$ and 0.75 $MtCO_2/a$, respectively.

Figure 24: Estimated emission reduction potential under Scenario 4 - Technology up-scaling under 100% saturation of the "Green Mortgage" by 2020



The aggregated GHG emission reduction potential from Scenario 4 including the emission reduction from broader participation (Scenario 1) could add 4.0 $MtCO_2/a$ additional to the baseline emission reductions. The emission reduction potential would more than triple compared to the baseline by 2020. In total, this scenario will create additional emissions reductions of 15.9 $MtCO_2$ between 2011 and 2020.

6.6. Discussion of emission reduction estimates

All scenarios show substantial emission reduction benefits over time. Scenario 2, due to the rapid inclusion of all new houses under the Green Mortgage by 2013 achieves the highest amount of reductions (27.1 $MtCO_2$ until 2020) that even the Scenario 4, which combines 100% saturation by 2020 and technology up-scaling, cannot achieve (15.9 $MtCO_2$). Among the other two scenarios, Scenario 1 (100% saturation by 2020) achieves higher emission reductions (7.9 $MtCO_2$) than scenario 3 (Technology up-scaling) (5.4 $MtCO_2$). This might point to the conclusion that technology up-scaling is the least effective means of curbing emissions for new residential buildings. However, due to lack of data, our baseline scenario assumed that the same amount of emission reductions of 0.99 tCO_2/house/a can be sustained until 2020 by the Green Mortgage in its current design. This assumption cannot be considered realistic. The houses that are going to be built under the current "Green Mortgage" in future years will very likely consume more energy (either due to an increasing number of appliances or by appliances that are not regulated under the Green Mortgage) and will show less emission reductions per house per year[30]. Therefore, the estimated emission reductions under Scenario 1 and 2 with a very high probability overestimate emission reductions that could be achieved through broader participation. If the Green Mortgage programme is not up-scaled by minimum requirements for new technology and is not transformed into a programme where GHG emission reductions are limited following a whole building approach, the trend of rising GHG emissions per house will not be reversed. Therefore, it is suggested that the NAMA should not only rely on broader participation but apply a technology up-scaling at the same time.

In how far the estimated emission reductions associated with the different possible scenarios for actions will materialise under a supported NAMA will depend on (i) the future detailed international rules for baseline setting under such frameworks, (ii) as well as the quality of argumentation that Mexico can provide on why certain technology standards should or should not be part of the baseline, and (iii) the willingness of donors to finance the more expensive components of technology-scale up such as PV.. Assuming that a benchmark approach combined with a whole building MRV, as discussed in chapter 5.1.2., should be the methodological first choice for the NAMA, further research on the energy efficiency level of business-as-usual Mexican new houses is required to precisely determine the benchmark level for supported NAMA. This would enable to improve the robustness of emission reductions estimates that can be achieved if the NAMA focuses on broader participation in the “Green Mortgage” programme without a technological up-scaling.

7. Financial requirements for the NAMA and associated monetary benefits for Mexico

This chapter presents the financial requirements for the scenarios of the extension of the “Green Mortgage” under the NAMA. Chapter 7.1 will illustrate the different financial needs over time for the baseline roll-out, the broader participation scenarios (Scenario 1 and 2) and the technology up-scaling scenario (Scenario 3) as well as the combination of technology up-scaling and broader participation with saturation of “Green Mortgages” by 2020 (Scenario 4). The chapter is also estimating the financial requirements for supportive and administrative actions.

As under a supported NAMA different opportunities for support are possible, namely, financial and technical, as well as support through capacity building, it is generally conceivable that some of the actions discussed under the NAMA so far could be supported by other than financial support. Under this NAMA this could for example be technology transfer to enable establishment for a Mexican domestic market for HC-based air-conditioners and refrigerators. Another possibility could be that donors support certain supportive actions with technical know-how and capacity-building instead of providing financial assistance (e.g. hosting workshops and training seminars). As the non-financial support will very likely depend on the interests and competencies of industrialised country governments and/or donor agencies supporting the NAMA, we have in this concept translated all

[30] As discussed, in chapter 5.1.2. in the MRV section, it would therefore be useful to change the current energy cost saving goal for the house owners under the Green Mortgage Programme to energy and CO_2 emission reduction saving goals for the purpose of the NAMA.

actions under the NAMA in financial requirements. Some of the actions that are financially quantified in this concept, could possible later be exchanged by other means of support.

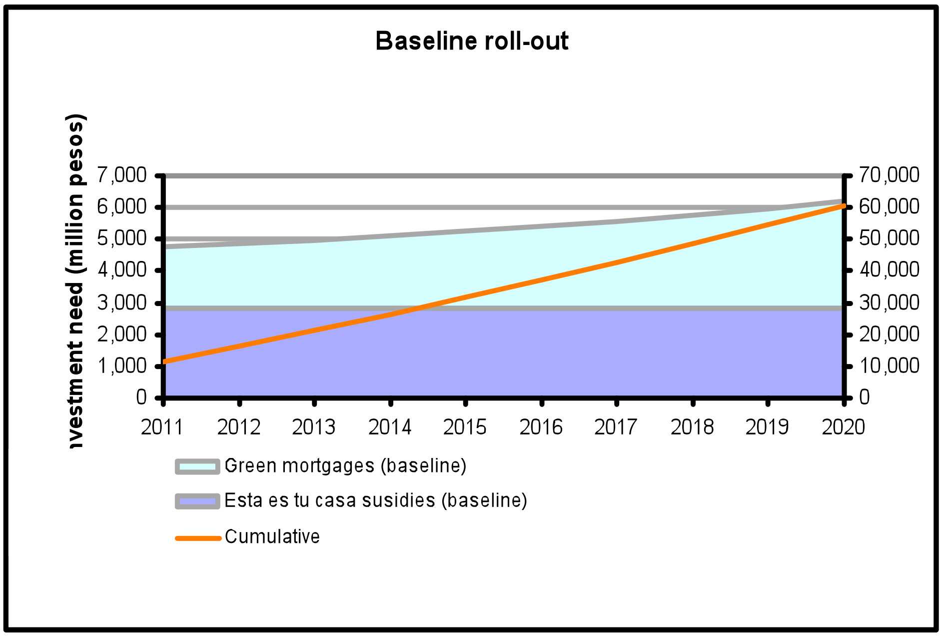
7.1. Financial requirements of NAMA implementation and operation

The financial requirements for the baseline roll-out plan and the up-scaling Scenarios 1 and 2 are based on the average subsidy granted under the "Ésta es tu casa" programme (only in the baseline) and the maximum loan awarded under the "Green Mortgage" as defined for different income ranges of the beneficiaries. The investment need for the technology scale up under Scenario 3 and 4 are based on the penetration and the incremental costs of the more efficient appliances (AC and refrigerator) and the investment costs (PV), respectively.

7.1.1. Baseline roll-out

Under the current roll-out plan for the "Ésta es tu casa" and the "Green Mortgage" programmes the annual financial requirement amount reaches MX$ 4.7 billion in 2011 and MX$ 6.2 billion by 2020.

Figure 25: Estimated subsidy for the baseline roll-out plan



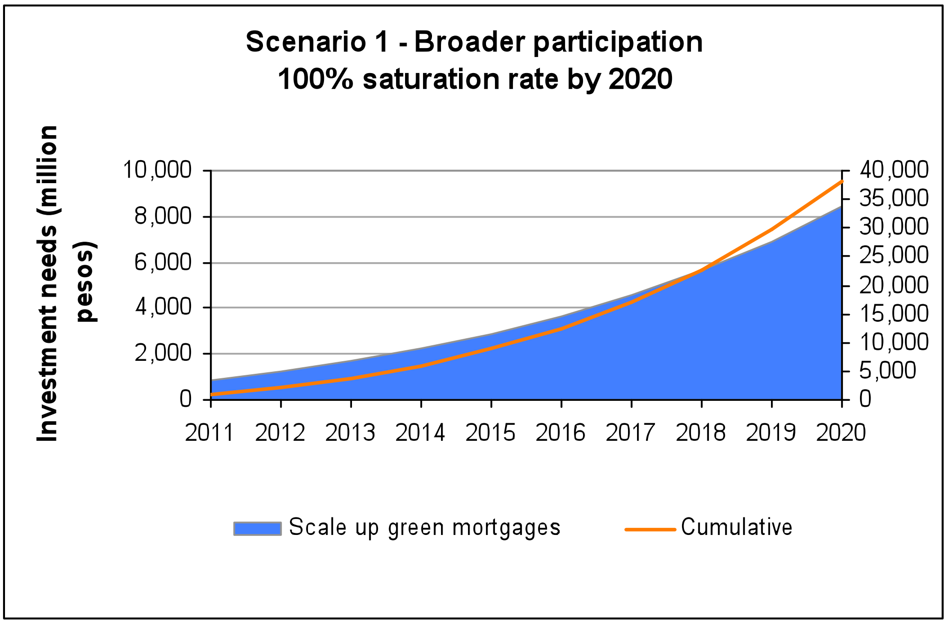
Cumulatively, the necessary amount of subsidies will reach MX$ 61 billion until 2020. Figure 25 above shows the financial requirements over time until 2020.

7.1.2. Scenario 1 - Broader participation - 100% saturation rate by 2020

The Scenario 1 with broader participation assuming a 100% saturation rate under the "Green

Mortgage" programme until 2020 would require total subsidies for the Green Mortgage of MX$ 38 billion until 2020. The annual financial need in 2020 would reach MX$ 8.4 billion.

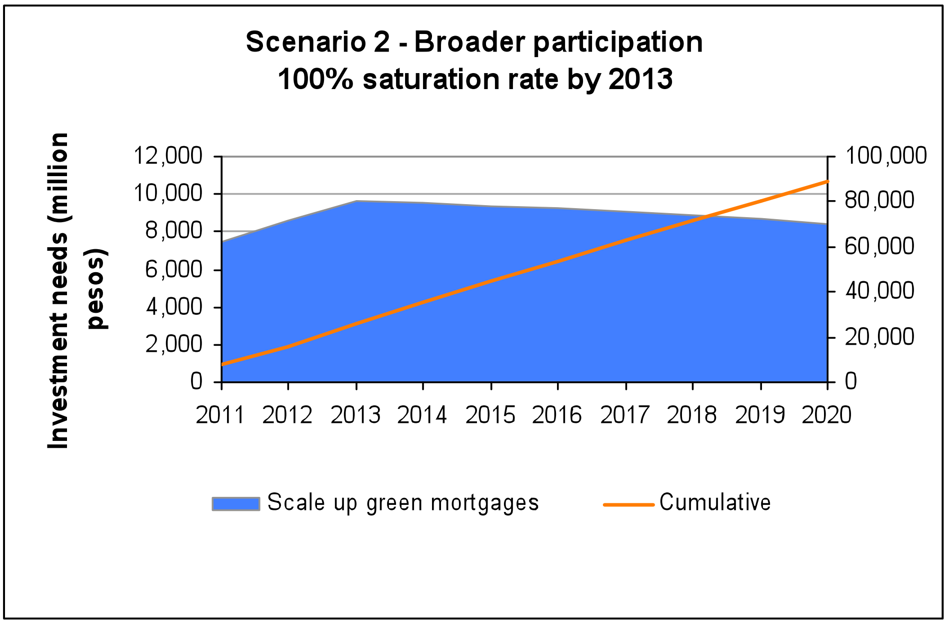
Figure 26: Estimated subsidy under Scenario 1 - 100% saturation of the "Green Mortgage" by 2020



7.1.3. Scenario 2 - Broader participation - 100% saturation by 2013

Under Scenario 2 the 100% saturation rate would be reached already 2013. This scenario would require subsidies of MX$ 89 billion until 2020. The maximum annual financial need would be reached in 2013, since the additional amount of mortgages would be the highest in this year. In 2013, approximately MX$ 10 billion would be required additionally under the up-scaling. Until 2020, the annual financial requirement is decreasing to the same level as in Scenario 1.

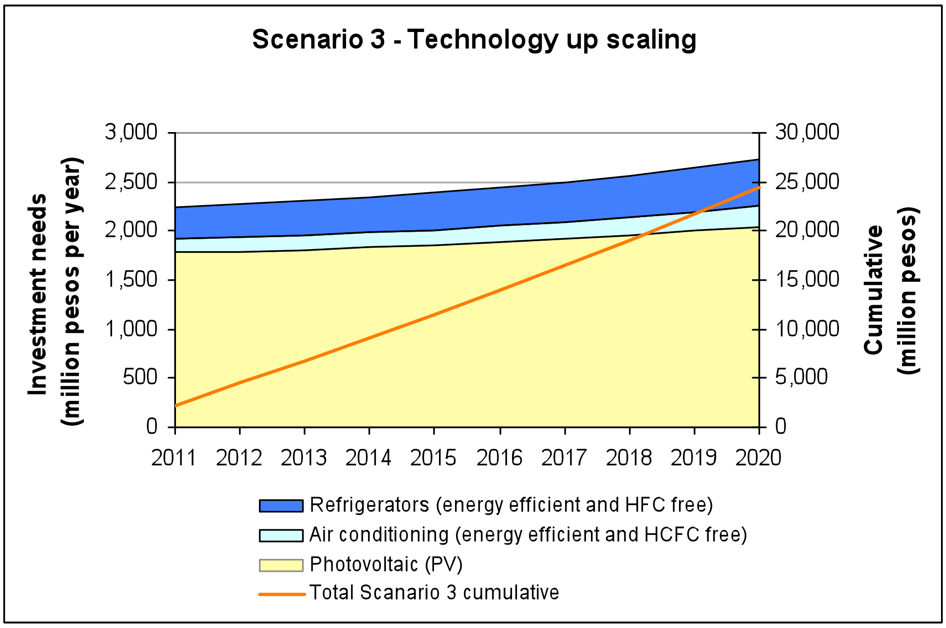
Figure 27: Estimated subsidy under Scenario 2 - 100% saturation of the "Green Mortgage" by 2013



7.1.4. Scenario 3 - Technology up-scaling

For the technology up-scaling under Scenario 3, the total incremental subsidy reaches MX$ 24 billion until 2020. The yearly financial need amount to MX$ 2.2 billion in 2011 and would increase until 2020 to MX$ 2.7 billion. The majority of the subsidy would be required for the installation of the PV systems. During the NAMA operation around 1.76 million PV systems with a total installed capacity of approximately 350 MWp would be installed. The total investment costs for PV only would add up to MX$ 19 billion until 2020. The incremental investment needs for AC and refrigerators until 2020 total MX$ 1.7 billion and MX$ 3.9 billion, respectively.

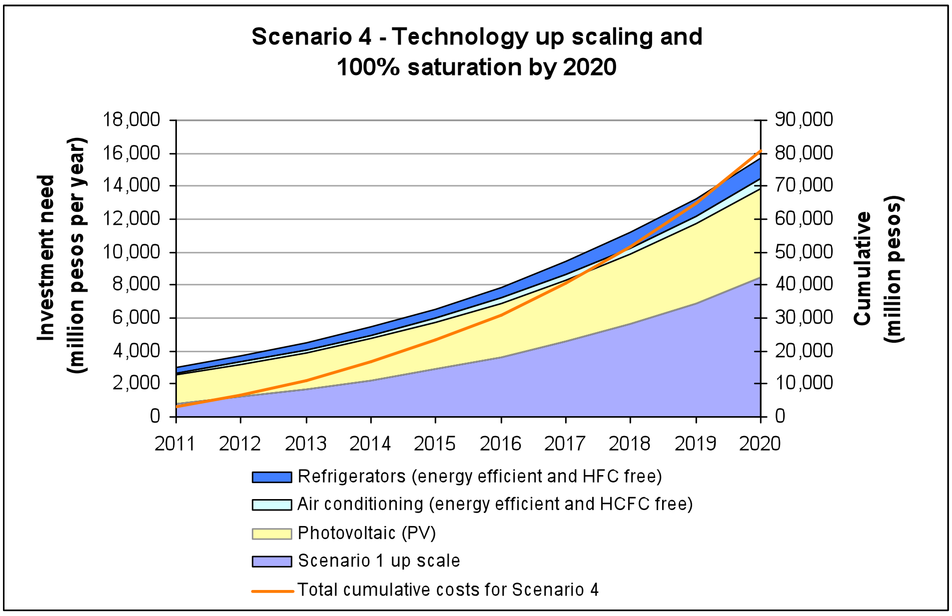
Figure 28: Estimated subsidy under Scenario 3 - Technology up-scaling



7.1.5. Scenario 4 - Technology up-scaling and 100% saturation by 2020

The combination of technology up-scaling and 100% saturation rate by 2020 will increase and accelerate the subsidy requirement under the NAMA. The total cumulative subsidy until 2020 would amount to MX$ 81 billion. 40% or MX$ 33 billion would be necessary for PV and about 47% or MX$ 38 billion for the broader participation related to the costs of the “Green Mortgage” extension plan. Under the scenario in total 3.1 million houses would be equipped with PV systems. The total installed capacity would amount to 630 MWp. The incremental investments for ACs and refrigerators by 2020 would be MX$ 3.0 billion and MX$ 6.9 billion, respectively.

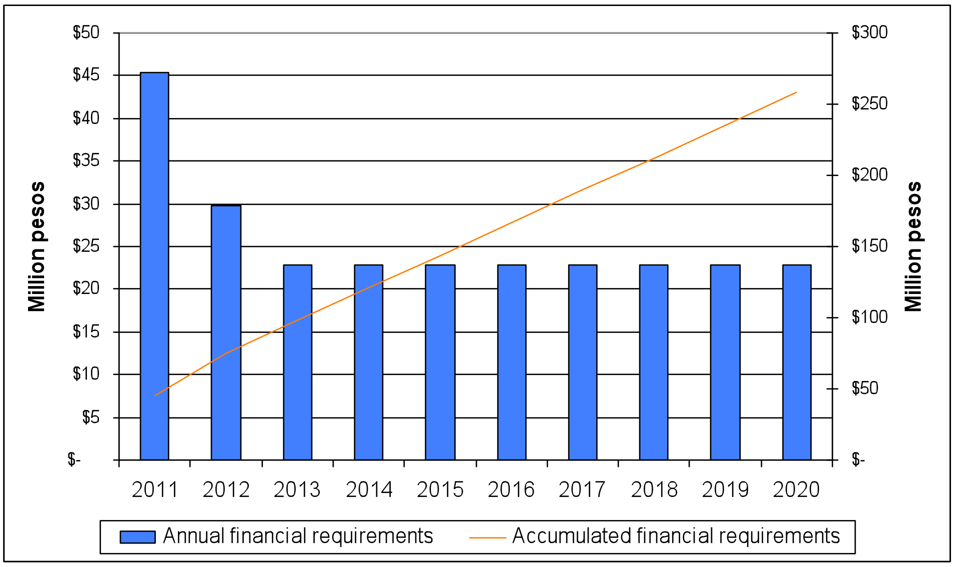
**Figure 29: Estimated subsidy under Scenario 4 -
Technology up-scaling and 100% saturation of the "Green Mortgage" by 2020**



7.2. Supportive and administrative actions

The NAMA implementation and operation would need supplemental financial support for the additional supportive actions and administrative tasks as described in detail in Chapter 4.5. The estimation is done to facilitate the implementation phase in 2011 and 2012 and to support the operation due to start in first half of 2012. The required support is expressed in financial requirements. However, some of the actions could also comprise direct support in terms of capacity building and technology transfer. Nevertheless finance is considered most appropriate to enable the implementation of the NAMA, but could be supplemented with direct capacity building and technology. The financial requirement for the supportive actions are estimated around MX $250 million in total until 2010; for the broader participation as well as the technology up-scaling. The budget is considered appropriate for both, as the scope administrative and supportive actions are almost independent of the choice of scenarios discussed in chapter 4. A major part, however, would be necessary in any case for the implementation phase during 2011 and 2012. The financial need for this period would add up to approximately MX$ 75 million. The cost estimated for the supportive and administrative actions are illustrated in Figure 30 below. A detailed cost allocation over time from 2011 to 2020 is available in Appendix 1.

Figure 30: Estimation of financial requirements for supportive and administrative actions for the NAMA



7.3. Associated monetary benefits for Mexico

The investment in energy efficiency measures and renewable energy encompassed in this NAMA could have a considerable positive impact on the Mexican national economy. Even though the investment in technologies with currently non-competitive costs in the market from a business perspective might be deemed less attractive or even unattractive, e.g. from the point of view of the house owner, there is a long term national economy dimension related to these investments.

The “Green mortgage” programme, also under the proposed NAMA concept, is primarily concerned with the payback of investments in energy efficiency measures and renewable energies from the perspective of the house owner; given that the monetary savings are used to refinance the loans from the mortgage. We have chosen to account the monetary benefits of the proposed actions from a national welfare point of view for Mexico. In the following we undertake a quantitative comparison of the financial requirements for the scale-up technology options (PV, energy efficient ACs and refrigerators) and those monetary benefits in order to analyse and assess the overall economic dimension of the investments to be carried out under the NAMA and how they relate to the financial benefits. Doing so, we account the monetary benefits on two levels only: (i) the house owner (ii) and the Mexican government. We assume that the house owner would be entitled to all the financial benefits from the technology scale-up through energy conservation and generation at his premises (which he will partly use for repayment of the mortgage). The financial benefit for the Mexican government is the avoided financial expenditure for subsidising the baseline energy consumption of the house owner. As currently the price/cost ratio for household electricity tariffs in Mexico is approximately 0.41 (Kornives et al. 2009) this means that every saved MWh of electricity on the household level would save the Mexican Government corresponding subsidies. This refers to a subsidy contribution of 1.6 MX$/kWh saved; considering the current average household electricity tariff of 1.1 MX$/kWh in 2010.

Table 27: Electricity tariff for households and related subsidies

	MX$/kWh
Electricity price households (Pesos /MWh)	MX$ 1.14
Real electricity price households unsubsidised (Pesos /MWh)	MX$ 2.78
Subsidies (Pesos/MWh)	MX$ 1.64

Source: SENER (2010), Komives et al. (2009)

How the monetary benefits under the NAMA concept could be shared differently and used to finance the investments should be discussed under the detailed NAMA design and is not part of the scope of this NAMA concept. We assume that in the future design of the financial structure, the monetary benefits will (partly) be used to be refinance the investments over time (e.g. though a fund or the public utility in case it would be involved in the investment under the NAMA).
Therefore, in the following comparison of investments and monetary benefits, the financial flows over time are not discounted.

7.3.1. Associated monetary benefits under Scenario 3

Under Scenario 3 the monetary benefits from electricity generated from PV under the NAMA (equivalent to saving at the house level; considering O&M costs) would exceed the subsidy in 2019 for the first time. Cumulatively, until 2020, the subsidy would amount to MX$ 18.9 billion and is accompanied by total monetary saving of MX$ 11.1 billion. The development over time is shown in Figure 31.

Figure 31: Associated monetary benefits and investments for PV under Scenario 3

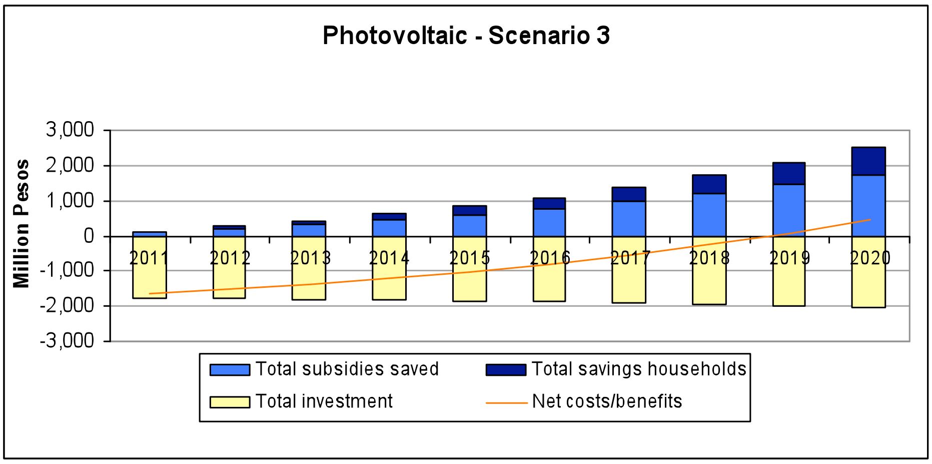
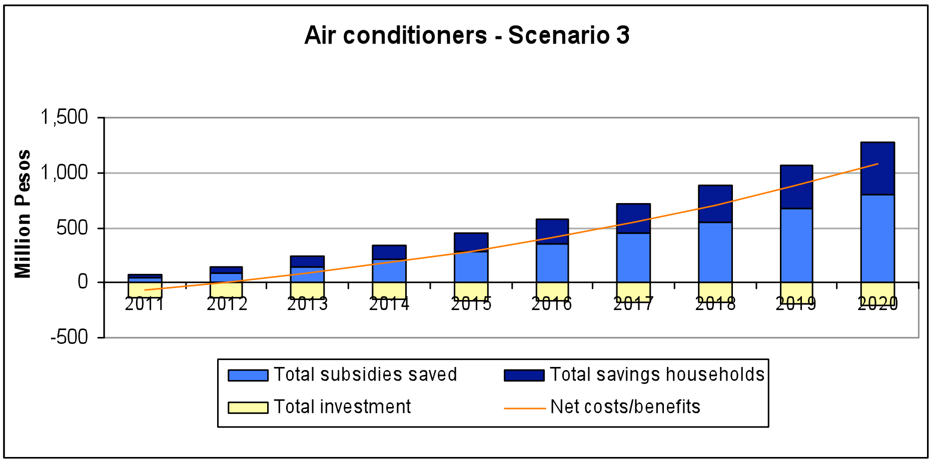


Figure 32 below illustrates the subsidy and the potential monetary benefits related to the employment of energy efficient ACs under the NAMA. The benefits would rise above the subsidy already in

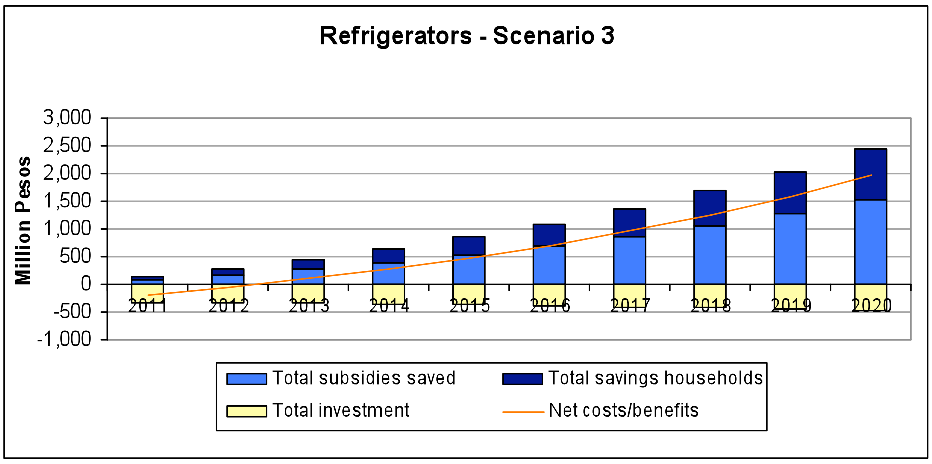
2012 and would total MX$ 5.8 billion by 2020. The accumulated subsidy would amount to MX$ 1.7 billion; resulting in a net benefit of MX$ 4.1 billion by 2020.

Figure 32: Associated monetary benefits and subsidy for AC under Scenario 3



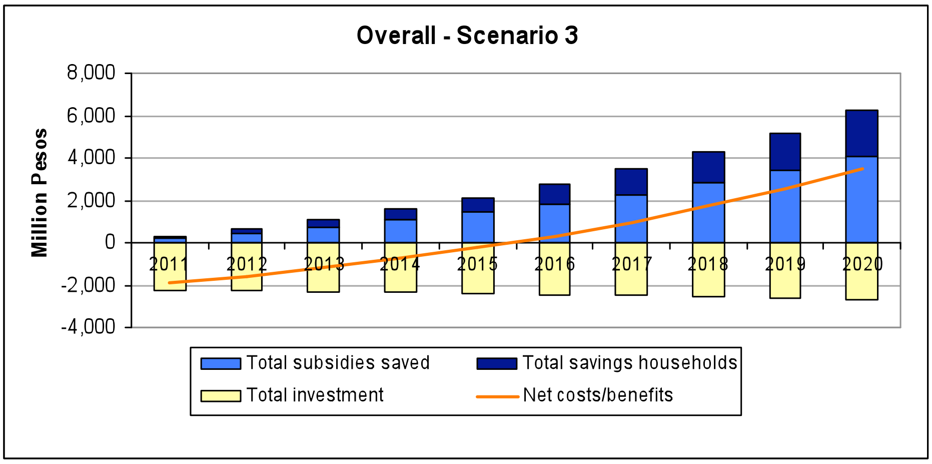
A similar development of the monetary benefits is given for energy efficient refrigerators under the NAMA in Scenario 3. The benefits would exceed the subsidies in 2013 and would add up to MX$ 11.0 billion by 2020. The accumulated investments on the other hand would amount to MX$ 3.9 billion; providing a net benefit of MX$ 7.1 billion by 2020.

Figure 33: Associated monetary benefits and subsidy for refrigerators under Scenario 3



Overall there could be a net benefit from the technology up-scaling under Scenario 3 and considerable annual monetary benefits. The benefits would for the first time exceed the newly annual investments in 2016. By 2020 the benefits would amount in total to MX$ 27.8 billion, whereas the accumulated investments would add up to MX$ 24.8 billion.

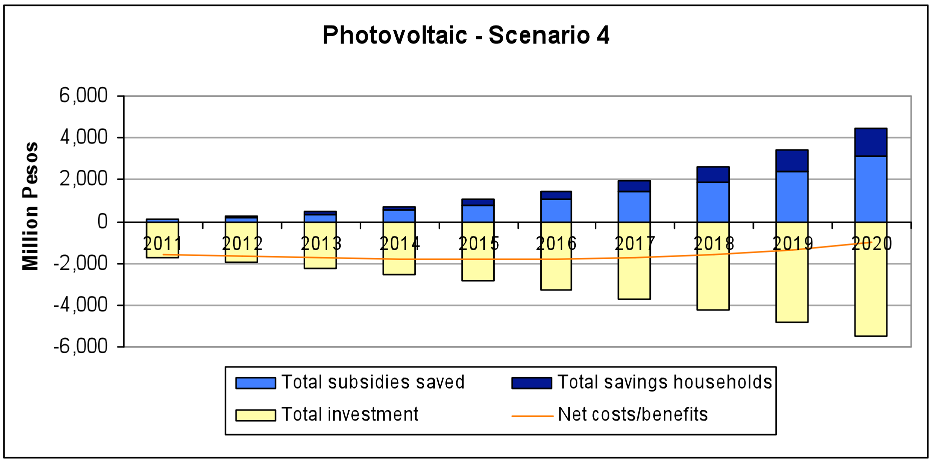
Figure 34: Associated monetary benefits and investments estimations under Scenario 3



7.3.2. Associated monetary benefits under Scenario 4

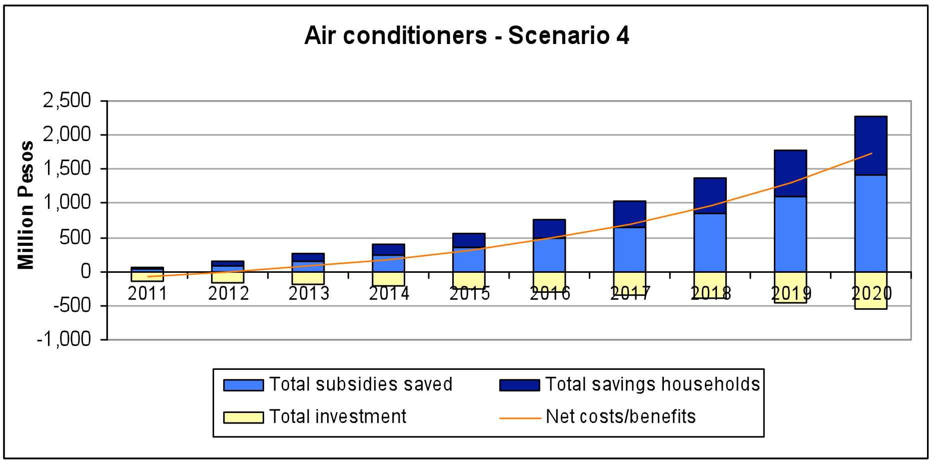
The monetary benefits under Scenario 4 from electricity generated from PV would cumulatively result in MX$ 16.7 billion. Until 2020 the investment would amount to MX$ 32.7 billion. The development over time is shown in Figure 35. Compared to PV in Scenario 3, benefits do not reach subsidy levels at any point in time until 2020, due to the larger scale of required investments due to broader participation.

Figure 35: Associated monetary benefits and subsidies for PV under Scenario 4



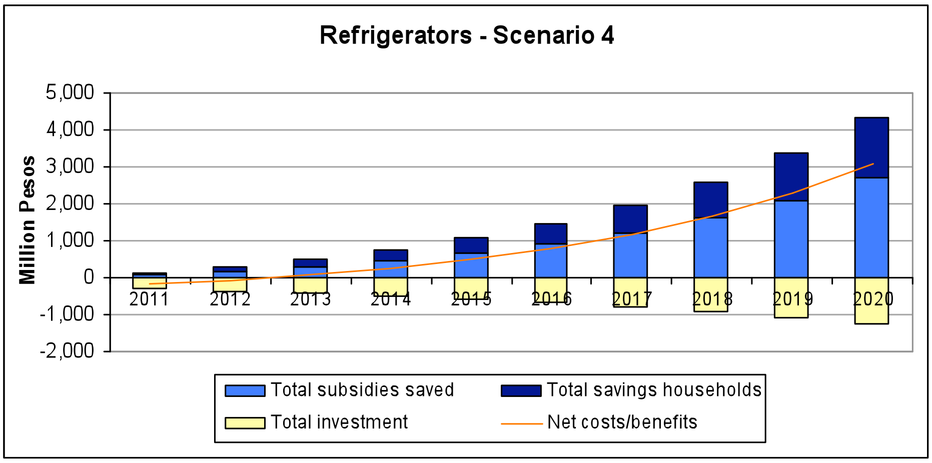
In Figure 36 below the investments and the potential monetary benefits related energy efficient ACs under NAMA are shown. The benefits would exceed the investments in 2013 and would eventually add up to MX$ 8.7 billion by 2020. The accumulated investment on the other hand would amount to MX$ 3.0 billion which leads to a net benefit of MX$ 57 billion by 2020. Compared to AC in Scenario 3, benefits reach subsidy levels at a later point.

Figure 36: Associated monetary benefits and subsidies for AC under Scenario 4



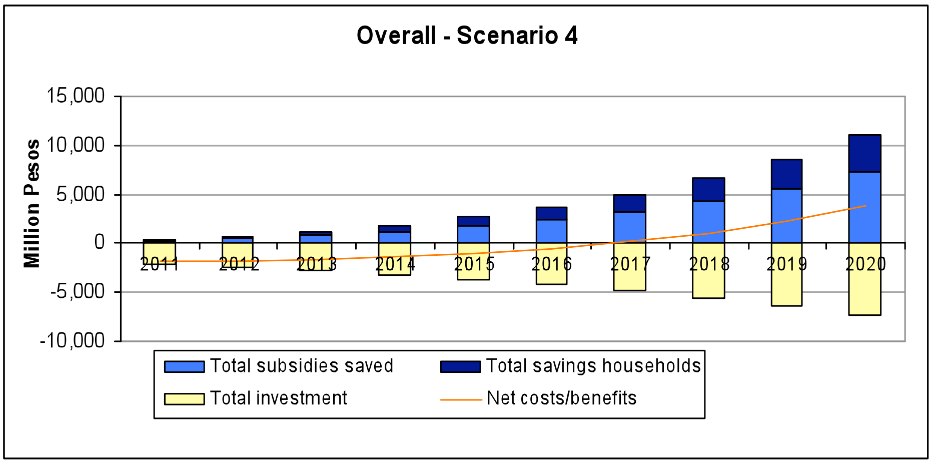
The monetary benefits from energy efficient refrigerators under the NAMA in Scenario 4 would exceed the subsidies in 2013 and add up to MX$ 16.4 billion by 2020. The accumulated investments would amount to MX$ 6.9 billion providing a net benefit of MX$ 9.6 billion by 2020..

Figure 37: Associated monetary benefits and subsidies for refrigerators under Scenario 4



For Scenario 4 considering a broader participation and a technology up-scaling the overall net benefit could reach MX$ 0.8 billion by 2020. The accumulated benefits would amount to approximately MX$ 41.7 billion, whereas the accumulated investments would add up to MX$ 42.5 billion. Figure 38 below is presenting the development of monetary benefits and investments over time until 2020. Benefits reach subsidy levels in 2017.

Figure 38: Associated monetary benefits and investments estimations under Scenario 4



The supported NAMA could help to path the way for a Low Carbon Development Strategy (LCDS) within the Mexican residential building sector. The NAMA would be necessary initially to provide sufficient funds and support to initialise this development and to establish the basis for a sustainable market mechanism.

8. Institutional requirements for the NAMA and opportunities for financing

8.1. Involved institutions and their role

A number of institutions will be involved in the NAMA implementation phase (2011-2012) and operation phase (2012-2020). As mentioned in chapter 4.5., the implementation phase involves a review of the current legislative and administrative framework to support the NAMA objectives. In addition, detailed financial plan and legal arrangements need to be place to support the operation phase. We suggest the creation of a workforce with combined efforts from CONAVI and SEMARNAT during the implementation phase to set up the institutional framework necessary for the NAMA operation.

A “NAMA Programme Office Unit” is necessary to keep records of all the international financial resources (multilateral and bilateral) that are directed to NAMA implementation, and possibly other functions. At the end of the NAMA funding cycle, Mexico should report back to donors and/or registry of NAMAs. The “NAMA Programme Office Unit” would be responsible for all the administrative tasks related to the NAMA as well as reporting the results achieved (and GHG emission reductions) to the donors.

We propose CONAVI as the coordinating entity and governing body of the NAMA. As the entity responsible for the creation of the housing policies, CONAVI is well placed to define the investment priorities and needs of the housing sector. This means that the allocation of the NAMA resources would be subject to CONAVI’s supervision. CONAVI would also be responsible for the coordination of the MRV data received from the auditors.

The management of MRV data is not part of CONAVI's role at the moment; therefore we suggest the creation of a strong technical committee and a data collection system to handle and process this information. A group of professional auditors (ideally with experience from working on Designated Operational Entities) should be established to design a comprehensive database (baseline and MRV) of energy consumption and conduct regular sample monitoring surveys to ensure to technologies are working properly. The technical committee should report back to CONAVI on the MRV data and results from the sample monitoring surveys. In addition, the committee could support CONAVI in the review of the minimum energy efficiency requirements for "Ésta es tu casa" and "Green Mortgage" programmes with the aim to incorporate new technologies as suggested in chapter 4.4.

In addition to the new activities proposed under the NAMA, CONAVI should promote the enforcement of building codes. As mentioned in chapter 4.5, we propose the mandatory enforcement of the codes in one pilot state to "show case" the benefits. CONAVI will require significant financial and administrative support to promote these activities. Using the NAMA resources, CONAVI can promote the creation of additional "Verification Units" (VU), responsible for the verification of building codes and norms at local level. The expansion of the number of VUs and supervision of their activities would be part of CONAVI's role in the NAMA implementation phase. During the operation phase, VUs performance in enforcing the building codes could be included as one of the MRV indicators for supportive actions under the NAMA.

Mexican universities can contribute to the NAMA implementation and operation phases with the provision of technical support and expertise to the different actors involved. In a first moment, Mexican engineers can support the capacity building campaigns with workshops and special training sessions directed to the housing developers. In the long-term, an extension of the university curricula on energy efficiency and renewable technologies would result in the creation of a specialized workforce which can support the wider objectives of the NAMA.

Housing developers are responsible for the installation of the energy efficiency technologies in the new houses. Due to their disperse nature, significant capacity building efforts and high transaction costs are often required to engage such stakeholders. In the long run, directed capacity building efforts would be necessary to engage the large number of developers necessary for the NAMA operation.

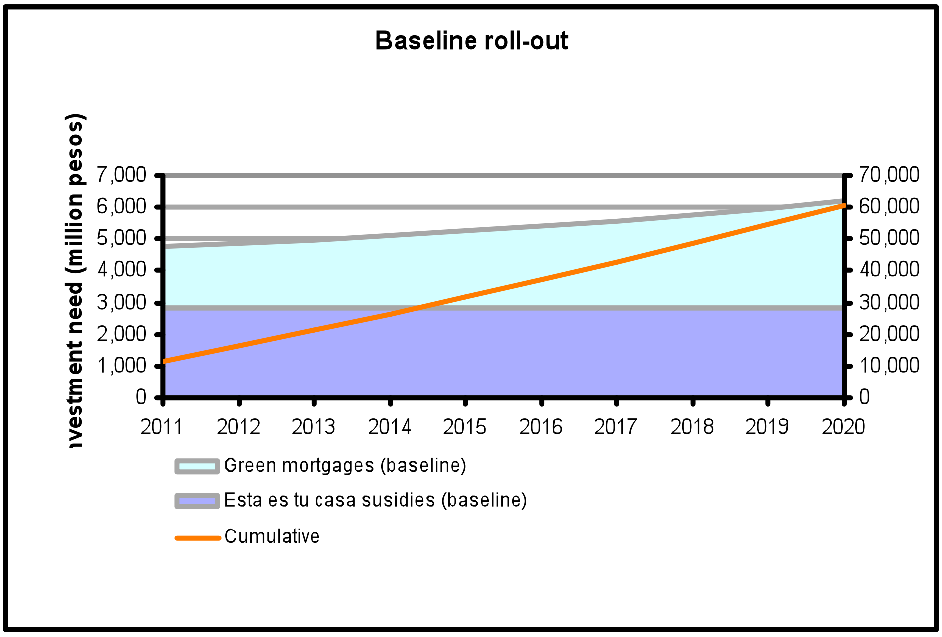
8.2. Financing opportunities

Having looked at the financial requirements to scale up the Green Mortgage programme, this section will focus on the different financing opportunities for the NAMA. There are several proposals of how to create a financing mechanism for NAMAs, ranging from the creation of a NAMA registry at UNFCCC level to the establishment of a Green NAMA bond which would engage the participation of the private sector. This section will discuss each one of these opportunities and propose a financial structure for the NAMA adapted to the Mexican context.

8.2.1. The Mexican contribution

NAMAs are voluntary and thus have to be consistent with the development goals of the host country. As discussed previously in this paper, Mexico already has a number of successful initiatives in place to promote the incorporation of energy efficient technologies in new houses and the general diffusion of more efficient energy appliances (such as the distribution of CFLs). In this context, the continuation of Mexican subsidies programme ("Ésta es tu casa") and the planned extension of the "Green Mortgage" programme (as discussed in section 2.3) could be seen as the unilateral component and Mexican contribution towards the NAMA. Figure 39 shows the funding requirements to maintain the subsidy programme at current levels and scale up the Green Mortgage scheme at 10% per year (according to CONAVI's plans discussed in section 2.4). Under the current roll-out plan the annual financial requirement amount to estimated MX$ 4.7 billion in 2011 and to approximately MX$ 6.2 billion by 2020, totalling 60 billion MX$. This is a substantial unilateral contribution.

Figure 37: Estimated financial requirement for the roll-out plan (BASELINE)



8.2.2. Supported NAMA: Potential financing sources

The up-scaling of the building programme requires subsidies of MX$ 24 billion (Scenario 3) to 89 billion (Scenario 2) by 2020. These funds could be sourced from different multi- or bilateral sources.

Bilateral support

The NAMA support can take the form of bilateral agreement between donor and host country. This is the most likely path given the problems industrialized countries face in spending their fast track finance and the absence of UNFCCC-agreed rules on multilateral financing of NAMAs. Several donors such as the US, EU member states and Japan have already announced financing of NAMA preparation and implementation in selected countries. However, the situation is characterized by a lack of transparency.

In this case, the activities undertaken under the NAMA would have to be previously agreed with the donors and are likely to be closely scrutinized by the financing parties. This is because donors desire to maximize the effectiveness of their spending in achieving set goals. More than one donor can be involved and different donors may choose to finance different activities under the NAMA. For example: one donor may choose to support the incorporation of new energy efficient technologies while another party may support the capacity building activities. This structure would generate a significant administrative workload; therefore we suggest the creation of a special administrative body to manage the NAMA resources.

Mexico might want to prevent repackaging of Official Development Assistance (ODA). and thus require that all funds goint into the NAMA are in addition to the existing ODA flows to Mexico, or to the forecast flows over the duration of the NAMA. .

A supported NAMA with bilateral support is likely to be subject to an international MRV system as specified in the Copenhagen Accord. This is because the international community and developed countries wants to ensure control and accountability of the activities supported under the NAMA framework. Even though developing countries generally prefer a domestic MRV scheme, the international MRV can raise the profile of the NAMA and potential attract further support. With a pilot NAMA, Mexico can influence the design of the MRV system. Ideally, the pilot would be financed by a combination of donors. While this increases transaction costs, it allows Mexico to prevent “capture” of the NAMA by one donor that might want to push a particular approach or technology.

Multilateral support through UNFCCC fund

In the negotiations of the Long-term Cooperative Action (LCA) Working Group the creation of a special fund for financing mitigation in developing countries has achieved some prominence. According to the latest negotiation text (UNFCCC 2010c), the main characteristics of the fund should be:

(a) new and additional, adequate, predictable and sustainable financial resources;

(b) be under the guidance of and accountable to the COP;

(c) efficient and effective operation;

(d) direct access where fiduciary standards of the implementing/executing entities are guaranteed;

(e) balanced allocation between mitigation and adaptation with priority for countries most vulnerable to the adverse impacts of climate change and unable to bear the costs.

While there is widespread support for the creation of the fund, its format and rules of procedure have not yet been discussed. The fund would probably be under the guidance and accountable to the COP, which implies that NAMA activities supported by the fund will most likely be subject to an international MRV. Even though an international MRV system has not been designed yet, MRV requirements for supported NAMAs would have to ensure: 1) that the mitigation support is being properly and efficiently deployed, and 2) that the expected results (which may not always involve

GHG reductions or removals) are being realized.

It is unlikely that a multilateral fund would be operational in time to finance the NAMA laid out in this study. Mexico could however use its experience with NAMA development and implementation to play a key role in the setup of the fund and potentially harness it for financing of further NAMAs in other sectors.

Multilateral support based on the Copenhagen Accord and a NAMA registry

The Copenhagen Accord establishes that NAMAs seeking international support should be recorded in a registry along with relevant technology, finance and capacity building support. There is no agreement on how the registry would be structured, but its objective is to gather NAMA proposals with a full description of the mitigation action, estimated full or incremental cost of implementation, indication of type of support required, estimation of mitigation benefits and timeframe of implementation. In addition, the registered NAMAs should define the nature of the MRV system, whether international or domestic MRV.

Countries interested to receive support would submit their NAMA proposals to the registry. Based on disbursement criteria, the registry would decide on the allocation of resources. Analysts propose that the NAMA registry could include several NAMAs packages or schemes according to the country's climate change mitigation and sustainable development needs (Cheng 2010).

Other analysts (CCAP 2009) have proposed that a Multilateral Facilitative Financing Mechanism would match the NAMA pledges with the funding sources once the NAMA registered is approved.

Given the current tendency to discard the Copenhagen Accord, a rapid decision on a NAMA registry coupled with a financing mechanism is unlikely. Therefore, Mexico should not wait for the setup of the registry.

8.2.3. NAMA crediting

Due to its close relation with the carbon market, there are different proposed structures to finance credited NAMAs, many of them promoting the engagement of the private sector. In this section we will focus on one of the most prominent proposals being discussed at the moment which is the Green NAMA Bond proposed by the International Emissions Trading Association (IETA). The Green NAMA bond is a mechanism to channel private investments to support mitigation actions in developing countries. According to IETA: "the host country (or possibly a Special Purpose Vehicle) would issue the green sectoral bond, with credit support provided by one or more International Financial Institution(s). In the case of a potential default on repayment, investors would therefore hold comfort in the existence of an OECD credit support agreement." (IETA 2010)

The Green NAMA bonds would be issued with a low-coupon rate and stream of carbon credits, the volume of which is tied to the host country's reduction target performance in the given sector or sub-sector. The bond issue would be fundamentally linked to predetermined baselines, standards and methodologies, as set forth in a bond issuance design document and approved by the international bond oversight and administrative body. Private investors would benefit from a low-rate coupon, a percentage of the returns for underlying and a proportion of the returns from carbon. This structure aims to attract pension funds, insurance firms and asset managers looking for exposure in emerging market economies.

An international body would be established to administer the mechanism and declare whether the proposed investment is acceptable and appropriately follows a set of approved, agreed-upon standards and methodologies. The same body would be responsible for the definition of the MRV requirements, which should be based on pre-determined benchmarks.
As mentioned earlier in this report, it can be assumed that the requirements for MRV and additionality within a credited NAMA will not differ to a large extent from the current requirements under CDM. Credit-generating NAMAs will generate CERs/offsets for developed countries just as today's project-based and programmatic CDM efforts do. However, they will differ in that sector-wide NAMAs will likely be more comprehensive, have more stringent baselines and be larger scale.

8.2.4. Discussion of financing opportunities

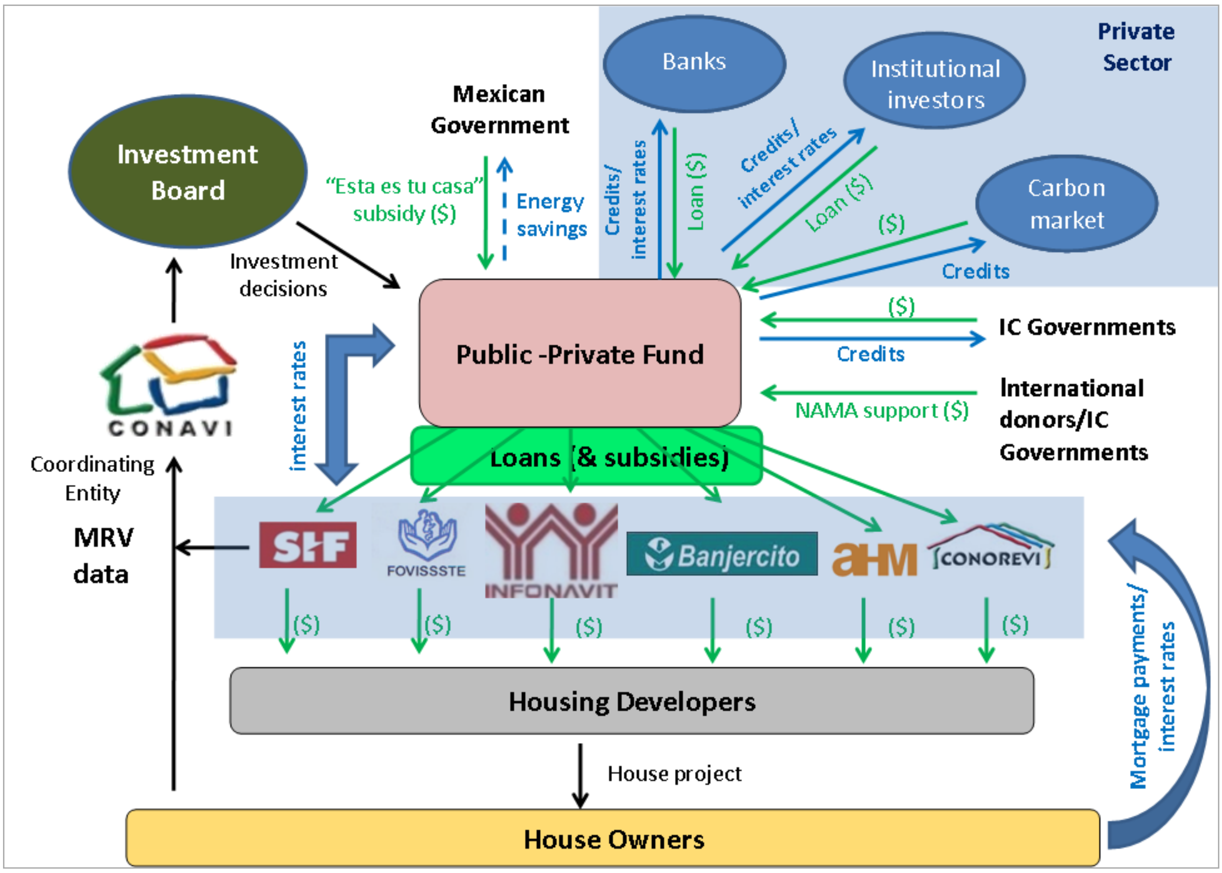
At this stage multilateral financing for the implementation and operation of the NAMA concept presented in this study is rather unlikely in the short term. There is a possibility that COP 16 in December 2010 will make decisions that will allow Mexico to assess the possibilities in a clearer light. Even in case important decisions are made at COP16, the detailed rules and procedures on support for NAMAs and international climate financing (e.g. a possible NAMA registry) will realistically need at least another year until COP17 until finally agreed. Given that the international negotiation process puts considerable emphasis on NAMA and financing for mitigation with the preparation of this study Mexico has made an important step towards receiving international support for the further implementation of this NAMA concept. Due to the ambitious timeline for NAMA implementation and operation (start 1st semester 2012) Mexico should, as long as uncertainty prevails on the multilateral level, seek to finance the next steps for the NAMA implementation through bilateral cooperation. Many bilateral donors are looking for good opportunities to spend their fast-track finance pledges, especially if these entail high visibility.

8.3. Suggested financial structure

Based on the above discussions this section aims to outline a business plan to support the NAMA implementation and operation. As described, there are several financing mechanisms and actors involved with different interests. In order to combine the different mechanisms and engage all the participants, we proposed the creation of a NAMA fund which will centralize all the financial resources received from donors, the private sector and the Mexican government. In addition, the fund would allocate the resources to the associated financing institutions which are responsible for the distribution of the loans to the housing developers. The model builds up on the current structure already in place between financing institutions, the housing developers and the house owners.
An investment board should decide on the allocation of the resources, taking into consideration

CONAVI's urban planning and housing policies. An overview of the NAMA fund is provided in the figure below.

Figure 40: Overview of the NAMA fund



An investment board composed by CONAVI, the private sector and representatives from the developed countries will decide on the resource allocation and the interest rates provided to each financing institutions (INFONAVIT, FOVISSSTE, SHF, etc). Under the fund structure, the NAMA resources should be allocated to the financing institutions at favourable interest rates in order to enable distribution of the subsidy to the housing developers. The NAMA fund will provide access to untapped resources from the private sector which will increase the number of loans provided. The large potential to scale up the green mortgage scheme already in place (and projected to reach up to a maximum of 4 million new houses by 2020 under the NAMA), will attract private investors interested in low-risk and low-return investments, but which can reach high volumes.

Private investors could be incentivized by receiving CERs in exchange for the investment, in case of a crediting NAMA. However, a decision on crediting NAMA depends on the Mexico government's position and the international rules on NAMA crediting (especially baseline and MRV). While crediting NAMA represents an effective strategy to attract private sector investment, the requirements for credited NAMAs are likely to be higher than the average CDM project.

A brief description of the role of each entity participating on the fund is presented below:

Investment Board: It should be the ultimate institution deciding on the allocation of the resources. It would be composed by representatives of the private sector, international donors and the Mexican government. Investment decisions could be taken based on a voting system, with the Mexican government's vote having a higher weight than the other actors.

Private Investors: They would be responsible for mobilizing low cost financing to support the development of sustainable housing. This fund structure is likely to attract pension funds and asset managers interested in guaranteed low-risk investments. The investment returns would be guaranteed by the financing institutions, backed by the energy savings generated from the households.

CONAVI: CONAVI would have a central role in the Investment Board and supervise the investments directed to each financing institution. As the government agency responsible for housing policies, CONAVI would also receive part of the funds to develop housing policies and other activities (such as: enforcement of buildings codes and capacity building activities). In addition, CONAVI would be responsible for the coordination of MRV activities and reporting to the donors.

Financing institutions (INFONAVIT, FOVISSSTE, SHF, etc): They would have a similar role as in the current programmes, acting as intermediaries between CONAVI and the housing developers and ensuring that the minimum set of energy efficiency requirements are met by the housing developers. Furthermore, the financing institutions would be responsible for hiring auditors and ensure compliance with the NAMA MRV requirements. This can be done with assistance provided by developed countries.

Housing developers: They would design housing projects according to the technical specifications defined by CONAVI. Under the NAMA framework, training and capacity building activities are expected to raise awareness about energy savings and facilitate the integration of green technologies in new housing developments.

House owners: House owners would be reached by the NAMA through the marketing and awareness raising campaigns promoted through TV, information brochures and the internet. Being the main beneficiaries of the programme, the house owners are expected to be attracted to the programme due to the energy and monetary savings they are expected to achieve.

The NAMA fund approach combines the participation of the public and private sector in a structure that aims to support existing policies. As a pilot concept, it aims to draw attention of the donors to the potential of scaling up *need-based* mitigation actions, based on national circumstances.

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Appendix 1

Cost allocation for supportive and administrative actions in Mexican pesos (MX$) and EUR

No	Activity	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	**Institutional set-up and NAMA administration**	**$ 18,317,500**	**$ 8,308,750**	**$ 5,652,500**	**$ 5,652,500**	**$ 5,652,500**	**$ 5,652,500**	**$ 5,652,500**	**$ 5,652,500**	**$ 5,652,500**	**$ 5,652,500**
1.1	Designing the final scope of the NAMA and the associated business model	$ 1,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.2	Designing final legislative framework to support underlying GHG reduction programme	$ 1,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.3	Designing the finance plan	$ 1,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.4	Designing fund for financial resources, incl. legal agreements	$ 2,550,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.5	Designing, establishment and operation of "NAMA Programme Office Unit"	$ 2,847,500	$ 2,847,500	$ 1,785,000	$ 1,785,000	$ 1,785,000	$ 1,785,000	$ 1,785,000	$ 1,785,000	$ 1,785,000	$ 1,785,000
1.6	Baseline, MRV and additionality framework	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.6.1	Design of final baseline, MRV and additionality framework	$ 850,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.6.2	Development of data-collection systems to accurately measure, report and verify emissions: Set up and operation of a comprehensive data base (baseline and MRV) of houses and energy consumption and demand	$ 2,295,000	$ 1,423,750	$ 892,500	$ 892,500	$ 892,500	$ 892,500	$ 892,500	$ 892,500	$ 892,500	$ 892,500
1.6.3	Capacity building and capacity build-up for monitoring and auditing - Establishment of a professional and specialized inspection and supervision system	$ 2,125,000	$ 1,062,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.6.4	Comprehensive household monitoring and auditing surveys (i.e. simulation using data base and detailed surveys)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Baseline	$ 2,550,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	MRV	$ -	$ 2,975,000	$ 2,975,000	$ 2,975,000	$ 2,975,000	$ 2,975,000	$ 2,975,000	$ 2,975,000	$ 2,975,000	$ 2,975,000
2	**Enforcement of mandatory Building Codes**	**$ 4,250,000**	**$ 4,250,000**	**$ 2,125,000**	**$ 2,125,000**	**$ 2,125,000**	**$ 2,125,000**	**$ 2,125,000**	**$ 2,125,000**	**$ 2,125,000**	**$ 2,125,000**
	Provision of capacity building and information campaigns to state administrations - Provide information and training to local governments and organizations - Implement pilot programs in municipalities with high housing development - Identify necessary changes in standards	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2.1	Show case in an advanced federal state for introduction, implementation and enforcement of building codes; Necessary consulting and internal resource support for adoption	$ 2,125,000	$ 2,125,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2.2	Up-scaling of promotion activities for adoption and adaption CEV and standards - CB for federal government and local administration	$ 2,125,000	$ 2,125,000	$ 2,125,000	$ 2,125,000	$ 2,125,000	$ 2,125,000	$ 2,125,000	$ 2,125,000	$ 2,125,000	$ 2,125,000
3	**Transformation of "Green Mortgage" programme into a country-wide holistic urban planning and building code framework**	**$ 8,075,000**	**$ 8,075,000**	**$ 5,950,000**	**$ 5,950,000**	**$ 5,950,000**	**$ 5,950,000**	**$ 5,950,000**	**$ 5,950,000**	**$ 5,950,000**	**$ 5,950,000**
	Enhancement of CEV and standards/criteria of subsidies and mortgages, i.e. SD/EE part , including enhanced urban planning considerations	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3.1	External support for initial update and consolidation	$ 2,125,000	$ 2,125,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3.2	Regular supervision and update (internal) with enhancement of urban planning criteria; development and update of NOM/NMX Establish committees made of certified professionals to develop and update existing codes Capacity building and resource for tests of new appliances in laboratories for norm testing/certification	$ 5,950,000	$ 5,950,000	$ 5,950,000	$ 5,950,000	$ 5,950,000	$ 5,950,000	$ 5,950,000	$ 5,950,000	$ 5,950,000	$ 5,950,000
3.3	Supportive dialogue between federal administration, NAMA stakeholders and donors on future process of federal policies relevant for the housing sector and the NAMA; basis for the general long term strategy and continuity towards a general and supportive policy for the housing sector.	$ 850,000	$ 1,275,000	$ 1,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4	**Capacity building**	**$ 12,970,000**	**$ 7,700,000**	**$ 7,700,000**	**$ 7,700,000**	**$ 7,700,000**	**$ 7,700,000**	**$ 7,700,000**	**$ 7,700,000**	**$ 7,700,000**	**$ 7,700,000**
	Outreach to stakeholders, workshops series etc.	$ 1,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4.1	Training of architects, engineers, constructors	$ 6,340,000	$ 6,340,000	$ 6,340,000	$ 6,340,000	$ 6,340,000	$ 6,340,000	$ 6,340,000	$ 6,340,000	$ 6,340,000	$ 6,340,000
4.2	Scaling up of university / commercial school curricula on EE buildings and RE in buildings with focus on supporting for the NAMA implementation and operation	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000
4.3	Preparation of an exhaustive study demonstrating the detailed potential in the housing sector; establishing a comprehensive data base and continuous update Survey and investigation on building codes penetration among municipalities	$ 4,250,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000	$ 680,000
5	**Marketing and advertisement**	**$ 1,780,750**	**$ 1,440,750**	**$ 1,440,750**	**$ 1,440,750**	**$ 1,440,750**	**$ 1,440,750**	**$ 1,440,750**	**$ 1,440,750**	**$ 1,440,750**	**$ 1,440,750**
	"Internal" marketing strategy in Mexico through several channels										
5.1	Website										
	Website development	$ 340,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Website maintenance	$ 165,750	$ 165,750	$ 165,750	$ 165,750	$ 165,750	$ 165,750	$ 165,750	$ 165,750	$ 165,750	$ 165,750
5.2	Mass media campaign (TV, radio, newspaper)	$ 850,000	$ 850,000	$ 850,000	$ 850,000	$ 850,000	$ 850,000	$ 850,000	$ 850,000	$ 850,000	$ 850,000
5.3	Promotion for the participation (Brochures and marketing material)	$ 425,000	$ 425,000	$ 425,000	$ 425,000	$ 425,000	$ 425,000	$ 425,000	$ 425,000	$ 425,000	$ 425,000
	TOTAL	**$ 45,393,250**	**$ 29,774,500**	**$ 22,868,250**	**$ 22,868,250**	**$ 22,868,250**	**$ 22,868,250**	**$ 22,868,250**	**$ 22,868,250**	**$ 22,868,250**	**$ 22,868,250**
	Accumulated	**$ 45,393,250**	**$ 75,167,750**	**$ 98,036,000**	**$ 120,904,250**	**$ 143,772,500**	**$ 166,640,750**	**$ 189,509,000**	**$ 212,377,250**	**$ 235,245,500**	**$ 258,113,750**

No	Activity	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	**Institutional set-up and NAMA administration**	**€ 1,077,500**	**€ 488,750**	**€ 332,500**	**€ 332,500**	**€ 332,500**	**€ 332,500**	**€ 332,500**	**€ 332,500**	**€ 332,500**	**€ 332,500**
1.1	Designing the final scope of the NAMA and the associated business model	€ 100,000									
1.2	Designing final legislative framework to support underlying GHG reduction programme	€ 100,000									
1.3	Designing the finance plan	€ 100,000									
1.4	Designing fund for financial resources, incl. legal agreements	€ 150,000									
1.5	Designing, establishment and operation of "NAMA Programme Office Unit"	€ 167,500	€ 167,500	€ 105,000	€ 105,000	€ 105,000	€ 105,000	€ 105,000	€ 105,000	€ 105,000	€ 105,000
1.6	Baseline, MRV and additionality framework										
1.6.1	Design of final baseline, MRV and additionality framework	€ 50,000									
1.6.2	Development of data-collection systems to accurately measure, report and verify emissions: Set up and operation of a comprehensive data base (baseline and MRV) of houses and energy consumption and demand	€ 135,000	€ 83,750	€ 52,500	€ 52,500	€ 52,500	€ 52,500	€ 52,500	€ 52,500	€ 52,500	€ 52,500
1.6.3	Capacity building and capacity build-up for monitoring and auditing - Establishment of a professional and specialized inspection and supervision system	€ 125,000	€ 62,500								
1.6.4	Comprehensive household monitoring and auditing surveys (i.e. simulation using data base and detailed surveys)										
	Baseline	€ 150,000									
	MRV		€ 175,000	€ 175,000	€ 175,000	€ 175,000	€ 175,000	€ 175,000	€ 175,000	€ 175,000	€ 175,000
2	**Enforcement of mandatory Building Codes**	**€ 250,000**	**€ 250,000**	**€ 125,000**	**€ 125,000**	**€ 125,000**	**€ 125,000**	**€ 125,000**	**€ 125,000**	**€ 125,000**	**€ 125,000**
	Provision of capacity building and information campaigns to state administrations - Provide information and training to local governments and organizations - Implement pilot programs in municipalities with high housing development - Identify necessary changes in standards										
2.1	Show case in an advanced federal state for introduction, implementation and enforcement of building codes; Necessary consulting and internal resource support for adoption	€ 125,000	€ 125,000								
2.2	Up-scaling of promotion activities for adoption and adaption CEV and standards - CB for federal government and local administration	€ 125,000	€ 125,000	€ 125,000	€ 125,000	€ 125,000	€ 125,000	€ 125,000	€ 125,000	€ 125,000	€ 125,000
3	**Transformation of "Green Mortgage" programme into a country-wide holistic urban planning and building code framework**	**€ 475,000**	**€ 475,000**	**€ 350,000**	**€ 350,000**	**€ 350,000**	**€ 350,000**	**€ 350,000**	**€ 350,000**	**€ 350,000**	**€ 350,000**
	Enhancement of CEV and standards/criteria of subsidies and mortgages, i.e. SD/EE part , including enhanced urban planning considerations										
3.1	External support for initial update and consolidation	€ 125,000	€ 125,000								
3.2	Regular supervision and update (internal) with enhancement of urban planning criteria; development and update of NOM/NMX Establish committees made of certified professionals to develop and update existing codes Capacity building and resource for tests of new appliances in laboratories for norm testing/certification	€ 350,000	€ 350,000	€ 350,000	€ 350,000	€ 350,000	€ 350,000	€ 350,000	€ 350,000	€ 350,000	€ 350,000
3.3	Supportive dialogue between federal administration, NAMA stakeholders and donors on future process of federal policies relevant for the housing sector and the NAMA; basis for the general long term strategy and continuity towards a general and supportive policy for the housing sector.	€ 50,000	€ 75,000	€ 100,000							
4	**Capacity building**	**€ 762,941**	**€ 452,941**	**€ 452,941**	**€ 452,941**	**€ 452,941**	**€ 452,941**	**€ 452,941**	**€ 452,941**	**€ 452,941**	**€ 452,941**
	Outreach to stakeholders, workshops series etc.	€ 100,000									
4.1	Training of architects, engineers, constructors	€ 372,941	€ 372,941	€ 372,941	€ 372,941	€ 372,941	€ 372,941	€ 372,941	€ 372,941	€ 372,941	€ 372,941
4.2	Scaling up of university / commercial school curricula on EE buildings and RE in buildings with focus on supporting for the NAMA implementation and operation	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000
4.3	Preparation of an exhaustive study demonstrating the detailed potential in the housing sector; establishing a comprehensive data base and continuous update Survey and investigation on building codes penetration among municipalities	€ 250,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000	€ 40,000
5	**Marketing and advertisement**	**€ 104,750**	**€ 84,750**	**€ 84,750**	**€ 84,750**	**€ 84,750**	**€ 84,750**	**€ 84,750**	**€ 84,750**	**€ 84,750**	**€ 84,750**
	"Internal" marketing strategy in Mexico through several channels										
5.1	Website										
	Website development	€ 20,000									
	Website maintenance	€ 9,750	€ 9,750	€ 9,750	€ 9,750	€ 9,750	€ 9,750	€ 9,750	€ 9,750	€ 9,750	€ 9,750
5.2	Mass media campaign (TV, radio, newspaper)	€ 50,000	€ 50,000	€ 50,000	€ 50,000	€ 50,000	€ 50,000	€ 50,000	€ 50,000	€ 50,000	€ 50,000
5.3	Promotion for the participation (Brochures and marketing material)	€ 25,000	€ 25,000	€ 25,000	€ 25,000	€ 25,000	€ 25,000	€ 25,000	€ 25,000	€ 25,000	€ 25,000
	TOTAL	**€ 2,670,191**	**€ 1,751,441**	**€ 1,345,191**	**€ 1,345,191**	**€ 1,345,191**	**€ 1,345,191**	**€ 1,345,191**	**€ 1,345,191**	**€ 1,345,191**	**€ 1,345,191**
	Accumulated	**€ 2,670,191**	**€ 4,421,632**	**€ 5,766,824**	**€ 7,112,015**	**€ 8,457,206**	**€ 9,802,397**	**€ 11,147,588**	**€ 12,492,779**	**€ 13,837,971**	**€ 15,183,162**