CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

A. General description of project activity

B. Application of a baseline methodology

C. Duration of the project activity / Crediting period

D. Application of a monitoring methodology and plan

E. Estimation of GHG emissions by sources

F. Environmental impacts

G. Stakeholders' comments

Annexes

Annex 1: Contact information on participants in the project activity

Annex 2: Information regarding public funding

Annex 3: Baseline information

Annex 4: Monitoring plan

SECTION A. General description of project activity

A.1 Title of the project activity:

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Electric motor replacement program in Mexico.

A.2. Description of the project activity:

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The purpose of the project is to offer incentives to users of electric motors so that they replace inefficient motors in use with new, high-efficiency motors that meet the standards of the FIDE seal ("Sello FIDE"). While Mexico has minimum efficiency standards covering electric motors, these standards determine motor efficiency at the time of purchase, without benefiting users of existing motors.

Electric motors represent 45% of the national electricity consumption in Mexico (36% in industry, 5% in agriculture, 3% in residential sector, and 1% in municipal services). The proposed program is intended primarily for three-phase induction motors among users in industry, agriculture and municipal services. Motors in the residential sector are low power units, not covered by the FIDE seal. Moreover, they are likely to be within household appliances where motor replacement is not a viable energy efficiency option.

A.3. Project participants:

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1. Project Developer: FIDE

2. Annex I country participant:

Japan. Electric Power Development Company (JPower).

See Contact Information in Annex 1 to this PDD.

PDD Consultant: MGM International, Ltda.

Official contact: Marco G. Monroy
MGM International Ltda.
Junín 1655 1° B - C1113AAQ Buenos Aires, Argentina
54.11.5219.1230
marcogmonroy@mgminter.com

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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Fideicomiso para el Ahorro de Energía Eléctrica

A.4.1.2. Region/State/Province etc.:

>>
Entire Country of Mexico.

A.4.1.3. City/Town/Community etc:

>>
Entire Country of Mexico.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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The project activity is the promotion of energy efficiency through replacement of motors among industrial and other users. The boundary for this project will be all consumers connected to the grid in Mexico, which covers most of the territory of the country.

A.4.2. Category(ies) of project activity:

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The UNFCCC CDM web site appears not to provide a list of categories of project activities, from which one might choose that applicable for this proposed new methodology.

If one were to use the "Sectoral Scope" classification as applied to Designated Operational Entities, a possible category could be: (3) Energy demand.

A.4.3. Technology to be employed by the project activity:

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Energy-efficient motors would replace existing motors in use, which are much less efficient. In the context, the energy efficiency of the replacement motors would be determined by minimum efficiency standards established by the project sponsor FIDE.

Mexico has minimum efficiency standards (called NOM) for electric motors sold, covering power output from 0.746 kW (1 HP) to 373 kW (500 HP). The most recent upgrade of the standards dates from 2002[1]. The project sponsor FIDE also has voluntary standards for energy efficient motors, compliance with which allows manufactures to place the FIDE seal ("Sello FIDE"). Following the 2002 upgrade of the NOM standards, the difference between the higher FIDE requirements and the national mandatory standards has decreased. Basically, the *minimum*-efficiency requirements of the FIDE standards (see Table A.4) are the same as the *nominal* efficiency requirements of NOM 2002.

[1] Mexican National Standard NOM-016-ENER-2002, Energy efficiency of three phase, squirrel cage, alternating current induction motors with nominal power from 0.746 to 373 kW, test method and labeling. ("Norma Oficial Mexicana NOM-016-ENER-2002, Eficiencia energética de motores de corriente alterna, trifásicos, de inducción, tipo jaula de ardilla, en potencia nominal de 0.746 a 373 kW limites, método de prueba y marcado.")

Table A.4. FIDE Standard: Nominal Limit Efficiency Values for Closed and Open Energy Efficient Motors									
Nominal	Nominal	Closed				Open			
power, kW	Power, HP	2 Pole	4 Pole	6 Pole	8 Pole	2 Pole	4 Pole	6 Pole	8 Pole
0.746	1.0	75.5	82.5	80.0	74.0	---	82.5	80.0	74.0
1.119	1.5	82.5	84.0	85.5	77.0	82.5	84.0	84.0	75.5
1.492	2.0	84.0	84.0	86.5	82.5	84.0	84.0	85.5	85.5
2.238	3.0	85.5	87.5	87.5	84.0	84.0	96.5	86.5	86.5
3.730	5.0	87.5	87.5	87.5	85.5	85.5	87.5	87.5	87.5
5.595	7.5	88.5	89.5	89.5	85.5	87.5	88.5	88.5	88.5
7.460	10.0	89.5	89.5	89.5	88.5	88.5	89.5	90.2	89.5
11.190	15.0	90.2	91.0	90.2	88.5	89.5	91.0	90.2	89.5
14.920	20.0	90.2	91.0	90.2	89.5	90.2	91.0	91.0	90.2
18.650	25.0	91.0	92.4	91.7	89.5	91.0	91.7	91.7	90.2
22.380	30.0	91.0	92.4	91.7	91.0	91.0	92.4	92.4	91.0
29.840	40.0	91.7	93.0	93.0	91.0	91.7	93.0	93.0	91.0
37.300	50.0	92.4	93.0	93.0	91.7	92.4	93.0	93.0	91.7
44.760	60.0	93.0	93.6	93.6	91.7	93.0	93.6	93.6	92.4
55.950	75.0	93.0	94.1	93.6	93.0	93.0	94.1	93.6	93.6
74.600	100.0	93.6	94.5	94.1	93.0	93.0	94.1	94.1	93.6
93.250	125.0	94.5	94.5	94.1	93.6	93.6	94.5	94.1	93.6
111.900	150.0	94.5	95.0	95.0	93.6	93.6	95.0	94.5	93.6
149.200	200.0	95.0	95.0	95.0	94.1	94.5	95.0	94.5	93.6
186.5	250.0	95.4	95.0	95.0	94.5	94.5	95.4	95.4	94.5
223.8	300.0	95.4	95.4	95.0	94.5	95.0	95.4	95.4	94.5
261.1	350.0	95.4	95.4	95.0	94.5	95.0	95.4	95.4	94.5
298.4	400.0	95.4	95.4	95.0	94.5	95.4	95.4	95.4	94.5
335.7	450.0	95.4	95.4	95.0	94.5	95.8	95.8	95.4	94.5
373.0	500.0	95.4	95.8	95.0	94.5	95.8	95.8	95.4	94.5

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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The project involves providing incentives to industrial and other large electricity users so that they replace inefficient electric motors currently in use by high-efficiency electric motors. As a result, there is reduction in motor energy consumption at the users' premises, reduced transmission and distribution losses and reduced electricity generation at power plants. Insofar as fuel consumption in some power plants are offset by the proposed project activity, carbon dioxide emissions are also reduced, compared to the baseline scenario.

Project additionality was analysed using the "Consolidated tool for the demonstration and assessment of additionality," approved and published by the CDM Executive Board at their 16th Meeting in December

2004. Details are provided in Section B.3 of this PDD. We show that there are basically two alternatives: (a) the business as usual option involving the continued use of existing electric motors until the end of their useful life and (b) the premature retirement of these motors and their replacement with high-efficiency motors. The first alternative comprises the baseline, while the latter the project scenario.

Both the baseline and the project alternative options would meet applicable laws and regulations.

Additionality is established through an analysis of barriers, as discussed in detail in Sec. B.3.

Our analysis indicates that the proposed project faces a number of barriers and its implementation would not have been considered at all if not for the possibility of emissions reductions credits. Thus, the proposed project is additional.

Estimation of the reduction in GHG emissions depends on three considerations: (a) motor energy consumption in the baseline and project scenarios; (b) transmission and distribution losses in the power grid, and (c) the emissions factor of the power grids connected to each motor user. The baseline methodology for making this determination is a new methodology being submitted with this PDD. The new methodology incorporates aspects of ACM0002 (Consolidated baseline methodology for grid-connected electricity generation from renewable sources)) as well as aspects of the methodologies for small-scale CDM projects. While the project does not involve renewable electricity generation, project electricity savings offset emissions elsewhere in the power grid in the same manner as if the project supplied renewable electricity, once transmission and distribution losses have been taken into account. This extension of a methodology developed for renewable electricity generation is both reasonable and supported by a previous decisions of the CDM Meth Panel and Executive Board. For instance, AM0014 which involves grid-connected natural gas cogeneration may use one of the approved methodologies for grid-connected renewable electricity generation.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

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The *ex ante* emissions reductions are estimated to be 568,774 tonnes CO_2e over the first 7-year crediting period, and 2,668,361 tonnes CO_2e over the entire 21-year crediting period.

A.4.5. Public funding of the project activity:

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The project sponsor, FIDE, is an Energy Savings Trust, that promotes electricity efficiency in Mexico, with revenues from various sources. It does not have any funding, from national or international sources, other than what may be generated through the CDM, in order to provide the incentives to users of electric motors to replace existing inefficient motors with high-efficiency models.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

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"Activities for the promotion of electricity efficiency, through the replacement of unitary equipment, by parties that are not the energy consumers."

This is a proposed new methodology being presented together with this PDD in the NMB template. See file "NMB_FIDE_14feb05.doc."

This new methodology incorporates parts of ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", as well as aspects of the methodologies for small-scale CDM projects.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

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The project activity is the promotion of energy efficiency by an organisation that is not the energy user. The project sponsor is FIDE ("Fideicomiso para el Ahorro de Energía Eléctrica", or Electricity Savings Trust) is precisely such an organisation. Energy users reached by the project activity could be any industrial or other large user of electricity.

Thus, the project activity is strictly within the applicability of the methodology. On the other hand, the new methodology is being proposed precisely for this type of energy efficiency promotion project.

B.2. Description of how the methodology is applied in the context of the project activity:

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The methodology is based on the case where baseline is defined in terms of "existing actual or historical emissions, as applicable", as defined in paragraph 48 (a) of CDM modalities and procedures.

The first step in applying the methodology is an evaluation of project additionality (sec. B.3, below).Then an appropriate project boundary is established (sec. B.4).

The methodology specifies that baseline and project emissions depend on the following parameters: (1) annual energy consumption of motors to be replaced; (2) annual energy consumption of replacement high-efficiency motors; (3) remaining life of motors to be replaced; and (4) emissions factor of grid-connected power plants. Annual motor energy consumption of each motor replaced depends on the number, power input, efficiency, and operating hours of each motor. The annual energy consumption depends on similar parameters for the high-efficiency replacement motor, where the power output and operating hours are assumed to remain unchanged. The remaining life of the motors removed needs to be estimated from previous data on motor life. The emissions factor for grid-connected power plants is determined using the Approved baseline methodology AM0005. This is based on the combined margin approach. Note that the procedure for determining baseline emissions rate from AM0005 was incorporated into the approved consolidated baseline methodology for grid-connected renewable energy, ACM0002. While the project in question deals with energy efficiency improvements and not grid-connected renewable electricity generation, the emissions avoided are similar, provided one takes into consideration that energy efficiency improvement also reduces transmission and distribution losses. The calculations are shown in Annex 3.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

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In December 2004, the CDM Executive Board approved and published the “Consolidated tool for the demonstration and assessment of additionality.” This document in effect interprets the requirements specified in the Marrakesh Accords of the UNFCCC with respect to the operation of the Clean Development Mechanism.[2]

The additionality tool consists of Steps 0 through 5.

Step 0 is applicable to project activities that have started before registration. It is possible that the project starts prior to registration.

Step 0 involves meeting two requirements:

a. *Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities submitted for registration before 31 December 2005 may claim for a crediting period starting before the date of registration; and*

b. *Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available to third parties at, or prior to, the start of the project activity.*

The requirement (a) itself involves two parts. The project in question has not yet started, thus its start date does not fall between 1 January 2000 and the date of registration of the first CDM project activity (late in 2004). The second part requires that the proposed project must be submitted for registration before 31 December 2005 in order for it to claim a crediting period prior to project registration.

This PDD is associated with a new methodology submission made in February 2005. The time for methodology approval as well as public comments period, project validation, etc. will determine whether the proposed project can be submitted for registration by year end. This is unlikely. Thus, the project start is likely to be deferred to 2006, and the crediting period will not be retroactive.

As far as requirement (b) is concerned, we note that the decision to proceed with the project activity has not been taken so far, pending presentation of this PDD, following extensive discussions (since early 2002) between project sponsor and CDM Consultant and other parties and analysis of how CDM could permit project execution. Supporting documentation will be presented together with the PDD when it is submitted for validation, pending approval of new methodologies submitted together with this version of the PDD.

We believe that the proposed project will either not be retroactive at all, or meet Step 0 of the additionality tool.

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[2] Decision 15/CP.7. Principles, nature and scope of the mechanisms pursuant to Articles 6, 12 and 17 of the Kyoto Protocol.

Step 1 of the tool (Identification of alternatives to the project activity consistent with current laws and regulations) comprises a number of sub-steps:

Sub-step 1a. Define alternatives to project activity.
The tool states:

> *Identify realistic and credible alternative(s) available to the project participants or similar project developers*[3] *that provide outputs or services comparable with the proposed CDM project activity*[4] *. These alternatives are to include:*
>
> - *The proposed project activity not undertaken as a CDM project activity;*
> - *All other plausible and credible alternatives to the project activity that deliver outputs and on services (e.g. electricity, heat or cement) with comparable quality, properties and application areas;*
> - *If applicable, continuation of the current situation (no project activity or other alternatives undertaken).*

The project comprises incentives so that users of electric motors replace their operating motors for high efficiency motors meeting voluntary standards as defined by FIDE Seal ("Sello FIDE"), a set of voluntary standards developed by the project sponsor to define high-efficiency equipment. Equipment covered by FIDE Seal ("Sello FIDE") includes electric motors. Complying with standards allows manufacturers to place the FIDE Seal ("Sello FIDE") label on qualifying models and for potential purchasers to identify these high efficiency models.

Besides FIDE Seal ("Sello FIDE"), which are voluntary standards, Mexico has mandatory standards (called NOM) that define the minimum efficiency levels for various energy using equipment that may be sold in Mexico. Any equipment in the categories covered by standards must meet the relevant NOM standards. Minimum efficiency standards for motors were established in 1994, and tightened in 1997 and in 2002.

While voluntary and mandatory standards have improved the efficiency of new electric motors sold in Mexico since 1994, these standards have had little effect on motors that are in use and functional. Electric motors have very long life, and even when they face problems, users may rewind or otherwise repair them and continue their use.

The proposed project activity comprises providing incentives to large energy users so that they may replace existing motors with energy-efficient models meeting the Sello FIDE standards. In the project scenario, given the proposed financial incentive, some users of inefficient electric motors would turn in their existing motors that are still in operation, and replace them with high-efficiency motors.

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[3] For example, a coal-fired power station or hydropower may not be an alternative for an independent power producer investing in wind energy or for a sugar factory owner investing in a co-generation, but may be an alternative for a public utility. Alternatives are, therefore, related to technology and circumstances as well as to the investor.

[4] For example, the outputs of a cogeneration project could include heat for on-site use, electricity for on-site use, and excess electricity for export to the grid. In the case of a proposed landfill gas capture project, the service provided by the projects includes operation of a capped landfill.

Despite a decade of mandatory standards and the existence of voluntary energy-efficiency standards, such as the FIDE Seal ("Sello FIDE"), most users are still using inefficient electric motors. They would continue to do so until the motors reach the end of their useful life. This situation represents the baseline scenario.

The project activity would not be undertaken without the CDM, since the incentives to be provided to users do not provide any economic benefits to FIDE, and the incentives can only be justified through potential CDM revenues.

There are no other credible alternatives except for those corresponding the baseline (where all users keep existing motors) and the project scenario (where some users decide to turn in their inefficient motors for new, high-efficiency motors).

Thus, there are no alternatives to the baseline or project scenarios described here.

Sub-step 1b. Enforcement with applicable laws and regulations

The consolidated tool for the demonstration and assessment of additionality states (para 2):

> *The alternative(s) shall be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution.*[5] *(This sub-step does not consider national and local policies that do not have legally-binding status.*[6]*).*

Note that the last footnote refers to "forthcoming guidance from the Executive Board on national and sectoral policies." Annex 3 of the Report of the 16th Meeting of the Executive Board starts to provide such guidance. This document defines Type E- national and/or sectoral policies as follows:

> *Type E-: National and/or sectoral policies or regulations that give positive comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs).*

The Mexican national standards for energy efficiency (denominated NOM), including those applicable to the efficiency of electric motors represent policies that fall in the category E-.

Annex 3 of EB 16 further states:

> *"Type E-" national and/or sectoral policies or regulations that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) may not be taken into account in developing a baseline scenario (i.e. the baseline scenario should refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).*

[5] For example, an alternative consisting of an open, uncapped landfill would be non-complying in a country where this scenario would imply violations of safety or environmental regulations pertaining to landfills.

[6] This aspect may be modified based on forthcoming guidance from the Executive Board on national and sectoral policies.

According to this criterion, we could set the reference efficiency levels of old motors being replaced to values prior to the enactment of national standards in 1994. If we were to take the new EB 16 criterion, energy savings and emissions reductions from the project would be significantly higher. We have chosen the more conservative approach and included the previous efficiency improvements as a part of the baseline.

Note also that the continued use of inefficient electric motors does not violate any laws or regulations. Thus the proposed project activity, to provide incentives so that users substitute their existing motors with new, efficient models, is not required to meet any regulations. Thus, additionality is not lost because of this sub-step.

The consolidated tool then offer two options: **Step 2** (Investment Analysis) or **Step 3** (Barrier Analysis), with a third option of applying both Steps.

The consolidated tool states that the purpose of Step 2 (Investment Analysis) is to determine whether the proposed project activity is the economically or financially less attractive than other alternatives without the revenue from sale of CERs.

While Step 2 was perhaps not intended to be applied to the type of project presented here, its application leads to a clear conclusion. The energy efficiency investment is made by the energy user, who also benefits economically from energy savings. The project sponsor contributes to that investment, by providing an economic incentive to the energy user, but derives no financial benefit from the investment. Thus, the application of this Step to the project sponsor, who does not derive any economic benefit from the project, is clear: the project sponsor obtains no benefits from the investment. If, however, the project sponsor is reimbursed for emissions reductions associated with the energy savings to be achieved through project implementation, then indeed the project sponsor would perceive a return on its investment, whose magnitude would depend on the relative size of the incentive to be provided, the potential energy savings and emissions reductions to be achieved, and the price of CERs. The expected incentive and reasonable assumptions (provided in Step 5 below) indicate that CER revenues can cover the cost of the providing the incentives. Thus the project sponsor can overcome the clear investment barrier through the CDM.

While we apply Step 2 Investment Analysis from the perspective of the project sponsor, we may also apply Step 3 Barrier Analysis from the perspective of the motor user.

Step 3 is Barrier Analysis.

We apply this Step for this project. We are required to show that the project faces barriers that:

(a) *Prevent the implementation of this type of proposed project activity; and*
(b) *Do not prevent the implementation of at least one of the alternatives.*

For the proposed project there are only two alternatives: (1) continued use of existing motors until the end of useful life (baseline scenario) and (2) premature replacement of existing motor with high-efficiency model (project scenario).

Step 3 also comprises two Sub-steps to analyse these two questions.

Sub-step 3a. Identify barriers that would prevent the implementation of the proposed project activity

We are required to establish that there are barriers that would prevent the proposed project activity from being carried out if the project were not registered as a CDM activity. Such barriers may include, among others:

1) Investment barriers
2) Technological barriers
3) Barriers due to prevailing practice

The proposed project activity is only applicable to those users who are still operating inefficient motors. The fact that such motors are in use, despite minimum efficiency standards for new motors in operation for a decade, points to the existence of barriers, which are likely to be a combination of investment barriers and those due to prevailing practice.

It is well known that many energy consumers invest in energy efficiency improvements when the financial returns are very high, far higher than rational discount rates for conventional investments. Thus energy efficiency frequently faces an investment barrier.

Moreover, there are also likely to be barriers whereby it is prevailing practice to not discard operating electric motors, or even rewind them when they burn out. Rewinding further reduces the efficiency of motors.

Thus, the continued existence of inefficient electric motors in use, the target of this project activity, confirms the existence of barriers.

The proposed project activity expects to overcome these barriers, through financial incentives, in a portion of the target users.

Following the application of either Step 2 or Step 3 (or both), the Consolidated Tool for Additionality require Steps 4 and 5, which are considered below.

Step 4 is Common Practice Analysis

Step 4 states:

> *"The above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region. This test is a credibility check to complement the investment analysis (Step 2) or barrier analysis (Step 3)."*

This step ensures that the stated barriers indeed have prevented similar projects from taking place. It is a credibility test on the validity of the barriers to project implementation. Step 4 comprises two Sub-Steps, which are discussed below.

Sub-step 4a. Analyse other activities similar to the proposed project activity:

1. Provide an analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects are considered similar if they are in the same country and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities are not to be included in this analysis. Provide quantitative information where relevant.

There have never been any similar activity in Mexico: providing incentives to users to replace existing motors in uses with high-efficiency models.

Sub-step 4b: "Discuss any similar options that are occurring"

For the proposed project activity, this step is not applicable, since there are no similar activities occurring.

The final step for demonstrating additionality is **Step 5. Impact of CDM Registration.**

The consolidated tool states:

"Explain how the approval and registration of the project activity as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the economic and financial hurdles (Step 2) or other identified barriers (Step 3) and thus enable the project to be undertaken."

The project sponsor, FIDE, is considering an incentive for each motor turned in for replacement of about MXN 350 (350 Mexican Pesos) per unit from 1 to 5 HP and MXN 85 *per HP* for motors from 5 to 500 HP.

As of this writing (mid-February 2005), the exchange rate is 11.14 MXN per USD, so that the incentive amounts to 7.63 USD per HP for motors from 5 to 500 HP.

Previous studies have shown that industrial motors are operated on average 6,565 hours per year.

We may conservatively assume that each motor replaced leads to a 4% energy savings. Note: The actual efficiency improvement in the substitution is expected to be 11 percentage points for small motors falling to 2.3 percentage points for large motors (over 100 HP).

Furthermore, motors to be replaced are from a vintage of 1974 to 1997, inclusive. The median-vintage motor (from 1985, say) would last till 2025, saving energy for 20 years.

Thus we may estimate lifetime energy savings to be:

Energy savings = 4% *0.746 kW/HP * 6565 h * 20 years = 3.92 MWh per HP.

In other words, for each HP motor replaced, accumulative energy savings would be 3.92 MWh.

Annex 3 provides an estimate of emissions factor for Mexico of 0.674 tCO_2/MWh considering generation as well as transmission and distribution.

Thus, emissions reduction would be 3.92 MWh/ HP * 0.674 t CO_2/MWh = 2.642 t CO_2/HP

At a CER sale price of USD 5 per tCO_2 , revenues would be 13.21 USD per HP.

For the assumptions stated, this simple calculation shows that CER revenues are likely to be sufficient to cover the costs of the incentive program including a reasonable amount of program overhead and CDM transactions costs.

Thus, we can clearly see that project registration under the CDM will permit the project sponsor to overcome its investment barrier.

CER revenues would thus permit the project sponsor to provide incentives to industrial and other large electricity users, helping some of them to turn in their inefficient electric motors for high-efficiency motors. While the magnitude to which these incentives are able to overcome the barriers can only be estimated a priori, since the project scales on a per-HP basis, the overall magnitude of incentives provided would remain proportional to the energy savings and emissions reductions to be achieved.

Thus, project registration under the CDM would also help users of inefficient motors to overcome their barriers.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

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The new methodology associated with this PDD follows the definition of project boundary proposed in connection with small-scale CDM project activities applicable to energy efficiency programs covering specific technologies:

> *"The project boundary is the physical, geographical location of each measure (each piece of equipment) installed." (Appendix B of the simplified modalities and procedures for small-scale CDM project activities: indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. Paragraph 47.)*

The project activity is the replacement of electric motors among industrial and other users. Thus, the project boundary includes all motors at their point of use in the industries.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

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Detailed baseline information is provided in Annex 3 to this PDD.

Date of completion of the baseline study: February 11, 2004.

Baseline study prepared by
Dr. Gautam Dutt and Ing. Lourdes Fernandez, MGM International, Ltda. (not a project participant).

Tel: +54-11-5219-1230
e-mail: gdutt@mgminter.com; lfernandez@mgminter.com;

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
1 June 2005.

C.1.2. Expected operational lifetime of the project activity:

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The project comprises incentives for the replacement of existing electric motors in use by new, high-efficiency motors. While new electric motors last 40 years or more, the project lifetime depends on the remaining life of the motors at the time of replacement. The incentive program is expected to last for seven years. However, regardless of when the incentive is applied and the replacement takes place, the remaining life can be expressed in terms of the date of original manufacture of each motor, if we assume a total useful life of 40 years. The proposed project divides motors into vintages according to expected efficiencies: these are 1974-1984; 1985-1994; and 1995-1997. Motors prior to 1974 will not be considered for the incentive program, since they are already close to the end of their useful life. Since motors manufactured after 1997 are already quite efficient and moreover very new, their replacement is also excluded from the proposed program.

We expect 1974-1984 motors to last till 2019 (= 1979 + 40). Thus energy savings and emissions reductions of motors manufactured between 1974 and 1984 (inclusive) to end in year 2019. Similarly, 1985-1994 motors would last till 2030. Finally, 1995-1997 motors would last till 2036 (= 1996 + 40).

Thus, the operational lifetime of the project activity would be 2019 for the replacement of motors manufactured up to and including 1984; year 2030 for motors manufactured between 1985 and 1994, inclusive; and 2036 for motors manufactured from 1995 to 1997 inclusive.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
1 January 2006. The crediting period starts later than the project activity since motors replaced in a given year are assumed to accrue energy savings from the following year. Note that this PDD depends on new methodologies. If it appears that the methodology approval process and other steps in the CDM cycle cannot be completed in order for the project to be presented for registration by 31 December 2005, then the crediting period will start following registration.

C.2.1.2. Length of the first crediting period:

>>

7 years.

C.2.2. Fixed crediting period:

NOT SELECTED.

C.2.2.1. Starting date:

>>N.A.

C.2.2.2. Length:

>>N.A.

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>

"Activities for the promotion of electricity efficiency, through the replacement of unitary equipment, by parties that are not the energy consumers."

This is a proposed new methodology being presented together with this PDD in the NMM template. See file "NMM_FIDE_14feb05.doc."

This new methodology incorporates ACM0002 "Consolidated monitoring methodology for grid-connected electricity generation from renewable sources" as well as aspects of the methodologies for small-scale CDM projects.

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

The methodology was selected in order to be applicable to projects such as that proposed here. Moreover, it is based on several approved methodologies.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P.1 i	*Category of electric motor (power output)*	*Program sponsor (FIDE) records*	*Text corres-ponding to average HP*	*See comments*	*See comments*	*See comments*	*Paper records and electronic copies*	*The data refer to the motor categories covered by the program, defined by type of motor and especially horse power.*
P.2. n_i	*Number of motors replaced in category "i"*	*Program sponsor (FIDE) records*	*units*	*m*	*monthly*	*100%*	*Paper (field) and electronic storage*	
P.3. hpn_i	*Average HP of category "i"*	*Program sponsor (FIDE) records*	*hp*	*See comments*	*See comments*	*See comments*	*Paper records and electronic copies*	*Refers to the average HP of the categories covered in the program.*
P.4. hh_i	*Efficiency of efficient motor in category "i"*	*FIDE standards*	*dimension-less*	*m*	*See comments*	*See comments*	*Electronic storage*	*Nominal values of efficiency of efficient motors as set by FIDE standards*
P.5. $EF_{elec\ gen,\ k}$	*Emissions factor for power generation*	*Comisión Federal de Electricidad (national utility)*	*kg* CO_2*/ MWh*	*c*	*annual*	*See comments*	*Electronic storage*	*Calculation to be updated annually*
P.6. TDL_k	*Transmission and*	*Comisión Federal de*	*dimension-less*	*c*	*annual*	*See comments*	*Electronic storage*	*Calculation to be updated annually*

	distribution losses in grid "k"	*Electricidad (national utility)*						

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

As stated in the methodology, project emissions *E* (tonne CO_2e/yr) are given by:

$$E = \sum_k EP_k \cdot EF_{elec\ gen,\ k} / (1 - TDL_k)$$

where

EP_k	is the total electricity purchased by all participants from the grid k, in the project scenario (e.g. MWh)
$EF_{elec\ gen,\ k}$	is the emissions factor for power generation in grid k (e.g. kg CO_2e/MWh)
TDL_k	are the transmission and distribution losses for the grid k (fraction)

Electricity purchases from each grid increases the requirement for generation at power plants supplying the grid by an amount that exceeds the magnitude of electricity consumed because of transmission and distribution losses (TDL). Values of TDL are determined for each grid involved in the project activity and summed to obtain total emissions.

The baseline methodology further states that for equipment with a fixed power input, total electricity purchase is given by the product of equipment quantity, power input, and no. of operating hours per year. Project emissions are given by:

$$E = \sum_k \left(\sum_i \left(n_i pn_i o_i \right) \right)_k \cdot EF_{elec\ gen,\ k} / (1 - TDL_k)$$

where

i = type of technology that is proposed to be replaced (e.g. 5 hp motor)

S_i = the sum over the group of "i" devices replaced (e.g. 5 hp motor), for which the replacement is operating during the year, implemented as part of the project.

n_i = the number of devices of the group of "i" devices replaced (e.g. 5 hp motor) for which the replacement is operating during the year.

pn_i = the power input of the efficient devices of group "i" (e.g. high efficiency 5 hp motor), taking into account the variation of efficiency over time; the calculation of energy consumption varies based on the type of technology. In the case of a retrofit programme, "power input" is the weighted average of the new devices.

o_i = the average annual operating hours of the devices of the group of "i" devices replaced.

k = the number of interconnected systems that supply of energy the geographic area of the base line of the project activity (MWh)

$EF_{elec\ gen,\ k}$ = the emissions factor for power generation in grid k (e.g. kg CO_2e/MWh)

TDL_k = the transmission and distribution losses for the grid k (fraction)

Electric motors may be considered to be of fixed power input, and indeed most motors are operated in such a mode. Even when motors are operated at variable load, they may be characterized by a load factor (lf) whereby

average power input $pn_i = lf\ .\ npn_i$,

where

npn_i = the nominal (full-load) power input of the efficient motor i.

The values of "i" correspond to different values of nominal power input of the motors given by:

$apn_i = 0.746\ hpn_i\ /\ \eta n_i$

where

hpn_i = average horse power of the motor in category "i",

hh_i = the efficiency of the efficient motor of this category, and

0.746 is a conversion factor from horse power to kW.

For each interconnected power grid, k, supplying electricity to the electric motors,

$EF_{elec\ gen,\ k}$ may de determined using ACM0002 or other approved methodology for grid-connected power generation.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B.1. η_i	*Efficiency of existing, inefficient motor in category "i"*	*Previous studies*	*dimension-less*	*e*	*See comments*	*See comments*	*Electronic storage*	*Nominal values of efficiency of inefficient motors as determined by a study conducted by the Instituto de Investigaciones Eléctricas.*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

Where energy consumption can be characterized by a constant power input (see section D.2.1.2), baseline emissions are given by:

$$BE = \sum_k \left(\sum_i (n_i p_i o_i) \right)_k \cdot EF_{elec\ gen,\ k} / (1 - TDL_k)$$

where the variables have the same meaning as in Section D.2.1.2, except:

p_i = Power input of inefficient motor in category "i" in use

The values of "i" correspond to different values of nominal power input of the motors.

As before, average power input $p_i = lf \cdot np_i$.

where

np_i = Nominal full-load power input of motors to be replaced

$ap_i = 0.746\ hp_i / \eta_i$

where

hp_i = average horse power of the inefficient motor in category "i" = hpn_i ,since category does not depend on efficiency.

η_i = the efficiency of the inefficient motor of this category

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

OPTION NOT USED

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Leakage would correspond to cases where participants in the incentive program would have discarded their operating motors and replaced them with new, efficient motors, without the incentive. We believe that such leakage is negligible, considering that this program addresses motors with those users who still use older, inefficient motors even after a decade of the existence of minimum efficiency standards. To reduce this risk, the program excludes the replacement of motors that are not in working condition as well as motors manufactured prior to 1974.

Another type of leakage might result if inefficient motors retired from participants' facilities continue in use, contributing to energy use and GHG emissions. Here, the program sponsor will retire and disable motors removed, with appropriate safeguards to confirm that the motors removed are no longer in a condition to consume electricity.

Another type of leakage might be where existing motors are already efficient, so that energy savings would be less than those estimated by the procedure given here. The program design eliminates this possibility by excluding the replacement of motors manufactured after 1997. Moreover, the procedure to be followed by the program sponsor (FIDE) includes a verification that the motors removed are, indeed, qualifying inefficient motors.

Section D.4 describes details of procedures to be followed in program execution, showing how leakage is eliminated. Thus, no consideration of leakage is needed for the proposed project activity.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

Not applicable -

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

Baseline and project emissions are both directly proportional to the number (n) and power input (p_i) of motors replaced.

Baseline emissions are given by:

$$BE = \sum_k \left(\sum_i (n_i p_i o_i)\right)_k \cdot EF_{elec\ gen,\ k} / (1 - TDL_k)$$

while project emissions are given by:

$$E = \sum_k \left(\sum_i (n_i pn_i o_i)\right)_k \cdot EF_{elec\ gen,\ k} / (1 - TDL_k)$$

Thus emissions reductions are given by

$$ER = \sum_k \left(\sum_i (n_i (p_i - pn_i) \cdot o_i)\right)_k \cdot EF_{elec\ gen,\ k} / (1 - TDL_k)$$

$$= \sum_k \left(\sum_i \left(n_i \cdot o_i \cdot 0.746 \cdot \frac{hp_i}{hh_i - h_i}\right)\right)_k \cdot EF_{elec\ gen,\ k} / (1 - TDL_k)$$

Emissions reductions are determined by the horse power of the motor to be replaced (hp_i), its estimated efficiency (h_i), the efficiency of the replacement high-efficiency motor (hh_i), the number (n_i) of motors replaced and their average operating hours (o_i), as well as by the emissions factor for electricity generation ($EF_{elec\ gen,\ k}$) and transmission and distribution losses (TDL).

The project comprises incentives for the replacement of existing electric motors in use by new, high-efficiency motors. While new electric motors last 40 years or more, the project lifetime depends on the remaining life of the motors at the time of replacement. The incentive program is expected to last for seven years. However, regardless of when the incentive is applied and the replacement takes place, the remaining life can be expressed in terms of the date of original manufacture of each motor, if we assume a total useful life of 40 years. The proposed project divides motors into vintages according to expected efficiencies: these are pre-1974; 1974-1984; 1985-1994; and 1995-1997. The proposed project does not cover motors manufactured before 1974, since they are already close to the end of their useful life. We expect 1974-1984 motors to last till 2019 (= 1979 + 40). Thus energy savings and emissions reductions of motors manufactured between 1974 and 1984 (inclusive) would end in year 2019.

Similarly, 1985-1994 motors would last till 2030. Finally, 1995-1997 motors would last till 2036 (= 1996 + 40). However, in both cases, the end year is beyond the total crediting period, which ends in 2026. Thus for motors manufactured from 1985 on, energy savings and emissions reductions would accrue up to 2026.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P.1 i	*None*	*Categories of motors are web defined*
P.2. n_i	*Low*	*Efficiency of existing, inefficient motors have been estimated in a previous study, and correspond to the design or nominal efficiency of these motors. We believe this to be a conservative estimate, since actual efficiency of these motors is likely to be lower, because of deterioration over time, especially if they have been rewound. Using these nominal values reduces estimated energy savings and emissions reductions.*
P.3. hpn_i	*Low*	*Power ratings of electric motors are likely to be accurate, determined and controlled by other standards. In any case, errors are likely to affect both new and existing motors.*
P.4. hh_i	*Low*	*Efficiency of new, efficient motors are based on FIDE voluntary standards. Qualifying models from various manufacturers have already been determined by manufacturer tests and verified by independent laboratory measurements.*
P.5. $EF_{elec\ gen,\ k}$	*Low*	*Determined from published data obtained from national utility.*
P.6. TDL_k	*Low*	*Determined from published data obtained from national utility.*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

Monitoring emissions reduction involves two quite different tasks:

1. monitoring electricity savings from motor replacement; and
2. determining emissions factor that permits converting electricity savings to GHG emissions reduction.

The first task will be conducted by project operator, FIDE. The second task will de undertaken by MGM International or other consulting company specialized in the development and application of CDM methodologies. The outcome of both monitoring tasks will be checked by the Designated Operational Entity selected for Verifying emissions reduction.

Below, we first describe the structure relevant for the project operator in order to monitor energy savings.

Monitoring energy savings

The General Directorate of FIDE under Ing. Mateo Treviño Gaspar has designated the FIDE Office of Programs, through its Department of Market and Energy Service Development and the Coordination of Commercial Financing Programs, to be responsible for program coordination, provide follow up to actions undertaken, collect and store program physical and electronic documentation related to the program.

The persons responsible for the project are:

- Lic. José Antonio Arteaga. Program Subdirector.
- Ing. Javier Ortega Solís. Manager of Market and Energy Service Development
- Ing. Francisco Nieto Colín. Coordinator of Commercial Financing Programs.

The program will operate nationally. It would provide a "bounty" to electricity end users who turn in their inefficient electric motors and purchase high-efficiency motors. This bounty will appear as a discount on the purchase price of the new high-efficiency motor purchase.

The energy efficient motors that would qualify in this program must have power output from 1 HP to 600 HP, meet or exceed the standards set forth in "Sello FIDE" and Mexican Official Standard NOM-016-ENER-2002 or upgrades for high-efficiency motors.

Some of the motor manufacturers that could participate in this program include Motores US de México, Baldor de México, Industrias IEM, Siemens, ABB Sistemas.

Prior to program launch, FIDE will prepare a list of makes and models that qualify as “high-efficiency” as eligible to participate in the program and replace inefficient motors that are retired from use. This list will be upgraded annually, or more frequently, incorporating modifications in the minimum efficiency requirements for qualifying in the program.

To this end, FIDE will designate Existing Motor Deposit Centres prior to program initiation. These Centres will check the following information for motors presented in order to confirm program eligibility:

- That the motor was manufactured between 1974 and 1997, inclusive. If the motor was made before 1974 or after 1997, it is not eligible to participate.
- That the motor operates on alternating current, with power between 1 HP and 600 HP.
- That the motor is in operating conditions. If not, the motor does not qualify.

If the motor is eligible, the Centre should record the follow data:

- Motor make and model
- Serial number of motor
- Motor power (between 1 HP and 600 HP)
- Year of manufacture: (a) between 1974 and 1984, inclusive; (b) between 1985 and 1994, inclusive; (c) between 1995 and 1997, inclusive.
- Name of company and its representative that is turning in the motor.

The Existing Motor Deposit Centres will keep the motor and provide a Certificate of Deposit in the name of the motor owner. These Certificates would be printed and distributed by FIDE, bearing Serial numbers. Each Certificate will record the data collected in the previous paragraph. This will permit the previous motor owner to apply to Authorized Efficient Motor Distributors in order to purchase a new, high-efficiency motor at a discount. The new motor must meet the FIDE standards for high-efficiency motors, mentioned above.

To this end, FIDE would designate Authorized Efficient Motor Distributors prior to initiating the motor replacement program. These distributors may be normal outlets for energy efficient motors or manufacturers of such motors, in either case requiring authorization by FIDE in order to qualify.

The motor owner that presents the Certificate of Deposit will have the right to purchase, at a discount, a high-efficiency motor of the power specified in the Certificate. The Authorized Efficient Motor Distributors will keep the Certificate, adding to it the following data:

- Make and model of efficient motor.
- Serial number of efficient motor.
- Motor power output (from 1 HP to 600 HP). The power output should be the same as indicated on the Certificate.

The bearer of the Certificate will have the right to purchase the high-efficiency motor at a discount determined by the motor power as listed below:

POWER	DISCOUNT
1 TO 5 HP	$350 PER MOTOR
FROM 5 TO 500 HP	$85 PER HP

Values are expressed in Mexican Pesos (MXN). In mid-February 2005, the exchange rate was 11.14 MXN per USD.

Once the motor purchase transaction is completed, the Authorized Efficient Motor Distributor will retain the Certificate of Deposit. Later, the Distributor will submit the Certificate to FIDE and request a payment corresponding to the discount given to the motor purchaser.

FIDE will also designate Inefficient Motor Destruction Agents for the removal and disabling of inefficient motors that have been turned in. These Destruction Agents may be the Existing Motor Deposit Centres or other organizations. In either case, FIDE will have to authorize them in order to qualify as Motor Destruction Agents.

The Destruction Agents will remove the inefficient motors to a storage centre and later render them unusable. This may take the form of perforating the rotor. At this time, the Destruction Agent will produce a Certificate of Equipment Destruction, including the data corresponding to the Certificate of Deposit and the date of destruction.

Each Destruction Centre will supply the Certificates of Equipment Destruction to FIDE on a monthly basis. However, the Destruction Centre will store the destroyed motor for a period of 120 days, allowing FIDE to check that the motor has indeed been destroyed.

Following the period of required storage, it may be possible to send the motors to a recycling facility where copper and other motor construction materials may be recovered for reuse.

FIDE will collect the Certificates of Deposit and Certificates of Equipment Destruction, and make sure that there is a one-to-one correspondence between them. FIDE will make periodic inspections of all authorized participants (Existing Motor Deposit Centres, Authorized Efficient Motor Distributors, and Inefficient Motor Destruction Agents) in order to check that procedures are being complied with.

Of particular importance is the destruction of inefficient motors, since energy savings require that the inefficient motors turned in do not return to use.

FIDE will collect the data on a monthly basis. However, the dates of motor deposit, destruction and sale of new motors may be spread in time. Thus a data reconciliation will need to be done on equipment carried over from one month to the next. The complete balance will be established at year end in order to determine energy savings in subsequent years as a consequence of motor replacement during the year in question.

Emission factor for electric power

The emissions factor relates energy savings to emissions reduction. This depends on the emissions factor for electricity generation as well as transmission and distribution losses. FIDE will subcontract this task to a specialized consulting company, who will follow the procedure described in Annex 3 of this PDD. Emissions factor for electricity generation will be updated yearly, while the values of transmission and distribution losses will be upgraded based on new reports from the Mexican National Power Utility (Federal Electricity Commission, CFE), Electricity Research Centre (IIE) or other reliable source.

Once the GHG emission factor for each kWh energy savings are known, the emissions reduction for each year can be readily determined, as described earlier in Section D.

D.5 Name of person/entity determining the monitoring methodology:

>>
Dr. Gautam Dutt and Ing. Lourdes Fernández, MGM International, Ltda. (not a project participant).
Tel: +54-11-5219-1230
e-mail: gdutt@mgminter.com; lfernandez@mgminter.com;

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

GHG emissions depend on energy consumption as well as the emissions factor for grid-connected power generation and transmission and distribution losses.

We consider national average values of emissions factor for power generation, and show this to be 584 kg CO_2 / MWh (see Annex 3).

Transmission losses are estimated to be 0.1334 for the first crediting period (see Annex 3).

Overall emissions factor including generation, as well as transmission and distribution losses, is given by:

$$EF_{elec\,gen,TDL} = \frac{EF_{elec\ gen}}{1-TDL} = \frac{584}{0.8666} = 674\ \text{kgCO}_2\text{/MWh}\ .$$

Baseline and project energy consumption, and therefore emissions, both depend on the number of motors to be replaced within the proposed project activity. Thus, it is easier to directly determine energy *savings* and emissions *reductions*.

E.2. Estimated leakage:

>>

No leakage is expected in this project activity.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>

Baseline and project energy consumption, and therefore emissions, both depend on the number of motors to be replaced within the proposed project activity. This methodology directly determines energy *savings* and emissions *reductions*.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

Baseline and project energy consumption, and therefore emissions, both depend on the number of motors to be replaced within the proposed project activity. This methodology directly determines energy *savings* and emissions *reductions*.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>>

As shown in Section D.2.4 of the PDD, emissions reductions are given by:

$$ER = \sum_k \left(\sum_i \left(n_i \cdot o_i \cdot 0.746 \cdot \frac{hp_i}{hh_i - h_i} \right) \right)_k \cdot EF_{elec\ gen,\ k} / (1 - TDL_k)$$

We have already seen the emissions factor corresponding to electricity generation, transmission and distribution losses.

The remainder deals with energy savings and depends on the number of motors replaced in each horse power category, and the change in efficiency brought about by the replacement.

These calculations are best done in a spreadsheet, attached: FIDE Motor Replacement Baseline.xls.

The spreadsheet first starts with an estimate of the number of motors by horse power and vintage. Motor sales data, disaggregated by horse power, are available for recent years. We extrapolated these values to as far back as 1974. While older motors may still be in operation, these motors would not qualify to participate in the proposed program, since they are already close to the end of their useful life. Thus, the ex-ante calculations go only as far back as 1974.

Moreover, motors purchased after 1997 (i.e. 1998 on) are not considered, since these are new, relatively efficient motors, and will also not be eligible to participate in the program.

Thus we only consider the replacement of motors manufactured from 1974 to 1997, inclusive.

Ex-ante estimates of energy savings and emissions reductions depend principally on estimates of the number of motors that would be replaced in the program.

The spreadsheet assumes that 10% of the eligible motors might participate in the program. The basic assumptions are as follows.

Once this percentage has been determined, energy savings calculation is entirely straightforward. We only need to note that the efficiency of the motors to be replaced depend both on the horse power as well as vintage. Eligible motors fall into three vintages: 1974-1984, 1985-1994 and 1995-1997, inclusive (see Table E.1).

E.6. Table providing values obtained when applying formulae above:

>>

Table E.1 shows efficiency levels by horse power for three vintages of motors to be replaced, as well as the efficiency levels of high-efficiency replacement motors.

Table E.1 Efficiency levels in terms of horse power and motor vintage. Efficiency levels corresponding to 1998 standards are not shown.

	Efficiency levels and corresponding standards			
Motor horse power	Vintage: 1974-1984	Vintage: 1985-1994	NOM-074-SCFI-1994. Vintage 1995-1997	"Sello FIDE" Standards. Replacement motor
1	69.0	70	74.7	81.2
1.5	73.9	75	78.4	84.0
2	74.9	76	80.3	85.3
3	76.8	78	80.8	87.6
5	78.8	80	83.6	88.8
7.5	79.8	81	85.4	90.0
10	81.8	83	86	90.9
15	83.7	85	86.5	91.4
20	84.7	86	86.8	91.8
25	85.7	87	88.4	92.3
30	86.7	88	89.4	92.9
40	87.7	89	89.5	93.4
50	88.7	90	90.4	94.0
60	89.1	90.5	90.9	94.0
75	89.6	91	91	94.5
100	90.1	91.5	91.5	94.7
125	90.6	92	91.7	95.0
150	91.1	92.5	92.1	95.2
200	91.6	93	92.7	95.3
250	*91.6*	*93*	*93*	95.3
300	*91.6*	*93*	*93*	95.4
350	*91.6*	*93*	*93*	95.5
400	*91.6*	*93*	*93*	95.7
500	*91.6*	*93*	*93*	95.8
600	*91.6*	*93*	*93*	*95.8*

Note: Values shown in italics are conservative assumptions, where official data are lacking.

For motors manufactured prior to 1985, efficiency values are considered to be 1.5% lower than values shown in the 1985-1994 column.

These values of motor efficiencies as well as estimates of energy savings and emissions reductions can be found in the attached spreadsheet: FIDE Motor Replacement Baseline.xls.

For the assumptions given, with a 10% replacement of existing motors, we estimate energy savings to be: 843.88 GWh over the first 7-year crediting period from 2006 to 2012. The corresponding emissions reductions would be 568,774 tonnes CO_2 over the same 7-year period.

Over the entire 21-year period from 2006 to 2026, energy savings would add up to 3959 GWh and emissions reductions would total 2,668,361 tonnes CO_2.

Note that these values are indicative since actual energy savings would depend on actual penetration rates of the program, and how replacement motors are distributed according to vintage and horse power. All these details form part of the monitoring plan (see Annex 4).

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

Promoting end-use energy efficiency improvement usually has only favourable environmental impact. This is indeed true for energy-efficient electric motors, which reduce local environmental impact associated with reduced electric consumption (such as local air pollution from thermal power plants) as well as reduced emissions of GHGs. Energy-efficient electric motors do not involve any toxic materials.

Note: This section may be modified if host party makes any observations.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

No significant negative environmental impact expected.

Note: This section may be modified if host party makes any observations.

SECTION G. Stakeholders' comments

>>

The stakeholder consultation process will be completed while methodology is under review.

G.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The stakeholder consultation process will be completed while methodology is under review.

G.2. Summary of the comments received:

>>

The stakeholder consultation process will be completed while methodology is under review.

G.3. Report on how due account was taken of any comments received:

>>

The stakeholder consultation process will be completed while methodology is under review.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Fideicomiso para el Ahorro de Energía Eléctrica
Street/P.O.Box:	Mariano Escobedo No.420 Col. Anzures,
Building:	
City:	Mexico City
State/Region:	Distrito Federal
Postfix/ZIP:	C.P. 11590
Country:	Mexico
Telephone:	(52) 55. 5254.3044
FAX:	(52) 55. 5254.2036
E-Mail:	
URL:	http://www.fide.org.mx
Represented by:	
Title:	Subdirector de Programas
Salutation:	Mr.
Last Name:	Urteaga
Middle Name:	Dufour
First Name:	José Antonio
Department:	Subdirección de Programas
Mobile:	
Direct FAX:	
Direct tel:	(52) 55.5545.6399
Personal E-Mail:	jose.urteaga@cfe.gob.mx

Organization:	Electric Power Development Co., Ltd.
Street/P.O.Box:	15-1, Ginza 6-Chome
Building:	
City:	Tokyo
State/Region:	Asia
Postfix/ZIP:	104-8165
Country:	Japan
Telephone:	(81.3) 3546-2211
FAX:	
E-Mail:	webmaster@jpower.co.jp
URL:	
Represented by:	
Title:	Director, Climate Change
Salutation:	
Last Name:	Nonaka
Middle Name:	
First Name:	Yuzuru
Department:	Corporate Planning and Administration Dept.
Mobile:	
Direct FAX:	(81.3) 3546-9531
Direct tel:	(81.3) 3546-9375
Personal E-Mail:	yuzuru_nonaka@jpower.co.jp

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project sponsor, FIDE, is an Energy Savings Trust, that promotes electricity efficiency in Mexico, with revenues from various sources. The project activity in question does not have any public funding, from national or international sources, other than what may be generated through the CDM. Without revenues from the sale of CERs, FIDE would not be able to provide incentives to users of electric motors so that they may replace existing inefficient motors with high-efficiency models.

Annex 3

BASELINE INFORMATION

Energy savings brought by the replacement of operating, inefficient electric motors by high-efficiency electric motors would reduce the need for electricity generation as well as transmission and distribution losses, each proportional to the energy savings to be obtained.

The emissions factor for grid-connected power generation may be determined using a number of approved methodologies, including ACM0002[7] "Consolidated baseline methodology for grid-connected electricity generation from renewable sources."

While this methodology was developed for use with CDM projects involving electricity generation using renewable sources, it is equally applicable to CDM projects involving energy efficiency, since such project activities (like renewable energy generation) do not generate emissions while they offset emissions at other power plants. One difference between renewable generation and energy efficiency improvement is that, in the latter case, transmission and distribution losses must be taken into account, as explained in the methodology accompanying this PDD, as well as in the main body of the PDD.

ACM0002 indicates that the emissions factor is a so-called "combined margin", which is determined in three steps:

1. **Calculate the Operating Margin emission factor**
2. **Calculate the Build Margin emission factor**
3. **Calculate the baseline emission factor Combined Margin** as the weighted average of the Operating Margin emission factor and the Build Margin emission factor

Step 1: Calculate the Operating Margin emission factor

Four different procedures are indicated for determining the operating margin. These are denominated:

(a) Simple Operating Margin
(b) Simple Adjusted Operating Margin
(c) Dispatch Data Analysis Operating Margin
(d) Average Operating Margin.

ACM0002 states that the Simple Operating Margin method can only be used where low-cost/must run (LCMR) resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term normals for hydroelectricity production.

ACM0002 further states:

> *Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.*

[7] Published as Annex 2 of the report of the 15th Meeting of the CDM Executive Board, Sept 3, 2004.

Electricity generation in Mexico is dominated by thermal power plants (see Table 3.1) and thus meets the eligibility requirement for the use of the Simple Operating Margin.

Table 3.1 Electricity generation by power plant type in Mexico 2001.[8]

Technology	GWh
Fuel oil or gas	89773
Combined cycle	20789
Dual (fuel oil /coal)	14109
Gas turbine	5066
Internal combustion	467
Coal	18567
Hydro	27810
Nuclear	8726
Geothermal	5567
Wind	7

Here "Fuel oil or gas" refers to steam turbines operated on either fuel. Federal Electricity Commission - CFE ("Comisión Federal de Electricidad") does not publish data on fuel efficiency of its power plants. However, it does publish total fuel consumption, by fuel type. The data corresponding to 2001 are given in Table 3.2 below.

Table 3.2. Fuel consumption for power generation in Mexico, 2001.[9]

	Quantity	Units	Energy, PJ
Fuel oil	21.952	10^6 m3	915.191
Natural gas	10.032	10^9 m3	355.329
Diesel	0.472	10^6 m3	18.252
Coal	11.398	10^6 ton	226.992
Uranium	29.419	tonne U*	96.699

IPCC (Ref. 2) provides values of Carbon emissions from fuel combustion in terms of tonnes of C per TJ. Considering a factor of (44/12) to convert from C to CO_2, we can estimate CO_2 emissions corresponding to fuel consumption in Mexico's power sector in 2001. The IPCC emissions factors and the resultant overall CO_2 emissions (in million tonnes) are given in Table 3.3 below.

[8] Source: Federal Electricity Commission ("Comisión Federal de Electricidad"), Annual Report, 2001

[9] Source: *op. cit.*

Table 3.3. Energy consumption and CO_2 emissions from fuel combustion in thermal power plants in Mexico, 2001.[10]					
	Quantity	Units	Energy use PJ	Emissions factor t C / TJ	CO_2 emissions million tonnes
Fuel oil	21.952	10^6 m3	915.191	21.1	70.81
Natural gas	10.032	10^9 m3	355.329	15.3	19.93
Diesel	0.472	10^6 m3	18.252	20.2	1.35
Coal	11.398	10^6 ton	226.992	26.2	21.81
Uranium	29.419	tonne U*	96.699	0	0
Total					**113.90**

Excluding low-cost /must run electricity generation (hydro, nuclear and wind power), total generation of 148,771 GWh required emissions of 113.9 MT CO_2. This gives an emissions factor of 766 kg CO_2 per MWh.

The above estimate was based on IPCC values of the carbon content of fuels rather than national values. This value may be checked against a national estimate from data published in the annual report called Electric Sector Outlook ("Prospectiva del Sector Eléctrico") of the Energy Ministry ("Secretaría de Energía"). This report provides data both on generation by source as well as CO_2 emissions. The operating margin emissions rate (excluding specified zero and low-cost sources) was 0.764 tCO_2/MWh. We use this value as the Operating Margin emissions factor.

Step 2: Calculate the Build Margin emission factor

According to ACM0002, the build margin is determined by the average emissions factor of a sample of recently built power plants. The sample may be the most recent five power plants built if they add up to more than 20% of the total generation in the grid. If not, the sample must include enough of the most recently built power plants in order that together they represent at least 20% of the total generation.

In the year 2001 (the last year for which the Prospectiva gives data), 96% of new capacity was natural gas combined cycle (NGCC). In fact, until 2006, the Secretaría de Energía (SENER) anticipates that most power plants to be added to the system would be NGCC as well. Therefore, NGCC power plants are reasonably representative of recent trends in new generation capacity.

Assuming an efficiency of 50%, natural gas consumption would be 7.2 TJ/GWh.[11] Considering an CO2 emissions factor from natural gas combustion of 56.1 kg CO_2/GJ, we have 404 kg CO_2 per MWh.

Thus an estimate for the build margin emission factor in the main Mexican grid would be 404 kg CO_2 per MWh.

[10] Source: *op. cit.* and IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual. Vol. 3. Intergovernmental Panel on Climate Change (1995).

[11] In unit conversion terms, 1 GWh = 3600 GJ = 3.6 TJ. If efficiency were 50%, twice the amount of fuel would be required per unit of electricity.

Step 3. Calculate the baseline emissions factor.

The consolidated methodology ACM0002 indicates that the emissions factor is a weighted average of the operating margin and the build margin, suggesting a 50/50 weighting. If we use such a weighting, the emissions factor for electricity generation would be :

$$EF_{elec\ gen} = \frac{764 + 404}{2} = 584 \text{ kg } CO_2\text{/MWh}$$

This is the emissions factor used for ex-ante estimates of emissions reduction. We recommend that this value be updated annually for monitoring purposes using the most recent data available at the time of analysis.

Electricity transmission and distribution losses

A report by the national power utility CFE (Federal Electricity Commission) provides projections for the electric power sector in Mexico up to 2010.[12] The data in the report allows us to determine the transmission and distribution losses in the electric power grid

The cited report includes two tables with information on transmission losses. The first set of data includes the entire power sector including independent power producers, while the second is limited to the part operated by the national utility, Federal Electricity Commission (CFE).

The two sets of data are translated and reproduced below:

Year	Power sector	Federal Electricity Commission
1996	15.91	14.85
1997	15.75	14.35
1998	15.81	14.08
1999	15.79	13.81
2000	15.41	13.38
2001	15.48	13.43
2002	15.37	13.27
2003	15.40	13.23
2004	15.44	13.28
2005	15.40	13.27
2006	15.49	13.45
2007	15.36	13.34
2008	15.38	13.41

[12] "Desarrollo del Mercado Eléctrico 1996-2010" (Projections of the Electric Power Market in Mexico, 1996-2010). Report of the Federal Electricity Commission (CFE, "Comisión Federal de Electricidad").

2009	15.28	13.33
2010	15.24	13.31
Av. 2004-2010	15.37	13.34

We see a slightly decreasing trend for losses in both lists. The numbers for the Electric Sector ("Sector Eléctrico") are about 2 points higher than that for CFE, for the relevant part of the table, from year 2004 to 2010. The 2004-2010 averages are 15.37 and 13.34. To be conservative, we consider the latter figure: **transmission and distribution losses are assumed to be 13.34% in this PDD.**

Thus, TDL = 0.1334.

This emissions factor is an average estimate for 2004-2010. Since the value is unlikely to fall much further, we recommend that this value of TDL be used for the entire crediting period. This would simplify calculations, without adding a significant amount of error.

Separate grids (k) serving Mexico

We have so far determined a single value for electricity generation in Mexico and a single value for transmission and distribution losses. In principle, these values will be different for each power grid.

Mexico's electric power grid is shown in Figure 3.1. Most electricity users are served by the main power grid. Northern Baja California and the Yucatan Peninsula are weakly connected to this grid, while Southern Baja California is an independent system depending on diesel generators.

The weakly connected grids and especially Southern Baja California have higher than average emissions rate for power generation, and are likely to have higher transmission and distribution losses as well. For simplicity, we choose to take the conservative assumption and consider the national average values to be applicable everywhere. Thus we use a single value of "k" in $EF_{elec\ gen,\ k}$ and TDL_k .

Overall emissions factor including generation, as well as transmission and distribution losses is given by:

$$EF_{elec\,gen,TDL} = \frac{EF_{elec\ gen}}{1 - TDL} = \frac{584}{0.8666} = 674\ \text{kgCO}_2\text{/MWh} .$$

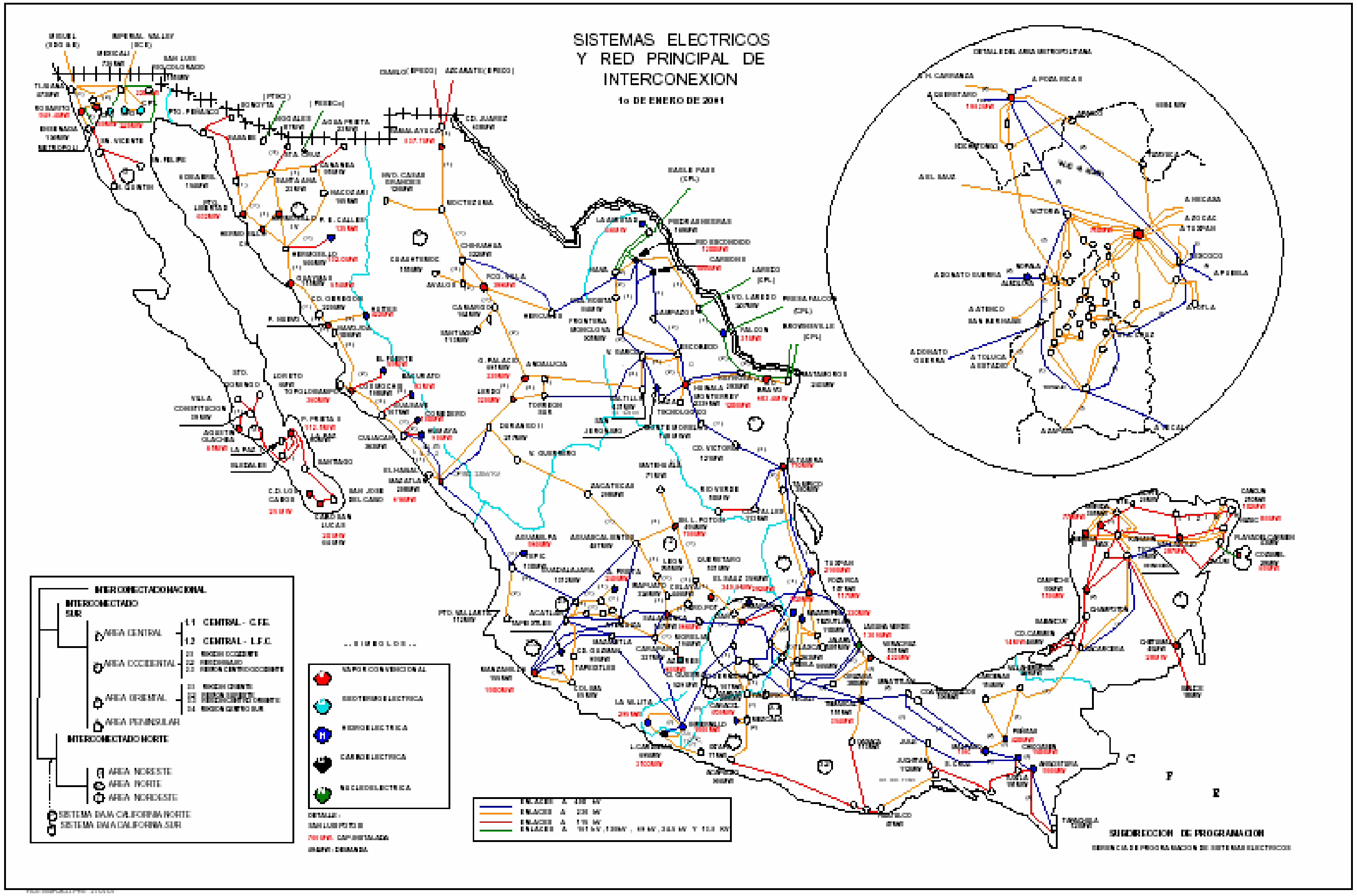

Figure 3.1 is a map of Mexico, indicating the electric power transmission lines. It can be seen that the southern part of the Baja California peninsula, at the West of the map, comprising the state of Baja California Sur (BCS) is isolated from the rest of the national grid.

(Source: Federal Electricity Commission. Projections of the Electric Power Market in Mexico, 1996-2010 ("Comisión Federal de Electricidad, Desarrollo del Mercado Eléctrico, 1996-2010.")

Annex 4

MONITORING PLAN

As shown in Section D.2.4 of the PDD, emissions reduction are given by:

$$ER = \sum_k \left(\sum_i \left(n_i \cdot o_i \cdot 0.746 \cdot \frac{hp_i}{\eta h_i - \eta_i} \right) \right)_k \cdot EF_{elec\ gen,\ k} /(1 - TDL_k)$$

Monitoring is required for the following purposes:

- To determine energy savings to be achieved through electric motor replacement.
- To determine the emissions factor for power generation.

Once these two quantities have been determined, the emissions reductions can be directly estimated, without the need to estimate, separately, baseline and project emissions.

The monitoring plan for the two items is described below.

Energy savings from electric motor replacement

Energy savings are given by terms such as:

$$ES_i = n_i \cdot o_i \cdot 0.746 \cdot \frac{hp_i}{\eta h_i - \eta_i}$$

where the subscript "i" stands for motor power. Thus, hp_i will have values from 1 HP to 600 HP. ηh_i and η_i correspond to the efficiency of the replacement (high-efficiency) motor and the original inefficient motor, respectively, for the motor power hp_i. n_i is the number of motors of power hp_i replaced and o_i is the average number of hours per use of each motor.

In the proposed monitoring plan, average operating hours are based on previous studies, and it is this estimated average value that would be used, so monitoring is not needed to establish o_i. Moreover, o_i is a constant, equal to 6565 hours for all motor sizes.

For each motor replaced (and destroyed), thus we need to know its horse power, an estimate of its efficiency, the efficiency of the replacement motor. While the efficiency of the replacement motor is determined exclusively by its horse power, defined by the FIDE standards (see Table 4.1), the efficiency of the operating motor will depend on its vintage, with three options: from 1974 to 1984, from 1985 to 1994, and from 1995 to 1997. Motors prior to 1974 will not be considered for the incentive program, since they are already close to their useful life. Efficiency standards for motors were set in 1994 (for application in 1995) and upgraded in 1998 and again in 2002. Since motors manufactured after 1997 are already quite efficient and moreover very new, their replacement is also excluded from this program.

Table 4.1 Efficiency levels in terms of horse power and motor vintage. Efficiency levels corresponding to 1998 standards are not shown.				
	Efficiency levels and corresponding standards			
Motor horse power	Vintage: 1974-1984	Vintage: 1985-1994	NOM-074-SCFI-1994. Vintage 1995-1997	"Sello FIDE" Standards. Replacement motor
1	69.0	70	74.7	81.2
1.5	73.9	75	78.4	84.0
2	74.9	76	80.3	85.3
3	76.8	78	80.8	87.6
5	78.8	80	83.6	88.8
7.5	79.8	81	85.4	90.0
10	81.8	83	86	90.9
15	83.7	85	86.5	91.4
20	84.7	86	86.8	91.8
25	85.7	87	88.4	92.3
30	86.7	88	89.4	92.9
40	87.7	89	89.5	93.4
50	88.7	90	90.4	94.0
60	89.1	90.5	90.9	94.0
75	89.6	91	91	94.5
100	90.1	91.5	91.5	94.7
125	90.6	92	91.7	95.0
150	91.1	92.5	92.1	95.2
200	91.6	93	92.7	95.3
250	*91.6*	*93*	*93*	95.3
300	*91.6*	*93*	*93*	95.4
350	*91.6*	*93*	*93*	95.5
400	*91.6*	*93*	*93*	95.7
500	*91.6*	*93*	*93*	95.8
600	*91.6*	*93*	*93*	*95.8*

Note: Values shown in italics are conservative assumptions, where official data are lacking.

For motors manufactured prior to 1985, efficiency values are considered to be 1.5% lower than values shown in the 1985-1994 column.

The number of motors removed for replacement should also be noted, by horse power category as well as by vintage, completing a Table such as 4.2 for each year the program is operational.

Table 4.2. Numbers of motors replaced by horse power and motor vintage. Complete for each year of program			
Motor horse power	Vintage 1974-1984	Vintage 1985-1994	Vintage 1995-1997
1			
1.5			
2			
3			
5			
7.5			
10			
15			
20			
25			
30			
40			
50			
60			
75			
100			
125			
150			
200			
250			
300			
350			
400			
500			
600			

Once these data are available, annual energy savings may be calculated. Note that energy savings are considered from the year following the year of motor replacement. Thus energy savings from all motors replaced in 2007 would be counted from 2008 on.

Emissions factor for grid-connected power generation

The monitoring requirements correspond to the Approved consolidated monitoring methodology ACM0002 "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources."

ACM0002 refers to grid-connected renewable energy projects and requires the monitoring of:

- Electricity generation from the proposed project activity;
- Data needed to recalculate the operating margin emission factor, if needed, based on the choice of the method to determine the operating margin (OM), consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
- Data needed to recalculate the build margin emission factor, if needed, consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);

The operating margin emissions factor may be determined in a manner such as shown in Annex 3. We recommend that a value be estimated annually based on the most recent annual values available of energy generation by power plant and fuel consumption by type of fuel.

The calculation is aided by completing Tables 4.3 and 4.4.

Table 4.3 Electricity generation by power plant type in Mexico for each year of data.	
Technology	GWh
Fuel oil or gas	
Combined cycle	
Dual (fuel oil /coal)	
Gas turbine	
Internal combustion	
Coal	
Hydro	
Nuclear	
Geothermal	
Wind	
TOTAL	

Table 4.4. Fuel consumption for power generation in Mexico and CO_2 emissions, for the same year of data as Table 4.3.					
	Quantity	Units	Energy PJ	Emissions factor t C / TJ	CO_2 emissions million tonnes
Fuel oil		10^6 m3		21.1	
Natural gas		10^9 m3		15.3	
Diesel		10^6 m3		20.2	
Coal		10^6 ton		26.2	
Uranium		tonne U*		0	
TOTAL					

By dividing total CO_2 emissions in Table 4.4 by total generation in Table 4.3, the emissions factor for electricity generation can be readily determined for each year of data.

Determining the build margin emissions factor requires similar data as above, except, in this case we also need the date each new power plant comes on line. We need to obtain date on the total generation of the most recent five power plants, or as many as are needed until we reach 20% of the total generation for the year in question. The procedure described in the previous Annex will need to be repeated for each year of crediting period.

Once operating margin and build margin emissions factors have been determined, the combined margin emissions factor may be readily determined as the arithmetic mean of the two values, as was shown in Annex 3, for *ex-ante* determination of this emissions factor.

Emissions reductions

Once the annual energy savings and emissions factor for grid-connected electricity generation have been determined, annual emissions reductions can be readily determined.

The project comprises incentives for the replacement of existing electric motors in use by new, high-efficiency motors. While new electric motors last 40 years or more, the project lifetime depends on the remaining life of the motors at the time of replacement. The incentive program is expected to last for seven years. However, regardless of when the incentive is applied and the replacement takes place, the remaining life can be expressed in terms of the date of original manufacture of each motor, if we assume a total useful life of 40 years. The proposed project divides motors into vintages according to expected efficiencies: these are pre-1974; 1974-1984; 1985-1994; and 1995-1997. The proposed project does not cover motors manufactured before 1974, since they are already close to their useful life. We expect 1974-1984 motors to last till 2019 (= 1979 + 40). Thus energy savings and emissions reductions of motors manufactured between 1974 and 1984 (inclusive) to end in year 2019.

Similarly, 1985-1994 motors would last till 2030. Finally, 1995-1997 motors would last till 2036 (= 1996 + 40). However, in both cases, the end year is beyond the total crediting period, which ends in 2026. Thus for motors manufactured from 1985 on, energy savings and emissions reductions would accrue up to and including 2026.

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