



# FIRST BIENNIAL UPDATE REPORT TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

## EXECUTIVE SUMMARY





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THE UNITED NATIONS FRAMEWORK  
CONVENTION ON CLIMATE CHANGE

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# EXECUTIVE SUMMARY

## I. NATIONAL CIRCUMSTANCES

For Mexico, a country highly vulnerable to climate change and which is responsible for 1.4% of global greenhouse gas emissions, climate change is a public policy priority (IEA, 2014). Therefore, the nation is promoting inclusive green growth and aspires to achieve a binding international agreement under the United Nations Framework Convention on Climate Change (UNFCCC).

Mexico is a country in North America with an area of 1,964,375 km<sup>2</sup>, making it the thirteenth largest nation in area worldwide (INEGI, 2014a). In 2013, it had 118,390,000 inhabitants, 51.17% of whom were female and 48.83% male (CONAPO, 2013). With these, it was the eleventh most populous country with 1.72% of the world's people (Banco Mundial, 2014b). Economically active population (EAP); represented 43.96% of this group 4.93% is unemployed (INEGI, 2014b). In the last few decades, Mexico has transformed into a predominantly urban country where tourist cities and border cities have shown the greatest growth (CONAPO, 2012).

Mexico had the fifteenth highest gross domestic product (GDP) in the world in 2013 (Banco Mundial, 2014a) and had a GDP of 13.425 trillion pesos at 2008 constant

value (1.3 trillion USD)<sup>1</sup>, and an average GDP per capita of 135,790 pesos. In 2013, it was in 71st place out of 187 countries in the HDI classification made by the United Nations Development Programme (UNDP), 45.5% of the total national population was in poverty in 2012.<sup>2</sup>

GDP contribution by sector was as follows: primary (3.0%), secondary (33.6%), tertiary (60.8%), and 2.6% related to net product taxes (INEGI, 2014b); these sectors employed 13.7%, 23.8%, and 62% of the EAP, respectively; 0.59% was reported as unspecified (INEGI, 2014c).

Mexico is one of the designated “megadiverse” countries. On Mexican soil, almost all types of vegetation that exist in the world are found, and they are inhabited by thousands of species from diverse taxonomic groups, many of which display high genetic variability. Among the country's main ranges of natural ecosystems are xeric scrublands (29.7% of the territory), temperate forests (17.7%), tropical forests (16.5%), and grasslands (16.0%). It is worth noting that Mexico is making important efforts to conserve and use its natural resources and biodiversity sustainably; however, the processes of degradation and loss of aquatic and land ecosystems are still occurring.

The geographic situation of Mexico makes it a country highly vulnerable to the effects of climate change

<sup>1</sup> Taking into account an exchange rate (end of 2013 period) of 13.08 pesos per USD (Banxico, 2014a).

<sup>2</sup> The National Assessment Council for Social Development Policy (CONEVAL, per its Spanish initials) defines population in situation of poverty as that which has at least one social deprivation and an income below the wellbeing line value. The wellbeing line equals the total value of the food basket and non-food basket per person per month (CONEVAL, 2013). It is suggested to consult the following link for the monthly value of the wellbeing line <http://www.coneval.gob.mx/Medicion/Paginas/Lineas-de-bienestar-y-canasta-basica.aspx>

given its location between two oceans, its latitude, and topography that expose it to extreme meteorological phenomena. Furthermore, poverty and the reliance of the poor on primary activities are contributing factors to social vulnerability in Mexico.

The most recent climate change scenarios, constructed by using results from 15 climate models, indicate that, on average, precipitation will decrease up to 10% and the temperature could rise between 1 and 1.5 °C on the majority of Mexican soil in the next 25 years<sup>3</sup>.

These figures indicate the challenge that the effects of climate change represent for Mexico and the need for the country to commit to implementing mitigation and adaptation actions alike.

In relation to the energy sector, primary energy production in 2013 amounted to 9025.75 petajoules (PJ), with 88% from hydrocarbons, making these the main source of primary energy in the country<sup>4</sup> (SENER, 2014). Oil production was at 2.52 million barrels per day and natural gas production was at 6,370 million cubic feet per day (MMcfd); 47.2% of the oil produced was exported and the rest went to refineries (SENER, 2013). As of January 1, 2014, Mexico had a level of total conventional hydrocarbon reserves of 42,158.4 million barrels of oil equivalents (mmboc) and, in 2012, 60,200 mmboc of unconventional resources were estimated<sup>5</sup>, specifically shale oil or shale gas. In 2013, the gross output of secondary energy totaled 5,659.55 PJ (SENER, 2014). The national energy consumption in 2013, equal to the total gross domestic energy supply<sup>6</sup>, stood at 9017.37 PJ; 85.6% was of hydrocarbons, 7.1% was of renewable energy, and the remainder was of coal and nuclear power. The transportation sector is one of the main energy consumers in Mexico. In 2013, it constituted 44.5% (2,305 PJ) of energy consumption. Industrial activity is the second

largest consumer of energy. It is also the second most important, owing to its contribution to the national GDP. In 2013, it represented 32.6% (1,612.31 PJ) of energy consumption (SENER, 2014; INEGI, 2014a).

Owing to the extent of its forest cover, Mexico was in twelfth place worldwide in 2010 according to the most recent report of the Food and Agriculture Organization of the United Nations (FAO, 2011). The average forest cover affected by fires has been 317,869 ha per year (8,717 fires/year) from 1998 to 2013. This phenomenon has been accentuated during long periods of deficit in precipitation and soil moisture, conditions which would be exacerbated under climate change.

In the agriculture and livestock sector, Mexico is the eighth global producer of food. It occupies one of the top ten positions worldwide in 58 agriculture and livestock products; however, domestic production is barely enough to supply the domestic market demand of some staple foods. Annually, 22 million ha on average are dedicated to agricultural activities – 26% have an irrigation system and 74% are cultivated in the temporary regime. The area where Mexico's six strategic staple crops (rice, beans, corn, wheat, soybeans, and sorghum) as well as sugarcane were grown was 13 million ha in 2013; whereas, of the 4.94 million tons of fertilizer consumed in 2012, 1.93 million tons were produced in the country.

The area dedicated to livestock is estimated at nearly 110 million ha with reported livestock populations in 2013—in millions of heads—, of 32.40 bovines, 2.41 of which were for dairy; 16.20 pigs; 8.66 goats; 8.49 sheep; and 528.05 poultry.<sup>7</sup>

In 2013, 117,258 tons/day (42.79 million tons/year) of municipal solid waste (MSW) were generated. Waste generation per capita was 0.852 kg/person/

<sup>3</sup> Source: <http://escenarios.inecc.gob.mx/>

<sup>4</sup> The contribution of coal, nuclear energy, and renewable energy complement the 100%.

<sup>5</sup> The sum of the parts may not correspond to the totals because of the rounding of the figures.

<sup>6</sup> The gross domestic supply is the sum of production, other sources, imports, and changes in inventories, minus exports and net maquila export operations.

<sup>7</sup> Source: Agri-Food Consultation Information System (SIACON, per its Spanish initials) of the Agri-Food and Fishery Information Service (SIAP, per its Spanish initials) of the Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food (SAGARPA, per its Spanish initials).

day or 311 kg/person/year (INECC, 2012b). Of this, 66% was disposed of in landfills or controlled sites and 18% in open dumps. With respect to wastewater, 210,010 liters/second of municipal wastewater were collected in the same year, or 91.5% of the flow generated that year. Of the water collected, 50.4% was treated at 2,287 municipal wastewater treatment plants (WWTP).<sup>8</sup> 60,751.9 liters/second of industrial wastewater were also treated at 2,610 WWTP.

In 2013, 125.1 Gg of black carbon (BC) were accounted for. Mobile sources were the main sector that contributed to BC emissions (37.8%), followed by the industrial sector with 28.3%, which was mainly due to burning bagasse at sugarcane mills. The residential and commercial sector accounted for 15.2%, owing to home fuelwood burning.

As part of efforts to mitigate emissions of short-lived climate pollutants (SLCPs), the country is a founding member of the voluntary association, the Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants (CCAC). At the high-level meeting of the CCAC in the middle of September 2014 in New York City, Mexico left its role as member of the CCAC executive committee after its yearly period was finished; however, it retains an active role in its different initiatives and working groups. For that purpose, the National Institute of Ecology and Climate Change (INECC, per its Spanish initials) promotes the establishment of an SLCP unit for the Institute that supports better performance in the country in the different CCAC initiatives, particularly those related to regional assessment for Latin America and the Caribbean and developing the second phase of support for the Strategic National Action Plan (SNAP) on SLCPs, among others.

## II. INSTITUTIONAL ARRANGEMENTS

The regulatory and legal framework that supports the alignment of public policies and the coordination of institutional arrangements on climate change in Mexico stems from the General Law on Climate Change (LGCC, spanish acronym), the National Development Plan 2013-2018 (PND, spanish acronym), and the Sectorial Program of Environment and Natural Resources 2013-2018 (PROMARNAT, per its Spanish initials).

The LGCC, which came into force in October 2012, sets aspirational goals for Mexico with regard to mitigation<sup>9</sup>, such as reducing emissions by 30% by 2020 and increasing the percentage of electricity generated by clean energy sources to 35% by 2024, among others. The PND goal, “Prosperous Mexico,” establishes the following in objective 4.4: “Encourage and guide inclusive and enabling green growth to preserve our natural heritage while generating wealth, competition and employment.” In the lines of action for strategies 4.4.1, 4.4.3, and 4.4.4 of this objective, mitigation and adaptation to climate change are addressed specifically.

As part of the institutional structure set out by the LGCC, the Inter-Secretariat Commission on Climate Change (CICC, per its Spanish initials) was permanently established<sup>10</sup>. The Council on Climate Change (C3), a permanent consultative body of the CICC, was instituted. The INECC and the National Climate Change System (SINACC, per its Spanish initials) were created to achieve effective coordination between the three levels of government and cooperation between the public, private, and social sectors on the issue of climate change.

<sup>8</sup> Source: INECC with data from the National Water Commission (CONAGUA, per its Spanish initials), June 2014.

<sup>9</sup> The goals mentioned can be reached if an international regime is established, including financial and technological support from developed countries for developing countries. These goals will be reviewed when the next National Climate Change Strategy (ENCC, per its Spanish initials) is published.

<sup>10</sup> The LGCC also anticipates the creation of six working groups that will have sessions in the CICC’s framework: I. PECC Working Group; II. Working Group for Adaptation Policies; III. Working Group on Reducing Emissions from Deforestation and Forest Degradation; IV. Working Group on Mitigation; V. Working Group for International Negotiations on Climate Change, and, VI. Mexican Committee for projects to reduce emissions and capture greenhouse gases.

The SINACC also integrate, other institutional structures envisaged by the same Law, such as the federal entities (states), associations of municipal authorities, and the Congress of the Union, (Figure 1).

Regarding the CICC, it is chaired by the head the federal executive branch, who may delegate this role to the head of the Secretary of Government (SEGOB, per its Spanish initials) or the Secretariat of Environment and Natural Resources (SEMARNAT, per its Spanish initials). It is a commission permanent in nature in compliance with the LGCC, and it has the mandate to formulate and implement national climate change policy by consulting and arranging for it with the social and private sectors. At the CICC participate 14 of the 18 Secretariats of the Federal Government.

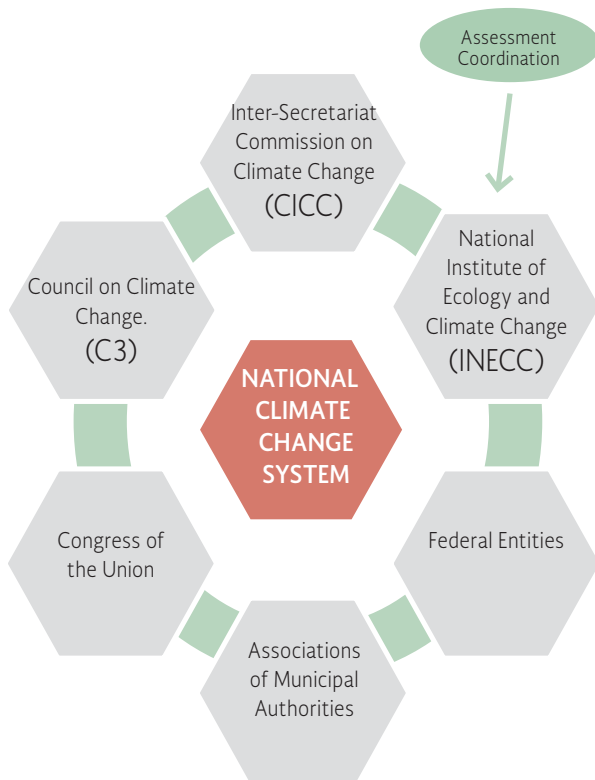
INECC, a decentralized public agency of the federal government sectored in the SEMARNAT according to the provisions of the LGCC, is in charge of generating technical inputs for decision making; coordinating a mainstreaming agenda that allows for convening

national and international public and private academic institutions and research institutions to develop scientific research on ecology, climate change, environmental sustainability, green growth, and the environment; as well as integrating the National Communications that Mexico presents to the UNFCCC and the development of the National Greenhouse Gas Inventory (INEGI, per its Spanish initials), with the INECC as the focal point of Mexico on the Intergovernmental Panel on Climate Change (IPCC).

The guiding instruments for planning national policy on climate change set out in the LGCC are the National Climate Change Strategy (ENCC, per its Spanish initials), with a vision for the next 10, 20, and 40 years, and the Special Climate Change Program (PECC, per its Spanish initials) 2014-2018, which establishes five objectives, 26 strategies, and 199 committed lines of action with an allocated budget. Of the PECC actions, 81 are emissions mitigation actions, 77 are adaptation actions, and 41 are related to climate change policy instruments. It incorporates ten performance indicators with the 2013 baseline, a goal for 2018, and a methodology for its calculation. Similarly, the 14 Secretariats of the CICC have implemented strategies and action plans in their sectorial programs to address mitigation and adaptation to climate change.

The governments of the 32 federal entities (states) and some of the 2,457 municipalities, in collaboration with SEMARNAT and INECC, are at different stages of development and integration of greenhouse gas (GHG) emission inventories within their jurisdiction, and in the development of state and municipal climate change programs consistent with the ENCC and PECC.

FIGURE 1 • SINACC Structure





### III. MEXICO NATIONAL GREENHOUSE GASES INVENTORY

#### ACTIONS TO STRENGTHEN THE INEGEI

Mexico has made progress in integrating climate change issues into national policy. For that reason, various instruments have been created to strengthen the development of the INEGEI with a view toward its systematization and continuous improvement, among which include:

- LGCC
- The INEGEI as information of national interest
- A single inventory project

With respect to strengthening inventory development, a significant effort has been made to improve the resolution and relevance of the figures reported in this INEGEI. In the case of 2013 emissions, significant improvements in practically all categories of emissions were achieved.

Therefore, it formed the basis for the analyses that support the Intended Nationally Determined Contribution (INDC) that Mexico submitted to the UNFCCC during the first quarter of 2015 in preparation for the 21st Conference of the Parties (COP21) and the new binding agreement to which the international community aspires. The 2013 INEGEI is based on the most current information, disaggregated data, and estimated with emission factors (EFs) according to national circumstances.

#### NATIONAL GREENHOUSE GAS INVENTORY 2013

Mexico presents its estimate of emissions corresponding to the year 2013 in the main sectors of the national economy below. The sectors analyzed are electricity generation; oil and gas; on-road and non-road

mobile sources; industry; agriculture; land use, land use change, and forestry (LULUCF); waste; and the residential and commercial sector.

In Mexico, total GHG emissions in 2013 were 665,304.92 Gg of CO<sub>2</sub>e. This refers to emissions resulting from the activities of the different sectors, excluding removals through LULUCF permanence. Net emissions, including removals through permanence, were 492,307.31 Gg of CO<sub>2</sub> equivalents (CO<sub>2</sub>e) (see Figure 2 and Table 2).<sup>11</sup>

#### Electricity Generation

In the sector of electricity generation, emissions reported include the use of fossil fuels from power plants operated by the Federal Electricity Commission (CFE, per its Spanish initials) and the Independent Power Producers (IPP) which provide electrical energy to the public sector. The gases reported for this sector are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) from fuel consumption in the following technologies: coal fired power, combined cycle, internal combustion, dual power, thermoelectric power, and gas turbines. In 2013, the electricity generation sector contributed 126,607.66 Gg of CO<sub>2</sub>e, corresponding to 19.0% of total GHG emissions nationally.

The 2013 inventory for this sector, compared to the 1990–2012 historic series estimate, has greater disaggregation of data by activity, as fuel use reports for all generating public service plants and independent production plants that exist in Mexico were used along with EFs —related to the technologies used— that fit the current national circumstances.

In the 2010–2013 period, the actual installed capacity of electricity generation serving the public grew by 551 MW (6.8%), which considers the commissioning of combined cycle and wind plants, as well as the withdrawal of conventional thermal power plants and gas turbines. In the same period, to a lesser extent, electricity generation increased by 16.4 TWh (1%).

<sup>11</sup> In the data presented in this document, the sum of the parts may not correspond to the totals because of the rounding of the figures.

TABLE 1 • Emissions of greenhouse gases and black carbon by sector and subsector in 2013

SECTOR / SUBSECTOR	GHG	BC
	Gg of CO <sub>2</sub> e	Gg
Mobile Sources	174,156.53	47.34
Motor Vehicles (gas)	88,456.25	0.71
Motor Vehicles (diesel)	64,434.79	30.07
Construction Machinery	749.33	0.76
Agricultural Machinery	9,087.30	13.93
Aviation	2,103.87	0.95
Maritime	2,164.83	0.69
Railroad n	7,160.20	0.23
Electricity Generation	126,607.66	8.46
Coal-fired power plant (Di+Ca)	17,310.02	0.35
Combined cycle power plant CFE (Di+NG)	17,805.71	0.20
Internal combustion engines (Co+Di)	945.36	0.74
Dual power plant (Di+Ca)	17,561.13	0.04
Thermoelectric (Co+Di+NG)	34,010.10	6.66
Thermoelectric + CC (GN)	3,757.95	0.04
Turbo gas power plant (Di+NG)	2,002.15	0.06
Combined cycle + PIE (Di+NG)	33,215.24	0.37
Residential and commercial	25,639.35	19.01
Residential LPG	16,092.19	0.05
Residential querosinas	95.85	
Residential natural gas	1,888.71	0.06
Residential wood	2,524.28	18.87
Commercial LPG	4,088.82	0.01
Commercial diesel	322.91	0.01
Commercial natural gas	626.59	0.02
Oil and Gas	80,455.26	2.17
PEMEX Exploration and Production - PEP (for its acronym in Spanish)	23,067.12	1.88
PEMEX Petrochemical -PPQ (for its acronym in Spanish)	6,285.812	0.01
PEMEX Gas and Basic Petrochemical - PGPB (for its acronym in Spanish)	5,536.36	0.07
REFINEMENT	15,578.29	0.20
Other emissions (including other fugitive)	29,987.68	
Industry	114,949.19	35.42
Cement - combustion	9,715.76	0.03
Cement - process	20,508.89	< 0.01
Line - combustion	931.35	
Lime- process	3,281.93	
Steel - combustion	15,008.92	0.10
Steel- process	8,783.47	
Chemical - combustion	7,991.93	0.07
Chemical- process	228.71	

SECTOR / SUBSECTOR	GHG	BC
	Gg of CO <sub>2</sub> e	Gg
Others for energy consumption *	30,430.00	35.21**
Consumption of other carbonates	1,833.70	
Production of Halocarbons – Process	2,402.91	
Consumption of SF <sub>6</sub> Halocarbons – Process	4,252.84	
Coal Mines – Fugitive Emissions	9,578.77	
<b>Agriculture and Livestock</b>	<b>80,169.09</b>	<b>8.86</b>
Enteric Fermentation	51,208.13	
Manure Management	13,735.52	
Agricultural Soils	13,298.63	
Agricultural Burning	1,330.04	8.84
Rice Cultivation	217.12	
Fuel consumption	379.06	0.03
Querosene combustion	0.58	< 0.01
<b>Waste</b>	<b>30,902.99</b>	<b>0.23</b>
Final Disposal of MSW	19,540.01	
Municipal wastewater (treatment)	3,367.92	
Municipal wastewater (without treatment)	3,441.17	
<b>Industrial Wastewater (treatment)</b>	<b>2,631.28</b>	
Industrial Wastewater (without treatment)	0.00	
Biological treatment of solid waste	199.51	
Incineration of toxic waste	1,431.57	< 0.01
Open-Pit Burning	291.52	0.22
<b>Land use, land use change and forestry (LULUCF)</b>	<b>32,424.86</b>	<b>3.61</b>
Land Converted to Forest Land	-12,582.75	
Land Converted to Grassland	28,877.56	
Land Converted to Cropland	4,425.85	
Land Converted to Settlements	783.93	
Other Land Converted to Other Land	1,306.18	
Incendios	9,614.08	3.61
<b>TOTAL NATIONAL EMISSIONS</b>	<b>665,304.92</b>	<b>125.10</b>
<b>LULUCF Remaining (absorptions)</b>	<b>-172,997.61</b>	
Forest Land Remaining Forest Land	-150,232.25	
Grassland Remaining Grassland	-21,672.10	
Cropland Remaining Cropland	-1,093.27	
<b>NET EMISSIONS (TOTAL EMISSIONS + REMOVALS BY REMAINING)</b>	<b>492,307.31</b>	<b>125.10</b>

## Notes:

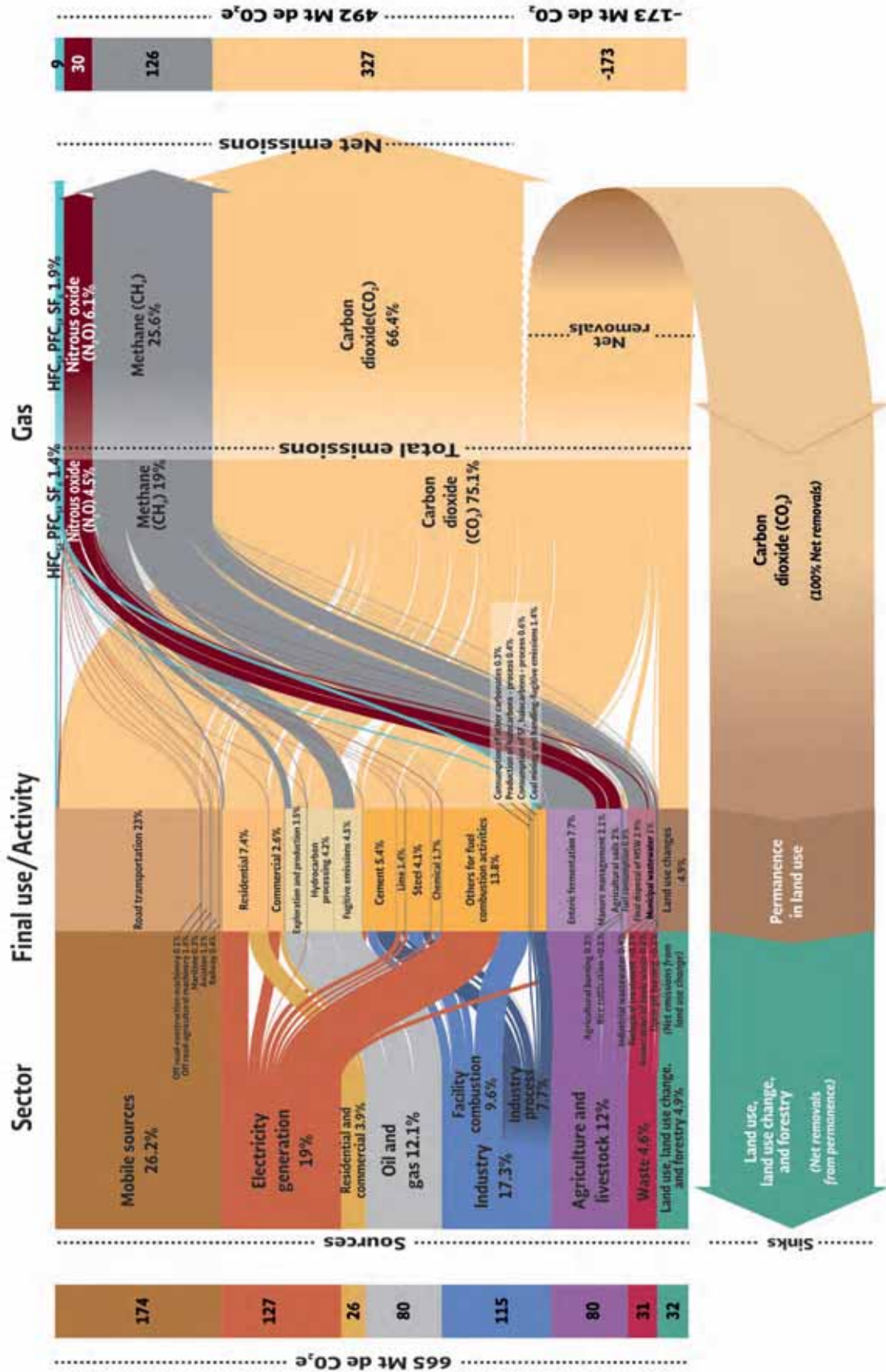
The sum of the parts may not correspond to the totals because of the rounding of the figures.

Global Warming Potentials (GWP100) used in this calculation for GHGs correspond to the Fifth Assessment Report of the IPCC (AR5) (IPCC, 2013).

\* Includes: metal, glass, automotive, food, beverages and snuff, paints and inks, pulp and paper, metal products, plastic products, asbestos, hazardous waste treatment and textiles.

\*\* 99.2% are black carbon emissions from the sugar mills.

FIGURE 2 • Mexico National Greenhouse Gas Inventory



Source: INECC y SEMARNAT, 2015. Primer Informe Bienal de Actualización ante la Convención Marco de las Naciones Unidas sobre el Cambio Climático. INECC/SEMARNAT. México.

TABLE 2 • GHG Emissions in 2013

Total GHG Emissions (Gg of CO <sub>2</sub> e)								
Total 665,304.92								
Sectors	Total GHG	Sectorial Contribution	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	HFC	PFC	SF <sub>6</sub>
Mobile Sources	174,156.53	26.2%	169,863.14	273.16	1,334.66	2,685.58		
Electricity Generation	126,607.66	19%	125,966.81	110.29	530.56			
Residential and Commercial	25,639.35	3.9%	23,028.00	2,281.06	330.28			
Oil and Gas	80,455.26	12.1%	49,510.60	30,944.66				
Industry	114,949.19	17.3%	97,864.44	9,910.30	518.70	6,464.06		191.69
Agriculture and Livestock	80,169.09	12%	376.99	54,620.30	25,171.79			
Waste*	30,902.99	4.6%	1,630.11	27,391.44	1,881.44			
LULUCF**	32,424.86	4.9%	31,461.60	633.51	329.75			
<b>Total Emissions</b>	<b>665,304.92</b>	<b>100%</b>	<b>499,701.68</b>	<b>126,164.73</b>	<b>30,097.18</b>	<b>9,149.64</b>		<b>191.69</b>
<b>Percentage by Gas (Total Emissions)</b>	<b>100%</b>		<b>75.1%</b>	<b>19%</b>	<b>4.5%</b>	<b>1.37%</b>	<b>0.0%</b>	<b>0.03%</b>
LULUCF Permanence ***	-172,997.61	<b>100%</b>	<b>-172,997.61</b>					
<b>Net Emissions</b>	<b>492,307.31</b>	<b>100%</b>	<b>326,704.07</b>	<b>126,164.73</b>	<b>30,097.18</b>	<b>9,149.64</b>		<b>191.69</b>
<b>Percentage by Gas (Net Emissions)</b>	<b>100%</b>		<b>66.4%</b>	<b>25.6%</b>	<b>6.1%</b>	<b>1.86%</b>	<b>0.0%</b>	<b>0.04%</b>

## Notes:

The sum of the parts may not correspond to the totals because of the rounding of the figures.

Global Warming Potentials (GWP100) used in this calculation for GHGs correspond to the Fifth Assessment Report of the IPCC (AR5) (IPCC, 2013).

Empty cells mean that there are no emissions from the pollutant in question (or CO<sub>2</sub> removals).

\* Includes MSW and hazardous waste as well as wastewater treatment and disposal.

\*\* Includes removals from land converted to forest land.

\*\*\* Includes permanence of forest land, grassland, and agricultural land..

Changes in fuel consumption for electricity generation in public service in 2013 with respect to 2010 were as follows: Coal: -1.7% (from 344.2 to 338.4 PJ); fuel oil: 12.8% (from 362.1 to 408.6 PJ); diesel: 97.2% (from 12.8 to 25.3 PJ); and natural gas: 20.3% (from 988.3 to 1,189.3 PJ), (SENER, 2014).

## Oil and Gas

In the oil and gas sector, emissions from production, transportation, distribution, processing, and use of hydrocarbons in the country are reported. The activity data are derived from information from *Petróleos Mexicanos* (PEMEX) and the Energy Information System

(SIE, per its Spanish initials). CO<sub>2</sub> and CH<sub>4</sub> emissions from burning fuel used in different combustion equipment were estimated; also included is an estimate of CO<sub>2</sub> and CH<sub>4</sub> leakage from processes of production, burning, venting, and distribution of hydrocarbons. In 2013, the oil and gas sector emitted 80,455.26 Gg of CO<sub>2</sub>e which accounted for 12.1% of total GHG emissions nationally.

Activity data from the 2013 inventory include emissions by source (equipment, oxidizers, burners, separators, towers, venting in ammonia plants, venting in ethylene plants, venting in natural gas plants, and fugitive emissions typical to such activity), determined by PEMEX.

Regarding fugitive emissions in previous inventories, default EFs from the 1996 IPCC guidelines were used; for the 2013 calculation, factors more appropriate for the national reality, documented in a study conducted by the INECC and the Mexican Petroleum Institute (IMP, per its Spanish initials) (INECC, 2012a), were used. In that study, fugitive emissions were systematized into 30 areas for oil and gas.

Since the Fifth National Communication, the level of oil and natural gas production displayed reductions of 3% and 7%, respectively. These are minor changes to the reduction of emissions compared to reductions through methodological refinements. In previous inventories, a single aggregated fuel consumption figure was used for the calculation of emissions, in contrast to the detail of 2013. In fugitive emissions, the result is a reduction of about 40% in reported emissions, compared to default factors.

## Mobile Sources (On-Road and Non-Road Vehicles)

In the on-road and non-road vehicle sector, emissions arise from internal combustion of motor vehicles with Otto cycle engines and diesel engines, as well as from the internal combustion from vehicles corresponding to the aviation, railway, maritime, construction, and agricultural sectors. In 2013, emissions from on-road and non-road mobile sources reached 174,156.53 Gg of CO<sub>2</sub>e, contributing 26.2% of the total national emissions.

The 2013 inventory was developed with a methodology for modeling the vehicle fleet that makes it possible to obtain emission factors according to the technological characteristics of the vehicle fleet, the maintenance that motor vehicles receive, and their traveling speed based on emission factors generated for the national vehicle fleet. In addition, the emissions calculation for tetrafluoroethane (HFC134) is included. Furthermore, in the case of non-road vehicles, emissions occur from machinery used in agriculture and construction.

In 2013 estimates, activity data were disaggregated, and flow characteristics of the vehicle fleet in Mexico were detailed. The vehicle fleet and vehicle activity of

mobile road sources were estimated from past sales of new units, the importation of used units, the retention rate of the vehicle fleet registered in 13 Mexican cities, as well as surveys on the use of vehicles in the country.

On the other hand, the figure was determined for units that use different fuels (liquefied petroleum gas, natural gas, gasoline, and diesel) as well as the proportion of each fuel used in these units.

## Industry

In the industry sector, emissions from the use of fossil fuels, GHG emissions from industrial processes that generate them by transforming raw materials through chemical and physical processes, and fugitive emissions from mining and handling coal are all reported. The subsectors that generate the most emissions in the industrial sector include cement, steel, and chemicals. In the estimate of fugitive emissions from mining, historical data from the National Energy Balance (BNE, spanish acronym) were used.

Emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from the burning of fuels in the different industries and CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, HFCs, and SF<sub>6</sub> through industrial processes are estimated. In 2013, emissions from industry totaled 114,949.19 Gg of CO<sub>2</sub>e, contributing to 17.3% of national emissions.

Activity data reported by companies under federal jurisdiction in the 2013 Annual Operations Certificate (COA, per its Spanish initials) to the SEMARNAT were considered. This information was supplemented by the SIE of the Secretariat of Energy (SENER, spanish acronym). In the case of the minerals industry, more information was obtained on raw materials used to produce cement, lime, and on the use of carbonates such as limestone and dolomite. In the estimate of fugitive emissions from mining, historical data from the BNE were used.

The activity data on type of fuel in the industrial sector for the calculation of the above inventories, as well as to update historic series, were those reported in the BNE. In the 2013 inventory, fuel consumption reported in the COA by type of fuel, plant, and equipment

was used for approximately 2,000 establishments in sectors under federal jurisdiction, and the BNE was used for the remainder.

For the mineral industry, information by plant on entry of carbonates into the furnace of carbonate raw materials as reported in the COA was used. For SF<sub>6</sub> emissions, usage information is incorporated, provided by the distribution branch of the CFE.

In emissions from refrigerants, the results were taken into account of a study conducted in 2013 (GIZ, 2014) which considers emissions of chlorofluorocarbons (CFCs), chlorodifluoromethane (HCFC-22), and HFCs by sector and includes projected HFC emissions in the different sub-sectors where it is used. The methodology is consistent with Level 1 and 2 of the 1996 IPCC Guidelines (IPCC, 1997) whose activity data are imports, exports, OEMs, and sales service providers, based on official information, as well as industrial and customs associations.

## Agriculture and Livestock

In the agriculture and livestock sector, CH<sub>4</sub>, N<sub>2</sub>O, and BC emissions occur from livestock activities (livestock enteric fermentation and manure management) as well as agricultural activities (soil management, rice cultivation, and field burning for crop residues). Also, CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the use of fuels for energy purposes, mainly used in irrigation systems, are included. Emissions from the agricultural and livestock sector were 80,169.09 Gg of CO<sub>2</sub>e, which represents 12.0% of total GHG emissions nationally.

This inventory includes the update to the 2013 activity data of the Agri-Food Consultation Information System (SIACON, per its Spanish initials), of the Agri-Food and Fishery Information Service (SIAP, per its Spanish initials), and from the Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food (SAGARPA, per its Spanish initials), allowing a greater systematization and disaggregation of data compared to previous inventories.

In the 2013 inventory, a rearrangement was made for the activities between two categories: N<sub>2</sub>O emissions

from application of animal fertilizer and decomposition of cattle manure from grazing. They were changed from the category management of agricultural soils to manure management, considering that they represent activities related to livestock.

## Land Use, Land Use Change, and Forestry

In the LULUCF sector, emissions and removals from the following land use changes are reported: Forest land, grassland, agricultural land, settlements (partly), and other lands; along with removals from permanence of forest land, grassland, and agricultural land. The quantified deposits are living biomass (aboveground and underground) and mineral soils, as well as emissions from fires on forest land and grassland.

CO<sub>2</sub> emissions and removals occur as a result of changes and permanence, as well as CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from forest fires.

In 2013, emissions from the LULUCF sector came to 32,424.86 Gg of CO<sub>2</sub>e, representing 4.9% of total emissions. Thus, emissions from land converted to grassland, settlements, and other land, as well as fires were 45,007.61 Gg of CO<sub>2</sub>e in total, while land converted to forest land sequestered a total of 12,582.75 Gg of CO<sub>2</sub>.

Removals from permanence of forest land, grassland, and agricultural land totaled -172,997.61 Gg of CO<sub>2</sub>. Therefore, net LULUCF emissions totaled -141,536.00 Gg of CO<sub>2</sub>e, which makes this sector an important carbon reservoir.

For the first time, information on carbon contents collected by the National Forest and Soil Inventory (INFyS, per its Spanish initials) of the National Forestry Commission (CONAFOR, per its Spanish initials) in their two sampling periods (2004-2007 and 2009-2013) is used (SEMARNAT, 2012b); Series V for Vegetation and Land Use of the INEGI was used, and national emission and removal factors were estimated. Similarly, use is made of a wide base of allometric equations suitable for Mexico in ecological terms that were collected from the technical-scientific literature (INEGI, 2011).

## Waste

This sector includes emissions of municipal solid waste (MSW) and hazardous waste as well as the treatment and disposal of municipal and industrial wastewater. In 2013, emissions from this sector totaled 30,903.02 Gg CO<sub>2</sub>e, of which 21,462.65 Gg CO<sub>2</sub>e correspond to MSW and 9,440.37 Gg CO<sub>2</sub>e to wastewater.

was considered according to the national records on MSW disposal and composition.

In the case of hazardous waste incineration, information on fuel, quantity of hazardous waste, and specific characteristics of each incinerator were used. Finally, for biological treatment, specific data from compost plants were used: Amount of composted waste, date of commencement of operations, and plant capacity.

### Municipal Solid Wastes and Hazardous Wastes

This subsector reports CH<sub>4</sub> emissions from MSW disposal; CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from open burning and incineration of hazardous waste; and CH<sub>4</sub> and N<sub>2</sub>O from biological treatment.

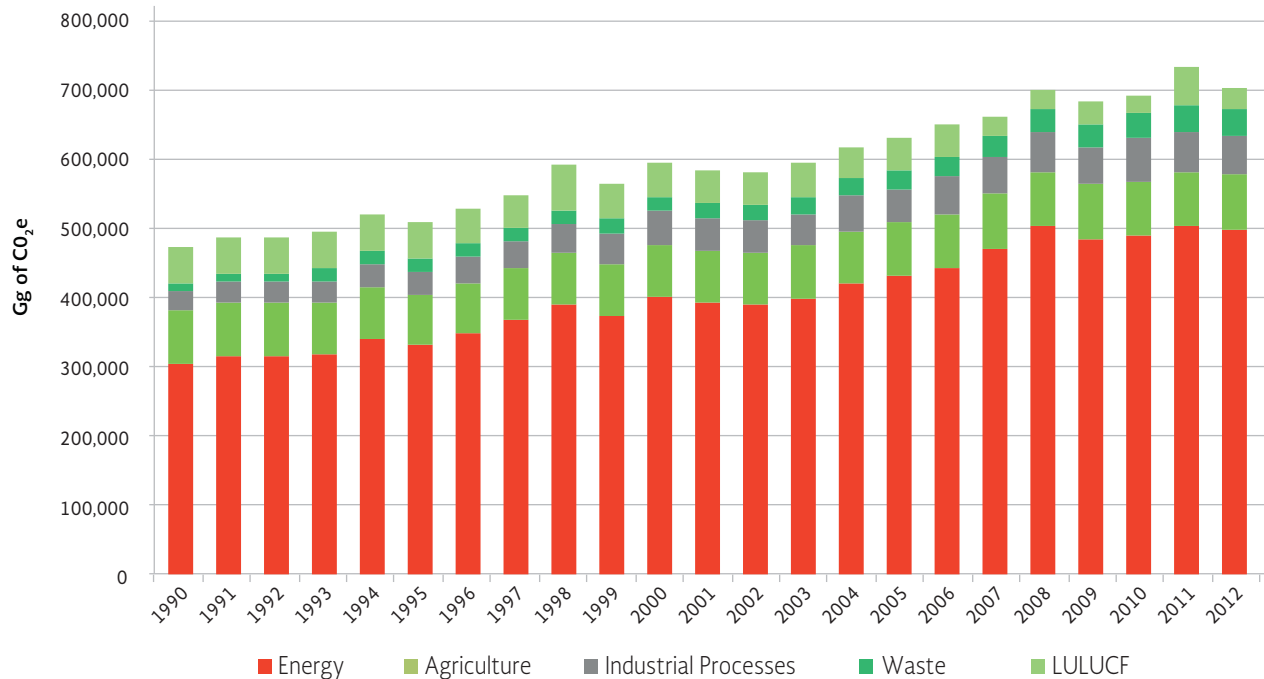
### Treatment and Disposal of Municipal and Industrial Wastewater

In the category of treatment and disposal of wastewater, emissions are reported from the wastewater generated in production processes of the following sub-sectors: Sugar, chemicals, pulp and paper, oil, beverages, textiles, and food primarily, as well as untreated wastewater from houses and municipal services.

For the 2013 inventory, estimates were made of emissions from each of the disposal sites (landfills, controlled sites, and open dumps) with the Mexican Biogas Model, and the estimated amount of recycling

CH<sub>4</sub> emissions from the decomposition of organic matter in wastewater and CH<sub>4</sub> and N<sub>2</sub>O emissions from

FIGURE 3 • GHG Emissions 1990-2012



Note: GHG emissions from the LULUCF category are included without considering removals from permanence in that category.



municipal wastewater were estimated. In both subcategories, emissions from the treatment process and, in the case of municipal waste, emissions from untreated water were considered. Information provided by the National Water Commission (CONAGUA, per its Spanish initials) on the treated wastewater flow from each plant in the industrial sector and each municipality was used.

Specific values were also used from the study conducted in Mexico (Noyola, *et al.*, 2013) for the WWTP with flow rates of 0-13 l/s, 14-70 l/s 71-620 l/s, and by technology type, obtained directly under operating conditions, allowing for the estimation of emissions using specific EFs for 87.5% of the treated flow.

## Residential and Commercial

For the residential and commercial sectors, CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the consumption of natural gas, LP gas, kerosene, diesel, and fuelwood are reported. In 2013, emissions from the residential and commercial sector totaled 25,639.35 Gg of CO<sub>2</sub>e and made up 3.9% of total GHG emissions nationally.

In the 2013 INEGI, the part on fuelwood consumption in the residential sector was estimated using the methodology developed for the use of solid biofuels in Mexico, fuelwood consumption estimated at the municipal level, and the use of emission factors considered for the type and conditions of fuelwood burning in the country. For other fuels, sectorial energy consumption was considered and the EFs from the IPCC guidelines were used.

## NATIONAL GREENHOUSE GAS INVENTORY 1990-2012

With the update of the INEGI for the 1990-2012 period (Figure 3), and with methodological improvements with regard to previous inventories, Mexico fulfills commitments both nationally and internationally as a

Non-Annex I party of the UNFCCC, and fulfills those mandated by the LGCC, among other public policy instruments.

GHG emissions for 2012 in CO<sub>2</sub>e units, excluding removals, were estimated at 706,867.20 Gg<sup>12</sup> for the six gases listed in Annex A of the Kyoto Protocol. These emissions had an increase of 49.2% with respect to the 1990 base year, with an Annual Average Growth (AAGR) of 1.7%.

In 2012, the contribution of GHG emissions from the different categories in terms of CO<sub>2</sub>e was the following: Energy: 70.8% (500,679.18 Gg); agriculture: 11.2% (78,920.83 Gg); industrial processes: 8.1% (57,408.59 Gg); waste: 5.4% (37,981.24 Gg); and land use, land use change, and forestry (LULUCF): 4.5% (31,877.37 Gg).

To update this inventory in the LULUCF category, the IPCC Good Practice Guides (GPG) of 2003 was followed. Therefore, the estimate for permanence in the 1990-2012 series is included. In the year 2012, removals totaled -172,997.61 Gg of CO<sub>2</sub>, resulting in a total of 533,869.59 Gg net GHG emissions in different categories in terms of CO<sub>2</sub>e.

## Carbon Dioxide (CO<sub>2</sub>) Emissions

Without considering permanence, CO<sub>2</sub> emissions reached 535,632.66 Gg in 2012, contributing 75.8% to the total emissions of the inventory and they had a 49.3% increase with respect to 1990.

Total CO<sub>2</sub> emissions in the country come mainly from the fossil fuel burning reported in the energy category, which accounted for 86.35%. Industrial processes accounted for 7.9%, and LULUCF for 5.8%.

Estimated CO<sub>2</sub> removals for 2012 in this inventory from the permanence of forest land, grassland, and agricultural totaled -172,997.61 Gg. Therefore, net CO<sub>2</sub> emissions came to 362,635.05 Gg.

<sup>12</sup> Considering the GWP of the AR5, over 100 years.

## Methane (CH<sub>4</sub>) Emissions

In 2012, CH<sub>4</sub> emissions totaled 127,622.83 Gg, which represents an increase of 47.4% with respect to 1990. The main sources of emissions were from the categories of agriculture (42.3%), energy (29.4%), and wastes (27.7%).

## Nitrous Oxide (N<sub>2</sub>O) Emissions

In 2012, N<sub>2</sub>O emissions totaled 28,547.48 Gg, which represents an increase of 5.4% with respect to 1990. The main source of emissions is the category of agriculture (87.5%), mainly in the following subcategories: livestock manure management, and direct nitrous oxide emissions from agricultural soil management.

## Emissions of Hydrofluorocarbons, Perfluorocarbons, and Sulfur Hexafluoride (HFCs, PFCs, and SF<sub>6</sub>)

Emissions from fluorinated gases (also known as F gases) amounted to 15,064.23 Gg of CO<sub>2</sub>e in 2012, which represents an increase of 1,094.3% with respect to 1990 owing to the substitution of CFCs by HFCs in the period. The main source of emissions is HFCs (98.9%), which are used in refrigeration systems.

## BLACK CARBON EMISSIONS 2013

BC emissions occur in the oil and gas, electricity generation, residential and commercial, industry, mobile sources, waste, agriculture, and LULUCF sectors. To estimate BC emissions, the same activity data from the 2013 INEGI were used. In the categories of oil and gas, electricity generation, industry, and waste (burning of solid waste), a strategy for estimating bottom-up emissions was used. Meanwhile, for mobile sources and LULUCF (forest fires), national data were used, but with a higher level of disaggregation and methodologies consistent with national circumstances.

It were estimated at 125.1 Gg of BC nationwide in 2013. The sector of on-road and non-road mobile sources made up 37.8% of national emissions, followed by the industrial sector (mainly by burning bagasse at sugarcane mills) with 28.3%, and the residential and commercial sector with 15.2%. The electricity generation sector and agriculture contributed 6.8% and 7.1%, respectively. The remaining sectors of oil and gas, LULUCF, and waste made up the remaining 4.8% (Table 3).

TABLE 3 • National BC Emissions in 2013 by Sector

Total BC Emissions	
Total 125.1 Gg	
Sectors	Gg
Oil and Gas	2.17
Electricity Generation	8.46
Residential and Commercial	19.01
Industry*	35.42
Mobile Sources	47.34
Wastes**	0.23
Agriculture and Livestock	8.86
LULUCF***	3.61

The sum of the parts may not match the totals owing to the rounding of figures.

\* Mainly from burning bagasse at sugarcane mills.

\*\* Includes open-pit burning of MSW and hazardous waste incineration.

\*\*\* From forest fires.

The main sources by consumption of fossil fuels which contribute to BC emissions were transportation based on diesel consumption, the residential sub-sector as a result of fuelwood consumption, and agricultural machinery based on diesel consumption, and power plants. In the industry sector, the main source of BC is sugarcane mills based on the burning of biomass. Emissions from the oil and gas sector come from burning fossil fuels at the four subsidiaries of PEMEX. LULUCF's BC contribution is due to forest fires, and finally from open-pit burning of MSW, either at final disposal sites or backyards in homes.

In short, Table 4 shows the black carbon estimation methodologies used for the 2013 inventory.

TABLE 4 • Summary of 2013 BC Estimation Methodologies

Methodology	Activity	Value	Activity or Unit
Fraction of PM <sub>2.5</sub>	Electricity Generation	20% <sup>a</sup>	Fuel Oil Combustion
		20% <sup>a</sup>	Diesel Combustion
		20% <sup>a</sup>	Natural Gas Combustion
	Residential and Commercial	14% <sup>a</sup>	Coal Combustion
		7% <sup>a</sup>	LP Gas Combustion
	Residential Fuelwood	17% <sup>a</sup>	Fuelwood Combustion
	Industry	3% <sup>b</sup>	Cement Industry
		5% <sup>b</sup>	Limekiln, Steel, Chemical Industry
		30% <sup>b</sup>	Bagasse Combustion
	LULUCF (Fires)	7.2-12% <sup>c</sup>	Forest Fires
	Construction and Agricultural Machinery	60% <sup>a</sup>	Diesel Combustion
Incineration of Hazardous Waste	2.4% <sup>a</sup>	Hazardous Waste Combustion	
Agriculture	7% <sup>a</sup>	LP Gas Combustion	
Emission Factor	Oil and Gas	E = 447,055 <sup>d</sup>	kg CN / Tg CO <sub>2</sub>
	Open-Pit Waste Burning	E = 0.646 <sup>e</sup>	g CN /Kg of burned waste
	Agricultural Burning	E = 0.73 <sup>b</sup>	t CN /Gg of dry-base burned agricultural biomass
	Railway	E = 1.53 <sup>b</sup>	g CN / kg of fuel
	Maritime	E = 1.02 <sup>b</sup>	kg CN / ton diesel
	Aviation	E = 0.1 <sup>b</sup>	g CN / kg of fuel
MOVES	Trucking		

Notes:

a. CARB, Speciation Profiles Used in ARB Modeling

b. Atmospheric Brown Clouds (ABC), Emission Inventory Manual.

c. [http://www.ine.gob.mx/descargas/cclimatico/2010\\_cca\\_mce2\\_temas\\_emergentes.pdf](http://www.ine.gob.mx/descargas/cclimatico/2010_cca_mce2_temas_emergentes.pdf)

d. McEwen, J y M. Johnson (2012). "Black carbon particulate matter emission factors for buoyancy-driven associated gas flares", Journal of the Air & Waste Management Association.

e. Christian, T., R. Yokelson, B. Cárdenas, L. Molina, G. Engling, and S. Hsu. 2010. "Trace gas and particle emissions from domestic and industrial biofuel use and garbage burning in central Mexico", Atmospheric Chemistry and Physics.

## IV. MITIGATION ACTIONS REPORT

### Strengthening the Enabling Framework to Address Climate Change Mitigation.

Since the last National Communication to the UNFCCC<sup>13</sup>, Mexico has managed to strengthen its institutional framework in order to have a climate change policy which integrates the efforts of the different levels of government and society as a whole to achieve its goals.

With regard to mitigation, the adopted measures create an enabling framework for the current and future development of actions that reduce emissions of greenhouse gas and compounds. Within them, it is

worth noting progress in implementing the LGCC and constitutional energy reforms.

The latter were enacted in December 2013 and, since that time, the design and publication of secondary and regulatory legislation needed to make them operational have been carried out. This new framework on energy provides the basis for a market for generation of renewable energy sources and cleaner technologies, along with promoting energy efficiency in generating, distributing, and transmitting electricity.

Among its most relevant aspects, this energy reform includes the promotion of investment in generating electricity with clean and efficient technologies by ensuring that generators have open and fair access to the national transmission network to sell energy

<sup>13</sup> Mexico submitted its Fifth National Communication to the UNFCCC in December of 2012. The reporting period of this update report starts from the reports of the Fifth National Communication.

on the wholesale electricity market. This eliminates investment barriers and facilitates the execution of large-scale projects.

Among the most relevant advances is the creation of clean energy certificates, with which all qualified suppliers and users must reach the proportion established for power generation through this type of energy sources.

As regards the hydrocarbons sector, the utilization of natural gas is favored, rapidly moving away from the use of fossil fuels with a higher carbon content. The Agency of Security, Energy and Environment (ASEA, per its Spanish initials) was created as a decentralized agency of the SEMARNAT with technical and managerial autonomy which regulates and supervises industrial safety, operational safety, and environmental protection in hydrocarbon sector activities.

Also, with respect to taxes, various reforms have been approved and have been in force since January 2014. Among these is a tax imposed on manufacturers, producers, and importers for the sale and importation of fossil fuels according to their carbon content.

In recent years, subsidies for fossil fuels, particularly for gasoline, diesel, and electricity, have decreased, which has fostered more efficient energy use in Mexico.

Among the pillars to achieve these goals is the implementation of the institutional arrangements and planning instruments set out in the LGCC. From 2012 to 2014, there was substantial progress in their design and implementation, which helps to establish the enabling framework for mitigation actions. Additionally, other tools and programs have been developed that contribute to the enabling framework for low carbon development in the country, above all in the area of energy and taxes. The most relevant progress is summarized below (Table 5).

TABLE 5 • Enabling Framework for Mitigation Actions

<b>LGCC Institutional Instruments:</b>
✓ The National Climate Change System was launched..
✓ The Inter-Secretariat Commission on Climate Change was established in accordance with LGCC guidelines..
✓ The Council on Climate Change was implemented
✓ The National Institute of Ecology and Climate Change was created.
✓ The Climate Change Policy Evaluation Coordination was established.
<b>LGCC Planning Mechanisms:</b>
✓ The National Climate Change Strategy, Vision 10-20-40 was published.
✓ The Special Climate Change Program 2014-2018 was developed and launched.
✓ The preparation, publication, and updating of state climate change programs are in progress.
✓ The development and publishing of programs at the municipal level are in progress.
<b>Sectorial Programs and Regulatory Developments:</b>
✓ The National Program for the Sustainable Use of Energy was developed and is in operation.
✓ The Special Program for the Use of Renewable Energy was developed and is in operation.
✓ 15 Official Mexican Standards that contribute to emissions reductions came into force and were updated.
<b>Information Tools:</b>
✓ The National Greenhouse Gas Inventory of the historic series from 1990-2010 to 1990-2012 was updated.
✓ The National Greenhouse Gas Inventory for 2013 was developed with a higher level of disaggregation.
✓ The National Emissions Registry entered into force following the publication of its rules.
✓ The registry of Appropriate National Mitigation Actions began operations.
✓ Progress was made in generating indicators for the Climate Change Information System.
✓ The National Renewable Energy Inventory was developed.

### Economic, Financial, and Fiscal Instruments

- ✓ Fossil fuel subsidies have been reduced.
- ✓ The implementation of a carbon tax began.
- ✓ The Climate Change Fund was created.
- ✓ The design and operation of projects for the Clean Development Mechanism continued.
- ✓ Progress was made in the design and operation of other carbon markets.

## National Climate Change System: Progress in the Institutional Framework

The National Climate Change System (SINACC, per its Spanish initials) consists of the CICC, the C3, the INECC, the governments of the federal entities (states), a representative of each legally recognized national association of local authorities, and representatives of the Congress of the Union.

As part of the SINACC consolidation process, a series of instruments has been generated, including the National Emissions Registry (RENE, per its Spanish initials); a proposal for a National Strategy for Reducing Emissions from Deforestation and Forest Degradation (ENAREED+, per its Spanish initials); and the Climate Change Fund; among others, which are described in the following sections.

### Inter-Secretariat Commission on Climate Change

The CICC, part of the structure of SINACC, was established on January 29, 2013 and has met regularly since then. Some of its most noteworthy agreements include its approval of the ENCC on May 30, 2013, its participation in developing the PECC 2014-2018 (published on April 28, 2014), and the approval of the INDC (see Figure 1).

### Council on Climate Change.

An essential part of the System is the Council on Climate Change (C3), made up of 15 members who

come from the social, private, and academic sectors with recognized qualifications and experience in climate change. It was established on February 26, 2013.

### National Institute of Ecology and Climate Change

The INECC is a public agency of the federal government whose mission is to generate and integrate technical and scientific knowledge and increase skilled human capital for the development, management, and assessment of public policies that contribute to environmental protection, ecological preservation and restoration, green growth, as well as climate change mitigation and adaptation in the country.

It is governed by an organic law in force since October 2013 and reformed in November 2014, and an institutional program published in April 2014. The structure of the INECC has specialized areas responsible for conducting scientific and technological research and sectorial forecasting analysis, and participating in the development of strategies, plans, programs, instruments, and actions related to climate change adaptation, mitigation of emissions from greenhouse gases and compounds (GyCEI, Spanish acronym), and low-carbon development, among other functions.

### Evaluation Coordination

The LGCC provides for the assessment of the national climate change policy on a regular and systematic basis to propose its amendment, expansion, or partial or total reorientation. The cited law provides for assessment

to be conducted by the Evaluation Coordination or by nonprofit independent assessing agencies. This is synchronized with other systems of the Mexican legal system which mandate the management and exercise of public expenditure based on results.

The Evaluation Coordination is made up of six social advisors and the Director General of the INECC, and has a technical secretariat to support the implementation of its mandate. Assessments will influence improvement or readjustment of these policies following the recommendations made to the Federal Executive Branch, state governments, and municipalities of the country.

## Planning Mechanisms from the General Law on Climate Change

### National Climate Change Strategy

Published in 2013, the ENCC set 10, 20, and 40-year milestones to guide climate change policy within the three levels of government (federal, state, and municipal) with different sectors of society beyond administrative periods and with a shared vision. It also integrates SLCP emissions abatement into national policy for the first time. From a diagnosis of the country's emissions, the ENCC defines five strategic pillars to create low carbon development:

- Goal 1. Accelerate energy transition toward clean energy sources.
- Goal 2. Reduce energy intensity through efficiency and responsible consumption schemes.
- Goal 3. Move to sustainable city models with systems of mobility, comprehensive waste management, and low carbon footprint constructions.
- Goal 4. Promote better agro-livestock and forestry practices to increase and preserve natural carbon sinks.
- Goal 5. Reduce SLCP emissions and encourage co-benefits to health and wellbeing.

### Special Climate Change Program 2014-2018

In the quest to move towards a competitive, sustainable, and low carbon economy, the federal government prepared the Special Climate Change Program (PECC, Spanish acronym) 2014-2018, which incorporates and articulates the actions set out in the National Development Program 2013-2018, the ENCC, and sectorial programs of 14 secretariats of the government. It includes measures which will reduce the emission of greenhouse gases and compounds and will also improve our ability to respond to environmental phenomena.

The PECC 2014-2018 represents the contribution of the federal government of 83.2 MtCO<sub>2</sub>e/year, backed by the established budget. It contains 81 lines of action directed toward reducing GHG emissions and SLCP in all emitting sectors of the country.

The actions contained in the Program may be potentiated and be more ambitious to include not only those of the federal government, but also those of the states, municipalities, and the social and private sectors (from large companies to small and medium enterprises). Additionally, its periodic review and improvement have been established, considering the design of transparency mechanisms, monitoring, and accountability for the established actions in order to ensure their appropriate implementation and generation of expected social and environmental benefits.

The progress achieved in the actions that promote emissions mitigation goes beyond the sectors dedicated to addressing environmental issues. The level of commitment of the different stakeholders of society is embodied in the actions mentioned below.

### State and Municipal Planning

Before the LGCC entered into force, some state governments had already developed or were in the process of developing their programs as reported in the Fifth National Communication. However, since then, a nationwide exercise has begun in order to ensure the state programs' alignment with the LGCC and the ENCC.

In addition to the provisions established in the LGCC, in October 2014, 64 municipal planning instruments were prepared, developed in 24 federal entities and 257 municipality are in the development phase.

## Sectorial Program and Regulatory Developments

### National Program for the Sustainable Use of Energy - 2014-2018

Based on the Law on Planning and the Law for Sustainable Use of Energy (LASE, per its Spanish initials), the 2014-2018 National Program for the Sustainable Use of Energy (PRONASE, per its Spanish initials) was prepared; it is an instrument which defines the strategies, objectives, lines of action, and goals which will enable the attainment of optimum energy use in processes and activities for its utilization, production, transformation, distribution, and final consumption.

### Special Program for the Use of Renewable Energy - 2014-2018

As an intersectorial effort to coordinate actions pertaining to promoting renewable energies, the 2014-2018 Special Program for the Use of Renewable Energy (PEAER, per its Spanish initials) was published in 2014. It specifies the actions that must guide the country toward achieving the goals established in the Law on the Use of Renewable Energies and Financing of Energy Transition (LAERFTE, per its Spanish initials).

The PEAER establishes the policies needed to promote energy generation from clean energy sources in order for it to reach at least 35% by 2024, a goal established in the LGCC.

### Inter-Secretariat Commission for the Development of Bioenergy

In December 2012, the Inter-Secretariat Commission for the Development of Bioenergy (CIB, per its Spanish

initials) arising from the Law for the Promotion and Development of Bioenergy was established. Its objective is to propose short-term, medium-term, and long-term programs connected to the production and marketing of inputs, as well as production, storage, transport and pipeline distribution, along with the marketing and efficient use of bioenergy. The Commission is made up of the heads of Finance and Public Credit; of Environment and Natural Resources; of Energy; of Economy; and of Agriculture, Livestock, Rural Development, Fisheries, and Food.

In the heart of this Commission, the draft is being worked on for the Mexican Standard which establishes specifications and requirements for the certification of environmental sustainability of the production of plant-based liquid bioenergy. This standard will be important for ordering a market that is growing and for providing information about the sustainability and impact of these fuels.

### National Strategy for Reducing Emissions from Deforestation and Forest Degradation

The National Strategy for Reducing Emissions from Deforestation and Forest Degradation (ENAREDD+, per its Spanish initials), along with the role of sustainable management of forests and the augmentation and conservation of forest carbon pools, seeks to contribute to mitigating GHG by proposing policies, measures, and actions that must be incorporated into planning instruments for sustainable development.

The ENAREDD+ seeks to reduce incentives that promote deforestation and degradation, and has the goal of moving to a zero-percent rate of carbon loss in original forest ecosystems. It also aims to increase the impetus for conservation, management, restoration, and sustainable use of forest resources. These incentives will be directed toward sustainable forest management as an additional impulse toward active management of forests focused on sustainable rural development, toward the evaluation of environmental goods and services of forests, and toward reducing pressures on forest ecosystems, arising from other activities and

economic circumstances. This is with the committed participation of multiple society stakeholders and public institutions involved in the development of the territory.

The Strategy is organized into seven components: public policy; financing schemes; institutional arrangements and capacity building; reference levels; monitoring, reporting, and verification (MRV); safeguards; and communication, social participation, and transparency. Through these components, we seek to meet the goal of reducing GHG emissions from deforestation and degradation of forest ecosystems, and conserving and increasing forest carbon stocks within the framework of sustainable rural development for Mexico.

## Official Mexican Standards

In terms of mitigation, between 2012 and 2014, nine energy efficiency standards, four transportation standards, one on waste and another on stationary sources have been published. Among the standards concerning transportation, NOM-163-SEMARNAT-SENER-SCFI-2013 stands out. It establishes the parameters and methodology to calculate the maximum allowable value for carbon dioxide emissions in terms of fuel efficiency. The national implementation of this standard has great benefits for the mitigation of CO<sub>2</sub> emissions.

Also, with the objective of developing regulatory instruments and instruments to promote the regulation of SLCP emissions, the PECC establishes specific actions related to the development of eight standards. Among the topics to be addressed in these standards are limiting emissions from gases and pollutants from gas turbines, field burners, pit burners, and high burners; reducing fugitive emissions from hydrocarbon storage tanks; mitigating emissions and particles from stationary sources that use hydrocarbons; among others. Also established is the importance of updating the standard for new light vehicles and issuing the standard for heavy vehicles, as well as promoting and regulating the use of compressed natural vehicular gas by updating the relevant standards.

## Participation of Civil Society

The activities that the Ministry of Foreign Affairs (SRE) has conducted through the general directorate for Building Links with Civil Society Organizations are framed in a dialogue process around the international negotiations on climate change following the sixteenth Conference of the Parties (COP16) of the UNFCCC in Cancun, Mexico in 2010. The activities are founded on the guidelines for the participation of civil society in matters of foreign policy of the SRE the LGCC and the PECC 2014-2018.

There have been periodic information meetings with civil society organizations on the state of international climate change negotiations. Between 2012 and 2014, nine information meetings and dialogue meetings with civil society were held in Mexico, as well as various meetings between the Delegation of Mexico and civil society organizations within the negotiations of COP18, COP19, and COP20.

At the international level, two officials of the mentioned Directorate participated as observers in the segment of civil society work of the Preparatory Meeting for COP20, called Social-Ministerial PreCOP, organized by the government of Venezuela in November of 2014. Likewise, the SRE has integrated representatives of civil society organizations into its official delegations as non-governmental advisors for COP18 in 2012, COP19 in 2013, and COP20 in 2014.

In 2013, a major public consultation exercise was conducted with society within the framework of the development of the ENCC. The consultation was held in April of that year and was structured in three parallel exercises: The first corresponding to a broad face consultation in Mexico City with over 270 people in attendance; the second face consultation exercise was carried out through the federal delegations of the SEMARNAT in the federal entities (states) and was attended by about 100 citizens. Finally, the third was an online consultation process with the participation of more than 3,200 people interested in contributing to the design of the ENCC, whose inputs and views were considered and incorporated into the final version of the document.



During the preparation of the PECC, a participatory process was held with society between the months of September and November 2013, which consisted of two face workshops with civil society organizations and citizens in general, an online questionnaire, and two more workshops, the first with members of academia and the second with members of the private sector. In total, about 900 citizens participated in this process. The results, as in the case of the ENCC, were incorporated into the PECC document.

The development of the INDC, in turn, included a participatory and consultative process. After discussing the main sectorial and process aspects with the C3 in November 2014, sectorial analyses were developed which were shared with civil society organizations and the private sector at a workshop in February 2015. Not only were the main goals and measures laid out, but also sectorial groups discussed possible additional measures for their incorporation, and lines of communication remained open in the subsequent weeks for more detailed suggestions. In a parallel manner, meetings with various industry chambers of the country as well as with civil society organizations were held. Also, in February and March, a survey conducted online, which collected 1,168 responses which were considered for the development of the INDC.

## Information Tools

### National Emissions Registry

The regulations of the LGCC on the RENE were published in October 2014 in response to the provisions of the mentioned Law. The RENE has two components. The first is emissions reporting for those who are obligated to report who engage in an industrial, productive, commercial, or service activity whose operation generates direct or indirect emissions of greenhouse gases or compounds that exceed the threshold of 25,000 tons of CO<sub>2</sub>e emissions per year, including stationary and mobile sources. The second component is the registry of projects on mitigation,

reductions, or removals of emissions that have been validated by an accredited body for this purpose.

The regulations of the Registry define an MRV system to guarantee the integrity, transparency, and precision of the data, and the linkage with other federal or state emissions registries. This includes an independently verified opinion for emissions reports and a validation opinion for emissions abated through registered projects. The first reporting period of the registry will begin in the second half of 2015.

### Registry of Nationally Appropriate Mitigation Actions

In Mexico, it is recognized that Nationally Appropriate Mitigation Actions (NAMA) are mitigation efforts that require public or private, domestic, and international financial support. To promote such initiatives, in October 2013, the National Registry of NAMA was put into operation. This voluntary registry contains complete and updated information on the NAMA of Mexico which have been registered in the program.

As of December 2015, 27 NAMA have been incorporated into the registry, five of which are also part of the International Registry of NAMA of the United Nations Framework Convention on Climate Change. It is anticipated that, with an application by a NAMA developer, the mitigation of the project can be registered in the RENE once it has been certified. In this way, there would be a link between the two registries.

### Climate Change Information System

The INEGI, in collaboration with the SEMARNAT, the INECC, and various government institutions<sup>14</sup>, has been working on the creation of a Climate Change Information System since 2013, which must generate a set of key indicators in the field. These indicators are national GHG emissions; GHG emissions by GDP;

<sup>14</sup> National Center for Prevention of Disasters (CENAPRED, per its Spanish initials), the CONAGUA, and the National Meteorological System.

GHG emissions per capita; carbon dioxide emissions from fossil fuel burning; carbon dioxide emissions by GDP; and carbon dioxide emissions per capita. Since May 2013, the INEGI is part of the Climate Change Information System. Also, on August 8, 2014, two agreements issued by the governing board of the INEGI were published in the Official Gazette of the Federation (DOF, per its Spanish initials). Through these, the inclusion of the National Catalogue of Indicators, the set of key indicators on climate change outlined above, is approved, along with another agreement through which the INEGI information is considered information of national interest.

## **Economic, Financial, and Fiscal Instruments**

### **Climate Change Fund**

In November 2012, the Climate Change Fund was created. Its assets are made up of federal grants, domestic or foreign donations, contributions from foreign governments, and those of international organizations. The resources of the fund will be applied to projects that contribute to climate change mitigation and adaptation in accordance with the priorities of the ENCC, the PECC, and the programs of the federal entities; research projects, innovation projects, technological development projects, and technology transfer projects; and in the purchase of certified reductions in emissions of projects registered with the RENE or with any other project approved by international agreements undersigned by Mexico.

The technical committee of the Fund held two regular meetings and one extraordinary meeting in 2013. At these meetings, the rules of operation of the Climate Change Fund were approved.

At the first extraordinary meeting of the Climate Change Fund in June 2014, the technical committee approved the first economic contributions to the Climate Change Fund to be made by the SEMARNAT.

## **Clean Development Mechanism**

In the reporting period, 16 new projects were registered in the Clean Development Mechanism (CDM) in the sectors of renewable energy, energy efficiency, landfills, waste, and cogeneration. With this, the number of registered projects amounts to 201. From 2005 (the CDM's starting year) to June 2014, Mexican projects received a total of 23,868,978 certified emission reductions (CERs).

## **Other Progress Related to Carbon Markets**

As regards other advances related to carbon markets, there is the establishment of a voluntary carbon trading platform on the Mexican Stock Exchange called MexiCO<sub>2</sub>; the signing of a memorandum of understanding with the state of California, United States that aims to create a link between carbon markets in Mexico and California; and the signing of a memorandum of cooperation with Japan to establish a joint mechanism for accreditation of emission reduction projects.

## **Concrete Mitigation Actions and Commitments**

This report presents 85 actions that Mexico is taking to comply with its international commitments and national goals on emission reduction projects and co-benefits for its population in terms of health and sustainable growth. These actions were included due to their reduction in reported emissions.

To facilitate reporting, these actions are classified according to the five strategic axes for mitigation according to the ENCC involving the transition to clean energy sources, promoting energy efficiency, sustainable city models, sustainable agro-livestock and forestry practices, and the reduction of SLCP emissions.

The actions related to efficiency and responsible consumption account for 38% of all reported initiatives, followed by those related to the use of clean energy sources (26%) and by actions for promoting the development

of sustainable cities (22%). The remaining 14% are related to the forestry sector, the agro-livestock sector, and mitigation measures for SLCP emissions.

In relation to the transition to clean energy sources, the implementation of wind farms, photovoltaic power plants, and the use of cleaner fuels stand out. On issues of energy efficiency, the key topics are cogeneration and clean transportation programs.

To reduce energy intensity through efficiency and responsible consumption schemes, the type of actions that predominate are the replacement of street lights in public lighting and improvement in the efficiency of PEMEX facilities. The 25% of projects remaining are on topics such as replacing fishing boats and motors, as well as efficiency in transportation and lighting on metro trains.

To move to sustainable city models through improving mobility systems, comprehensive waste management, and promoting low carbon footprint constructions, it was identified that 59% of the actions pertain to NAMA projects in urban transportation, BRT transportation corridors, and vehicle replacement. Projects to convert biogas to energy in landfills and composting projects represent 27% of the actions. Another 18% are sustainability projects in housing such as NAMA, the use of fuelwood-saving stoves, and green mortgages. The remaining 10% are focused on issues of reforestation and composting plants.

The improvement of agro-livestock and forestry practices which reduce GHGC emissions counts on different established commitments related to forest conservation through early action, promoting sustainable practices in livestock production, and reforestation of forest areas.

To reduce SLCP emissions, actions to improve waste management are included, such as increasing WWTP and constructing landfills, which represent 25% of the projects. Furthermore, transport initiatives such as the modernization of freight and issuance of energy efficiency standards for heavy vehicles (25%) are reported. PEMEX initiatives to monitor and mitigate black carbon emissions from the burning, venting, and use of gas represent 38% of the actions, while the remaining actions are based on reducing sugarcane burning in agricultural activities.

The analysis shows the quantified mitigations (whether already achieved and reported, estimated, or expected) and the stage of maturity of each project.

It is encouraging to observe impact initiatives in all areas, both for their mitigation and for the precedent they establish. At the same time, the fulfillment of the goals will require that such participation continue to increase steadily in all sectors.

## Progress in Establishing a Measurement, Reporting, and Verification System

In Mexico, actions to implement the reporting of the mitigated emissions are being strengthened; in this sense, instruments arising from the General Law on Climate Change recognize the need to have elements of MRV which allow for following up on the progress and results of the national climate change policy.

An important part of the progress for the consolidation of an MRV System is the RENE, which came into force in October 2014. This Registry regulates the sectors, sources, and thresholds that will report greenhouse gas and compound emissions. It also enables reporting of verified voluntary emissions reductions. The Registry will allow for an online electronic report that will make it possible to have different types of users within the government and outside it, and will give greater transparency to the process.

The Registry will include direct and indirect emissions, i.e., those generated in the processes and activities of the establishment that must report, as well as those generated off-site as a result of its electric and thermal consumption. It will also allow interested parties to register projects or activities on a voluntary basis that result in the mitigation of emissions, contributing to the creation of synergies, attracting investments, and transactions arising from this. The mitigation of emissions that these projects report must have the support of verifying agencies.

The information provided annually by establishments is subject to inspection and monitoring by the Federal

Attorney's Office for Environmental Protection (PROFEPA, per its Spanish initials)<sup>15</sup>, as part of the verification actions.

Another initiative that is anticipated to be linked with RENE is the National Registry of NAMA, in which, in a voluntary manner, the NAMA developer will be able to register the mitigation obtained by the implementation of their project once it is certified by an accredited organization and approved for verification of emissions or for the certification of its reduction.

Through the National Registry of NAMA, it will be possible to concentrate information, assist in the process of international registration with the UNFCCC, and facilitate the channeling of possible supports. Additionally, the NAMA may be linked to the MexiCO<sub>2</sub> platform for the commercialization of certified reductions.

Another noteworthy advance is represented by the design of an improved system for electronic reporting and monitoring of advances in courses of action undertaken by the Federal Public Administration (APF, per its Spanish initials) through the PECC 2014-2018. The measurement and monitoring of committed actions is under the supervisions of the focal points of the agencies belonging to the CICC, which report periodically on progress. The analysis and verification of advances is reported by the General Directorate of Climate Change Policy of the SEMARNAT. Additionally, it is anticipated that the dissemination of results will be done through an annual progress report from the PECC to be published on the SEMARNAT website.

There is also sectorial progress to be noted. In the forestry sector, the National REDD+ Strategy envisages the development of a national forest monitoring system that allows for monitoring, reporting, and verifying mitigation activities in this sector as one of its components. In its design, it is being considered to implement an operational system of remote sensors to monitor land use changes on national territory, as well as to improve EFs and methodologies and protocols to gradually standardize the MRV at the national, subnational, and local levels.

<sup>15</sup> The Federal Attorney's Office for Environmental Protection is a decentralized administrative agency of the SEMARNAT with technical and operational autonomy, whose main task is to increase levels of compliance with environmental regulations in order to contribute to sustainable development and enforcing laws on environmental matters.

A fundamental part of establishing an MRV system consists of having increasingly more precise data. In this regard, the experience of Mexico in relation to INEGI development plays an important role in developing national EFs, which will generate a wealth of methods for the quantification of these factors and will raise the level of precision of the emissions data.

The elements generated through the MRV system also constitute important inputs for the assessment of the national climate change policy, and they feed into the recommendations generated by the Evaluation Coordination. Therefore, they will necessarily evolve in tandem in order to respond to the challenges that assessing public policy involves.

Additionally, work is being done to have a database on the flow of national and international resources intended for projects on climate change in Mexico.

## Challenges regarding Monitoring, Reporting, and Verification in Mexico

Beyond the MRV system, a system of carbon paths or "budgets" is recommendable which allows us to compare the situation as it is (mitigations achieved and validated per year) with how it should be (annual mitigations required per year to be on a consistent pathway to meet goals).

## Areas of Opportunity

- Achieve throughout the MRV system such certainty and transparency so as to facilitate entry into international financing and incorporation into a possible carbon market.
- Design and/or adapt methodologies to measure, monitor, verify, and report mitigation actions.
- Provide feedback on the design and planning of climate change policy with the inputs generated through an MRV system.

## V. COMMITMENT, OPPORTUNITIES AND NEEDS

### Commitment Provided for and Determined at the National Level

In March 2015, Mexico announced its INDC, the mitigation component includes unconditional measures, which refer to those that the country is committed to fulfilling under existing international agreements, and conditional measures, which require a robust and binding global agreement, including an international carbon price.

The committed GHG mitigation goal for 2030 is to reduce emissions to 22% relative to a baseline trend, i.e., approximately 210 MtCO<sub>2</sub>e. Furthermore, reducing BC emissions by 51% has been proposed. There is an additional commitment to achieving an emission ceiling around the year 2026 (Figure 4). This reduction of GHG emissions would imply reducing carbon intensity by about 40% between 2013 and 2030.

In terms of adaptation, Mexico has taken a geographical approach with targeted actions in three areas: reducing social vulnerability, adaptation via ecosystems, and reducing risk to strategic infrastructure. Important areas for action –and a quantified goal– are indicated in each of them. This information is summarized in Table 6.

The commitment to reduce GHG and BC may be increased conditionally if a global agreement is adopted that includes a price on international carbon, adjustments to tariffs by carbon content, technical cooperation, low-cost financial resource access, and access to technology transfer, all at a scale equivalent to the challenge of global climate change. Under these conditions, national GHG reductions may increase to 36% and BC reductions may reach 70% by 2030, arriving at a path consistent with the route proposed in the General Law on Climate Change, which seeks to reduce the volume of GHG emissions by 50% by 2050 compared to those recorded in 2000.

The achievement of the INDC goals will require a number of important changes in all sectors, and therefore decisive policy measures.

FIGURE 4 • Indicative Emission Path to Achieve Mexico's INDC

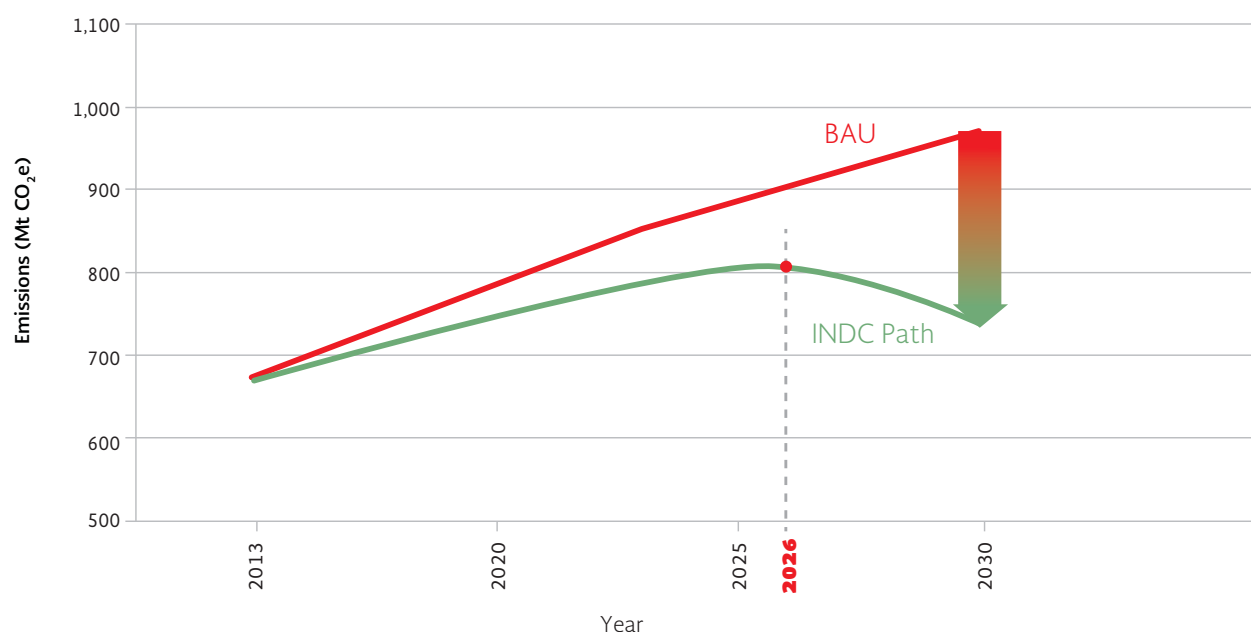


TABLE 6 • Areas with a Geographic Approach to Adaptation

Social Sector	Ecosystem-Based Adaptation	Strategic Infrastructure and Productive Sectors
<ul style="list-style-type: none"> <li>Achieve resilience in 50% of the most vulnerable municipalities in the country</li> </ul>	<ul style="list-style-type: none"> <li>Reach a deforestation rate of zero by 2030</li> </ul>	<ul style="list-style-type: none"> <li>Install the early alert system and risk management at the three levels of government</li> </ul>
<ul style="list-style-type: none"> <li>Incorporate a climate, gender, and human rights approach into all the instruments of territorial planning and risk management</li> </ul>	<ul style="list-style-type: none"> <li>Reforest the high, medium, and low watersheds taking their native species into account</li> </ul>	<ul style="list-style-type: none"> <li>Ensure and monitor urban waste water treatment in settlements with more than 500,000 inhabitants</li> </ul>
<ul style="list-style-type: none"> <li>Increase financial resources for disaster prevention and relief</li> </ul>	<ul style="list-style-type: none"> <li>Increase ecological connectivity and carbon sequestration through conservation and restoration</li> </ul>	<ul style="list-style-type: none"> <li>Ensure the safety of strategic infrastructure</li> </ul>
<ul style="list-style-type: none"> <li>Establish land use regulation in areas at risk</li> </ul>	<ul style="list-style-type: none"> <li>Increasing carbon sequestration and coastal protection through conservation of coastal ecosystems</li> </ul>	<ul style="list-style-type: none"> <li>Incorporate climate change criteria in agricultural and livestock programs</li> </ul>
<ul style="list-style-type: none"> <li>Comprehensive watershed management to ensure access to water</li> </ul>	<ul style="list-style-type: none"> <li>Synergies of actions to reduce emissions from deforestation and forest degradation (REDD+)</li> </ul>	<ul style="list-style-type: none"> <li>Implement the standard for specifications for environmental protection and adaptation in coastal tourist real estate developments</li> </ul>
<ul style="list-style-type: none"> <li>Ensure training and participation of society in the adaptation policy</li> </ul>	<ul style="list-style-type: none"> <li>Ensure comprehensive water management in its various uses (agricultural, ecological, urban, industrial, domestic)</li> </ul>	<ul style="list-style-type: none"> <li>Incorporate adaptation criteria in public investment projects that consider infrastructure construction and maintenance</li> </ul>

There is significant potential for reducing emissions in the country, as shown by various studies. For example, analyses of abatement cost curves<sup>16</sup> show a mitigation potential by 2020 of between 260 and 280 MtCO<sub>2</sub>e, consistent with mitigation goals established in the LGCC (see Figure 5).

These studies show that the cost or benefit of abatement actions has a strong sensitivity to the cost of capital, which means that access to funds at competitive rates will be a fundamental element to meeting the objectives of low-emission growth in Mexico.

Other studies illustrate that the macroeconomic impact of the implementation of a portfolio for types of mitigation actions may be positive (see Figure 6).

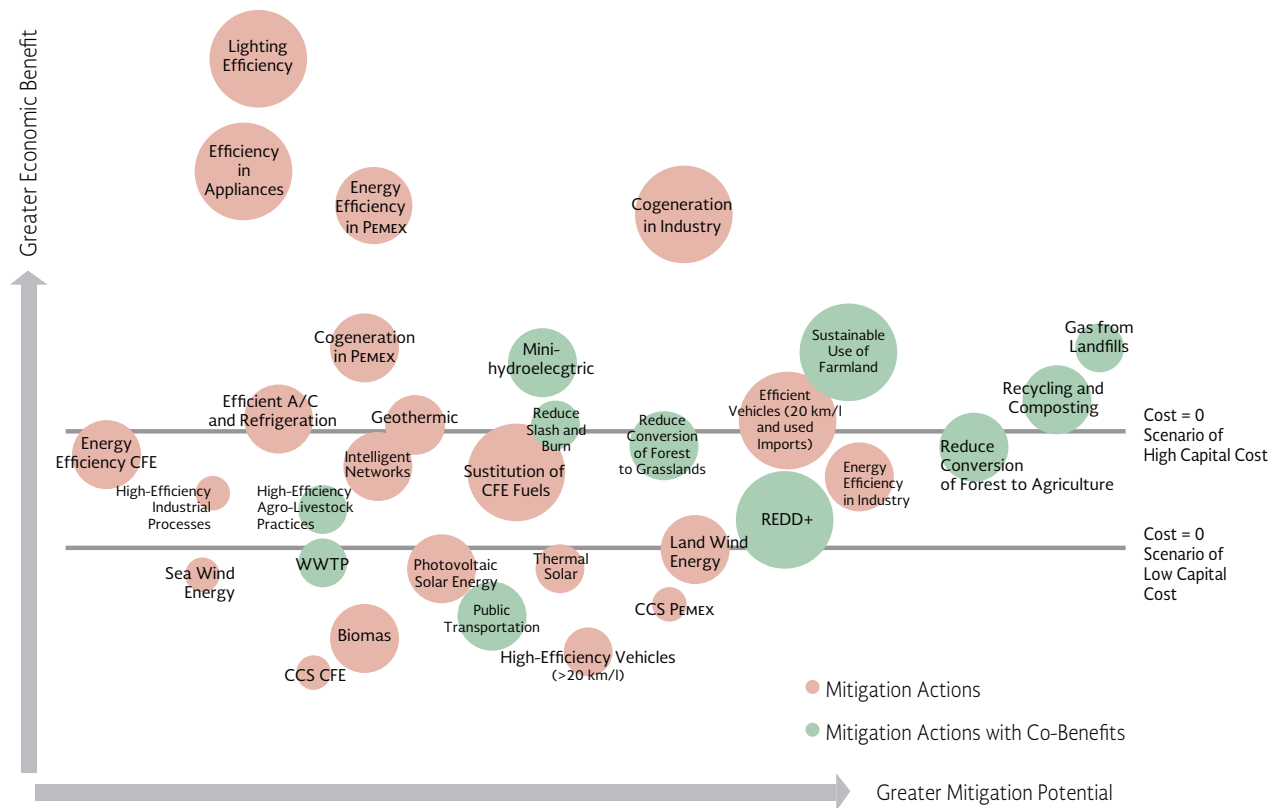
Important areas of opportunity have been identified for reducing GHG emissions at the sectorial level. The most notable areas are summarized below.

## Oil and Gas

- Prioritize projects for increased operational and energy efficiency in PEMEX, even if they are not as profitable as the extraction of oil and gas.
- Reduce fugitive emissions by adopting international best practices that are feasible based on the new governance structure of the sector. It is necessary to identify appropriate methodologies to exploit gas from geographically isolated fields, particularly in unconventional and deepwater gas reservoirs.
- Ensure operating practices typical of the industry through increased competition and transparency owing to the entry of new international producers.
- Increase the supply of natural gas intended to displace fuels with higher carbon intensity (coke, fuel oil, and diesel) in sectors such as industry and electricity generation.

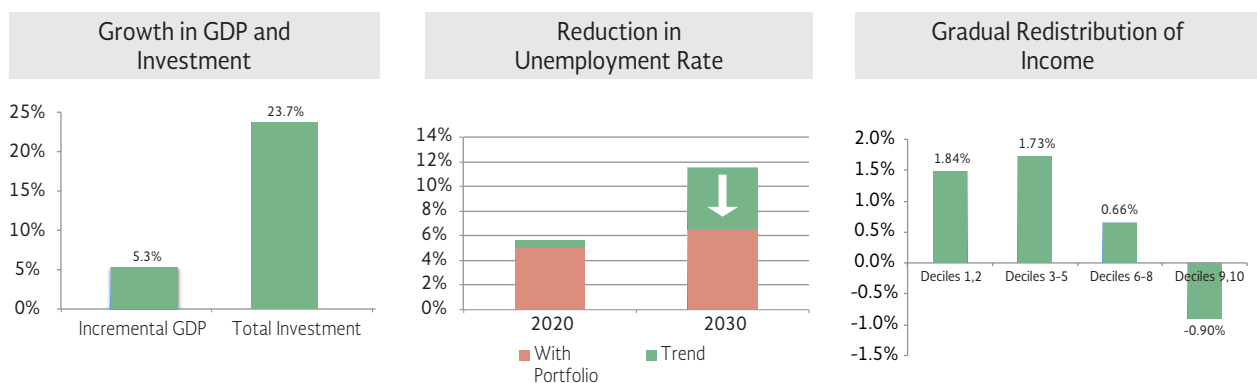
<sup>16</sup> Potential mitigation of greenhouse gases in Mexico by 2020 in the context of international cooperation, INE, 2010.

FIGURE 5 • Cost Matrix, Potential Co-Benefits, and Feasibility of Abatement in Mexico by 2030



Source: Developed by the author based on the National Climate Change Strategy, SEMARNAT, 2013.

FIGURE 6 • Macroeconomic Impacts of a Mitigation Portfolio by 2030



Source: Source: Author's calculations based on economic analysis of Mexico's Low Emissions Development Strategy, INE, 2011.

- Increase production of light hydrocarbons, thanks to the restructuring of refineries to increase the use of the heavier and more carbon-intensive fractions.
- Implement a platform for research, innovation, development, and adaptation of climate technologies in the sector. For example, the development of systems for sequestering and storing carbon.

## Power Generation

- Develop tax policies and economic and financial instruments which spark investment in renewable energy projects to achieve the goals of the LGCC and LAERFTE.
- Generate a suitable system of supports and incentives to internalize the environmental benefits of clean energy in electricity production, including distributed generation.
- Implement electricity dispatch smart grids to improve the management of supply and demand in an array with a higher content of intermittent sources of energy (including renewable ones) and to identify non-technical losses in distribution.
- Attract investment in research and development of technologies to lower their cost and increase the use of renewable energy by maximizing the benefit of these investments for the Mexican economy, including job creation.
- Develop a strategy for biofuel production that considers the conservation of ecosystems, sustainable water use, the maximization of environmental performance, and preservation of soil quality.

## Industry

- Support increased efficiency and adoption of better practices, above all in small industries.
- Develop standard regulations and an incentive system for regulating future energy consumption, including energy services markets.
- Adopt the best practices and behaviors both along the production chains and for the end consumers.
- Certify products generated from efficient technologies.

## Transportation

- Expand and improve infrastructure for public transportation systems to support massive modal transportation changes.
- Increase energy efficiency of the national vehicle fleet and regulate emission levels.
- Optimize mobility management. For example, introduce electronic road tolls, restriction on movement in congested areas, incentives for non-motorized transportation.
- Improve the efficiency of freight transportation through participation of railways in land cargo transport and with the coordinated operation of vehicles, the construction of specialized terminals and freight corridors, and the implementation of reliable information systems.
- Promote the development of a climate culture and plan urban centers to reduce demand for transportation and increase its efficiency.
- Planning urban centers to reduce demand for transportation and increase its efficiency.
- Use biofuels in the production of gasoline distributed nationwide.

## Residential, Commercial, and Services

- Remove the electricity subsidy that discourages the investment required for migration to more efficient technologies.
- Promote distributed generation, for example, with photovoltaic cells on roofs in urban areas.
- Increase adoption of efficient wood stoves.
- Meet progressive regulations for energy efficient consumer appliances and in new constructions.
- Strengthen incentives to purchase efficient electrical appliances through the electricity bill.



## Wastes

- Encourage the use of energy derived from waste management.
- Develop policies and mainstreaming, inclusive, and coordinated actions which work in favor of collaboration between institutions (including municipal governments) and private project developers to encourage responsible and comprehensive waste treatment.
- Improve institutional capabilities to develop planning, implementation, and operation of collection systems and waste management as well as power generation projects.
- Strengthen the chain of custody from collection through processing to final disposal to optimize the recovery of waste.

## Agriculture and Livestock

- Adjustments to stocking and planning on rangeland and the spread of treatment of agro-livestock wastes for energy generation.
- Improve productivity and crop variety toward less resource and energy-intensive systems and, extended rotation, the use of cover crops, and conservation tillage in agrosilvopastoral and agroforestry systems.
- Adopt better practices for sustainable use of fertilizers.
- Develop economic and financial instruments which redirect energy subsidies to support energy efficiency and the use of alternative energies.
- Adapt to crops with lower water requirements to improve the conservation of water and soil.

## Forestry

- Finalize and implement the REDD+National Strategy including the development of the corresponding MRV system.

- Create mechanisms and platforms for innovation and development that strengthen comprehensive planning in rural areas to reconcile the aptitudes, priorities, and needs of land use with the resources and services they offer and with the expectations of growth and social inclusion of the country.

## Paths and Transparency in Reporting INDC

The fulfillment of the INDC goals will require coordinated efforts in the areas of regulation, planning, programs, investments, and incentives to maintain a long-term approach. A great part of the required mitigation actions require a sequence of changes (in regulations, programs, investment, and incentives, etc.) that often are interdependent. Thus, achieving efficient mitigation requires us to develop pathways for each sector. They must reflect causal routes of change, starting from the present and culminating in the fulfillment of goals by 2030 and 2050. They will have to attain critical milestones in order to recognize their partial compliance according to an established schedule and avoid setbacks that could create risk of non-compliance.

Just like the goals, compliance in relation to the ambition will be expressed with respect to the baseline, which is “dynamic” because it can be updated as available information improves. This is the fairest way to express the ambition for mitigation in a country whose emissions will continue to increase in the absence of strong climate policies.

However, taking a dynamic baseline as a reference creates the risk of future uncertainty regarding the level of ambition in the event of updates to the baseline itself. To minimize this uncertainty, Mexico will work transparently on any adjustment to the baseline, reaffirming the country’s commitment to comply with avoiding backsliding on the level of ambition.



## ACRONYMS AND ABBREVIATIONS

AAGR	Annual Average Growth
APF	Federal Public Administration, per its Spanish initials
AR5	Fifth Assessment Report of the IPCC
ASEA	Agency of Security, Energy and Environment, per its Spanish initials
BC	Black carbon
BNE	National Energy Balance, per its Spanish initials
C3	Council on Climate Change
CCAC	Climate and Clean Air Coalition to Reduce Short Lived Climate Pollutants
CDM	Clean Development Mechanism
CENAPRED	National Center for Prevention of Disasters, per its Spanish initials
CERs	Certified emission reductions
CFE	Federal Electricity Commission, per its Spanish initials
CIB	Inter-Ministerial Commission for the Development of Bioenergy, per its Spanish initials
CICC	Inter-ministerial Commission on Climate Change
COA	Annual Operations Document, per its Spanish initials
CONAFOR	National Forests Commission, per its Spanish initials
CONAGUA	National Water Commission, per its Spanish initials
CONAPO	National Population Council, per its Spanish initials
CONEVAL	National Council for the Evaluation of Social Policy
COP	Conference of the Parties
DOF	Official Journal of the Federation, per its Spanish initials
EAP	Economically Active Population
EFs	Emission factors
ENAREDD+	National Strategy for Reducing Emissions from Deforestation and Forest Degradation, per its Spanish initials
ENCC	National Strategy for Climate Change, per its Spanish initials
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GHG	Greenhouse gas

GPG	IPCC Good Practice Guidance
GWP	Global Warming Potentials
IEA	International Energy Agency
IMP	Mexican Petroleum Institute, per its Spanish initials
INECC	National Institute of Ecology and Climate Change, per its Spanish initials
INEGI	National Greenhouse Gas Inventory, per its Spanish initials
INEGI	National Institute of Statistics and Geography, per its Spanish initials
INFyS	National Forest and Soil Inventory, per its Spanish initials
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
LAERFTE	Law for the Use of Renewable Energies and Financing of Energy Transition, per its Spanish initials
LASE	Law for Sustainable Use of Energy, per its Spanish initials
LGCC	General Law on Climate Change, per its Spanish initials
LULUCF	Land use, land use change, and forestry
MRV	Monitoring, reporting, and verification
MSW	Municipal solid waste
NAMA	Nationally Appropriate Mitigation Actions
INDC	Intended Nationally Determined Contribution
PEAER	Special Program for the Use of Renewable Energy, per its Spanish initials
PECC	Special Program on Climate Change, per its Spanish initials
PEMEX	Petróleos Mexicanos (Mexican Oil Company, per its Spanish initials)
PND	National Development Plan 2013-2018, per its Spanish initials
PROFEPA	Federal Attorney's Office for Environmental Protection, per its Spanish initials
PROMARNAT	Sectorial Program of Environment and Natural Resources, per its Spanish initials
PRONASE	National Program for the Sustainable Energy Use, per its Spanish initials
RENE	National Emissions Registry, per its Spanish initials
SEGOB	Ministry of Government, per its Spanish initials
SEMARNAT	Ministry of Environment and Natural Resources, per its Spanish initials
SENER	Ministry of Energy
SIACON	Agri-Food Consultation Information System, per its Spanish initials
SIAP	Agri-Food and Fishery Information Service, per its Spanish initials

SIE	Energy Information System, per its Spanish initials
SINACC	National System for Climate Change
SLCPs	Short-Lived Climate Pollutants
SNAP	Strategic National Action Plan
SRE	Ministry of Foreign Affairs, per its Spanish initials
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WWTP	Wastewater treatment plants

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