



ESTIMATING THE COSTS OF UNCONDITIONAL MITIGATION MEASURES TO SUPPORT THE IMPLEMENTATION OF MEXICO'S NDC

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ACTION AREA: Mitigation

FOCUS AREA: Preparing

COUNTRY: Mexico

SECTORS

INVOLVED: Cross-sectoral

TIMEFRAME: May 2016 - July 2017

CASE SUMMARY: Following the ratification of the Paris Agreement by Mexico in December 2016, a process was carried out to estimate the cost of implementing the unconditional Nationally Determined Contribution (NDC) target. The NDC target was defined by the Mexican Ministry of Environment (SEMARNAT) and the National Institute of Ecology and Climate Change (INECC) based on the results of a participatory process.

As a starting point, 30 mitigation measures were chosen to achieve the unconditional GHG mitigation component that had been identified. With support from the Mexico-Denmark Climate Change Mitigation and Energy Programme, the Green Growth Coordination Unit (CGCV) within INECC led the process of estimating the costs of the 30 mitigation measures. A team of external sectoral experts was hired to work in-house in close consultation with the sectoral secretariats of energy, transport, housing, industry and agriculture. The process was complemented with sectoral public private dialogues to add the inputs from relevant stakeholders. As a final step, the results from this analysis were cross-checked with other modelling results to guarantee consistency. The final results showed that the implementation of all 30 mitigation measures would result in savings of up to 17 billion USD in comparison the business-as-usual (BAU) scenario for the period 2014-2030 (SEMARNAT & INECC, 2018).

Mexico's costing exercise is considered a good practice as it has been a technically comprehensive effort that was carried out by local experts for each sector. It has been well documented and is readily available for planning and decision-making. Information needed for the calculations was provided by official entities and close sectoral coordination was prioritised. The process has furthermore been characterised by a high-level of stakeholder participation.





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BACKGROUND: Mexico approved its Climate Change Law in October 2012, establishing a political and institutional framework for addressing climate change in the country. It set clear objectives and targets and established a multi-stakeholder institutional arrangement, based on which Mexico has continuously advanced its climate policies and commitments (International Partnership on Mitigation and MRV, 2015). The Climate Change Law also establishes the mandate to prioritise cost-effective mitigation actions (i.e. those with higher potential of GHG reductions and lower costs, and with social benefits for the Mexican population).

In March 2015, Mexico presented its Intended Nationally Determined Contribution (iNDC). To formulate the NDC, a consultation process was carried out, that involved NGOs, academia and private industry representatives from all economic sectors through participatory workshops and a survey. This resulted in the preliminary identification of several potential measures that could allow the achievement of the unconditional NDC target (SEMARNAT & INECC, 2018). The iNDC was converted into the NDC in April 2016 with the signature of the Paris Agreement and the ratification of the latter by the Senate in December 2016. Mexico's NDC was developed in a participatory manner that involved multiple governmental entities. It follows an economy-wide approach that includes mitigation and adaptation commitments and splits the mitigation commitment into an unconditional target (a 22% reduction of GHG emissions and a 51% reduction of black carbon below the business-as-usual (BAU) scenario until 2030) and a conditional target (36% reduction of GHG emissions and 70% reduction of black carbon). The BAU scenario is based on projections of economic growth in the absence of climate policies, starting in 2013. The achievement of the conditional target is subject to international support, inter alia access to low-cost financial resources and technology transfer (Government of the Republic of Mexico, 2015a).

While the NDC target is economy-wide, sectoral targets and measures were set that can help achieve the NDC target as a whole. Based on the participatory process followed for the definition of the NDC, the National Institute of Ecology and Climate Change (INECC for its acronym in Spanish), defined initial sectoral targets (see Figure 1) and preliminary measures for eight economic sectors. INECC is a decentralised public organ of the SEMARNAT. While SEMARNAT is the entity responsible for high-level decisions and climate policies (including the NDC), INECC supports the NDC-related work of SEMARNAT through assessing options to achieve the NDC targets by identifying technological pathways and the corresponding costs (SEMARNAT & INECC, 2018).



Figure 1: National emissions of GHGs under the BAU-scenario and unconditional NDC goals for the years 2013-2030 (Government of the Republic of Mexico, 2015b)

Building upon the information already collected in the NDC preparation process, SEMARNAT and INECC identified and provided a detailed description of 30 mitigation measures for eight economic sectors that would support the achievement of the unconditional NDC mitigation target (see Table 1). Although these measures counted with their own narrative and detailed information, these are not considered in the official NDC, but are indicative measures (SEMARNAT & INECC, 2018).

SECTOR	MEASURES
TRANSPORT (MOBILE SOURCES)	<ul style="list-style-type: none"> · Update norm on emission and energy efficiency for new light vehicles. · Execute programmes on densification of cities and actions to adopt integrated transport systems · Modal change in freight transport · Publish norm on emission and energy efficiency for new heavy vehicles · Restrict imports of used vehicles · Build interurban passenger trains · Accelerate the penetration of clean and efficient technologies in autotransport · Apply programmes for introduction of public transport gas vehicles
ELECTRICITY	<ul style="list-style-type: none"> · Reach 35% of clean energy in 2024 and 43% in 2030 · Modernise the generation plant · Reduce technical losses on electric network · Substitute oil for natural gas
RESIDENTIAL AND COMMERCIAL	<ul style="list-style-type: none"> · Use water saving equipment to reduce demand on energy for water heating · Replace conventional heaters with efficient alternatives
OIL AND GAS	<ul style="list-style-type: none"> · Execute the Global Initiative on Methane Reduction · Reduce fugitive emissions through NAMA · Targets on generation and self-supply with clean energy (co-generation) · Instrument systems of capture, storing and use of carbon dioxide · Replace heavy fuels by natural gas in the National Refining System
INDUSTRY	<ul style="list-style-type: none"> · Execute NAMA of cement sector · Contribute in the targets on generation and self-supply with clean energy · Use sugar cane by-products as fuels · Substitute fuel oil with clean fuels such as natural gas
AGRICULTURE AND LIVESTOCK	<ul style="list-style-type: none"> · Reduce burning of crop waste on site, providing assistance to seven states with higher generation of waste · Install and operate biodigestors in stock cattle facilities · Substitute nitrogenous synthetic fertilisers with biofertilisers
WASTE	<ul style="list-style-type: none"> · Achieve zero emissions of methane from landfills by 2030 · Achieve zero open fires by 2030
LULUCF	<ul style="list-style-type: none"> · Achieve a zero deforestation rate by 2030 through the REDD* National Strategy · Promote sustainable forest management and increase productivity of forests with productive potential and in land with potential for commercial forest plantations

Table 1: Indicative mitigation measures for the unconditional NDC target (SEMARNAT & INECC, 2018)



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ACTIVITIES: ————— A range of activities was carried out for the cost analysis of the 30 unconditional mitigation measures that are linked to Mexico's NDC. Starting in May 2016, and under the leadership of the General Coordination of Green Growth (CGCV for its acronym in Spanish) within INECC, the costs of the 30 unconditional measures for the period 2014-2030 were estimated. The costing exercise was carried out within the framework of the Mexico-Denmark Climate Change Mitigation and Energy Programme (CCMEP) with support from the Danish Energy Agency (DEA).

The lines of action that the CGCV followed for the economic analysis included (SEMARNAT&INECC, 2018):

- Disaggregated cost analysis for each sector and measure;
- Public-private dialogues with sectoral experts to support the definition of measures, identification of barriers and means of implementation options;
- Analysis of criteria beyond economic factors, such as social and environmental benefits linking to sustainable development targets

The process started by establishing a team of experts that would be in charge of carrying out the cost analysis. Rigorous terms of reference were prepared and agreed between CCMEP and the CGCV. PhD candidates with an environmental economics background were hired to lead the costing exercise for each sector with a senior supervisor coordinating the whole process. All the team members were based full time in the CGGV offices during the 12 months of operation.

ECONOMIC ANALYSIS

The estimation of mitigation costs considered all resources needed for the entire project cycle, including planning, initial investments and operation and maintenance. The analysis included five steps:

1. Design and description of the BAU scenario and its associated GHG emissions
2. Design and description of the mitigation scenario
3. Calculation of costs associated to each of the previous scenarios, considering investment, operation and maintenance (costs of the mitigation measures are considered gross costs in the analysis)
4. Calculation of the net cost, based on the difference between the gross (mitigation measure) cost and the BAU cost. This methodology is a proxy of the opportunity cost concept. Negative results are considered savings from mitigation measures.
5. Estimation of the mean cost of mitigation, based on the net cost and the expected GHG mitigation, resulting in cost (or saving) per mitigated tonne and expressed in dollars per tonne of carbon dioxide equivalent (USD/tCO₂e)

For comparability issues among measures, results were given as present value, using a discount rate of 10%, as used by the Secretary of Finance and Public Credit for the assessment of social investment projects. Other variables, parameters and indicators used for the calculations in different measures were also standardised for all sectors to use the same values as basic assumptions. This applied for the exchange rate (pesos to American dollar), consumer's price index and gross domestic product, among others.

All estimations were based on specific information on each one of the sectoral measures. Information was collected from different sources, including:

1. Information available within INECC or SEMARNAT
2. Public information from other governmental institutions (Energy Ministry, National Forestry Commission, others)
3. Information provided by private companies, universities and other relevant stakeholders
4. Information on financial markets, project financing and financial instruments from financial institutions

PUBLIC-PRIVATE DIALOGUES

Based on the experience of the consultation process on the NDC that was held in 2015 (see background section), a series of Public Private Dialogues (DPP for its acronym in Spanish) was organised. The goal of these dialogues was to disseminate, validate and gather feedback regarding the mitigation measures and to collect relevant information for the costing exercise. Each DPP included presentations from experts on the technical elements from the sectoral measures; discussion panels on mitigation, public policy, finance and monitoring, reporting and verification; and, open discussions with participants, with guiding questions to collect specific inputs.

From May 2016 to July 2017, eight DPPs were realised, one general and seven sectoral. The DPPs reached almost 1,000 participants representing key stakeholders from the private and public sector, academia, civil society and international organisations (see Table 2) and gathering their statements and inputs.

DATE	TOPIC/SECTOR	# OF PARTICIPANTS
May 19th 2016	General	110
August 11th, 2016	Electric generation	130
August 24th, 2016	Residential and commercial	80
September 29th, 2016	Industrial processes	90
October 05TH, 2016	Waste	110
October 13TH, 2016	Transport	100
April 20TH, 2017	Agriculture and livestock	160
July 14TH, 2017	LULUCF	140

Table 2: Summary of Public-Private Dialogues (SEMARNAT&INECC 2018)

Further information from each one of the DPPs can be found in the INECC website:
<http://dialogos.cnds.inecc.gob.mx/>



Contributions from participants were registered in a digital platform for their analysis. As part of the dialogues, proposals on new actions, measures and strategies that could help in raising ambition were also collected, inter alia on available financing options to cover finance needs (SEMARNAT & INECC, 2018).

COMPARISON WITH RESULTS FROM OTHER MODELS

In order to validate the bottom-up calculations, the results were cross-checked with existing results from other models that estimated costs with broader scopes and approaches. Results from the following models were considered for comparison (INECC, 2018):

- ENERDATA (2015): Prospective outlook on Long-Term Energy Systems (POLES). This corresponds to a partial equilibrium simulation model for the energy system applied by the Europe-based firm ENERDATA. The model analyses the emission reduction potential of mitigation measures in the context of the NDC and their viability
- World Resources Institute (WRI) & Centro Mario Molina (2016) : Achieving Mexico's Climate Change Goals: An Eight Point Action Plan
- Price Waterhouse Coopers and CESPEDES (2015): Study about necessary investments for Mexico to accomplish the Clean Energy targets
- National University of Mexico (UNAM), National Council for Science and Technology (CONACyT) and Secretariat of Energy (SENER) (2015): Towards a low carbon energy system in Mexico

Although some of these models were applied to different measures, sectors or time periods, they proved useful to be compared to the results from the bottom-up cost analysis. Important coincidences were found and with that, the results from the bottom-up costing exercise were considered strong and reliable.

FINAL RESULTS

Final results of the costing exercise were consolidated in a final report prepared by INECC. It is estimated that Mexico can save more than USD 17 billion in implementing the unconditional NDC target compared to the BAU scenario for the period 2014-2030 (see Table 3). The estimated aggregated cost of the 30 mitigation measures is USD 126 billion with an expected reduction of 1.5 billion tonnes of CO₂eq (SEMARNAT&INECC, 2018). Results show that the NDC implementation pathway is more cost-effective than the BAU scenario. The latter, besides being more costly in financial and operative terms, would delay the transition of Mexico towards a decarbonisation of the economy (INECC, 2018).

SECTOR	MITIGATION (MTCO2E)	GROSS COST (MILLION USD)	NET COST * (MILLION USD)	MITIGATION COST (USD/TCO2E)
Total	1,520	126,024	- 17,397	-11.5
Electric	428	67,750	-26,234	-61.3
Transport	374	29,580	-10,039	-26.8
LULUCF	221	11,789	11,789	53.3
Waste	202	2,193	2,193	10.9
Oil and gas	151	5,425	5,425	35.9
Industrial	79	7,888	-159	-2
Agriculture and Livestock	47	280	-140	-3
Residential and commercial	18	1,124	-227	-12.6

Table 3: Summary of the results of the mitigation costs for the period 2014-2030 (INECC, 2018)
*The net cost is the difference between the mitigation scenario cost and the BAU scenario cost.

INSTITUTIONS

- INVOLVED:** —————
- **INECC:** As part of its mandate, INECC is in charge of generating the economic information regarding the emission reduction commitment. Within INECC, the Green Growth Department was in charge of leading the cost analysis process.
 - **SEMARNAT:** Is responsible for high-level decisions regarding climate change policies and implementation of the NDC.

COOPERATION

- WITH:** —————
- **MEXICO-DENMARK CLIMATE CHANGE MITIGATION AND ENERGY PROGRAMME (CCMEP):** Provided financial and technical support for the analysis of unconditional mitigation targets and the realisation of the DPPs.
 - **UNITED NATIONS DEVELOPMENT PROGRAM (UNDP):** Provided support in co-organising seven sectoral and two general DPPs.

- FINANCE:** —————
- The CCMEP provided 4,160,000 Mexican pesos (approximately 215,000 USD) for the process held between May 2016 and April 2017. These resources were used for hiring the expert consultants in charge of the sectoral costing exercise, the senior coordinator, the application of the POLES model and the dialogues, among other expenses

IMPACT OF

- ACTIVITIES:** —————
- **AVAILABLE INFORMATION FOR THE DESIGN OF NEW POLICIES AND PROJECTS:** Detailed assessment of 30 mitigation measures with quantified and systematised information is available as a useful tool for decision-making in future climate policy and planning as well as a basis towards the preparation of bankable projects. Results have been published in a public and comprehensive report and have been included in Mexico's sixth National Communication submitted to the UNFCCC.
 - **CLEAR PICTURE:** Besides the results in terms of costs of mitigation measures, the effort provides a clear picture of the productive structure of the country, neatly showing the production patterns and goods and energy consumption, including the negative externalities (INECC, 2018).
 - **INCREASED INTEREST FROM DIFFERENT STAKEHOLDERS.** The increased general interest for detailed information regarding the NDC and mitigation measures is evidenced by the participation of almost 1000 stakeholders from academia, private sector and civil society in all eight DPPs – and more than 430,000 online visits (until May 2018) to the microsite.
 - **CAPACITIES:** At least two of the experts hired for the costing exercise remained working for INECC further on, leaving the technical capacities within INECC.



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WHY IS IT

GOOD PRACTICE:

- **INTER-SECTORAL COOPERATION:** The costing exercise was conducted for each sector by INECC. Accordingly, INECC cooperated with each sectoral secretariat, thus significantly strengthening cooperation between different sectors and government institutions.
- **STAKEHOLDER ENGAGEMENT:** An important part of the process were the eight DPPs, where preliminary results were presented and validated with key representatives from diverse relevant sectoral stakeholders and further inputs and assumptions were collected as inputs for the costing exercise. The multi-stakeholder participation in the DPPs provided visibility to the ongoing effort and engaged key institutions that provide information and valuable inputs for the ongoing costing process.
- **TECHNICAL FEASIBILITY:** Clear and detailed terms of reference combined with high technical capacities of experts in charge of the costing process set the basis for a solid costing exercise.

SUCCESS FACTORS:

- **WELL-DOCUMENTED TECHNICAL STUDIES:** The costing exercise for the 30 unconditional mitigation measures identified for the NDC resulted in a comprehensive study that proved the cost-effectiveness of the identified measures. The detailed results are available through a specific report and are part of the Sixth National Communication.
- **COUNTRY-DRIVEN PROCESS:** The key to achieve the attained results was to count with a creative in-house team of environmental economists solely devoted to the economic analysis, closely supervised by INECC and with continuous feedback on intermediate results. In addition, the DPPs promoted continuous improvements based on expert recommendations and pushed the team to promptly produce results for diverse public fora.
- **WORK ENVIRONMENT:** There was a positive work environment established between the CGCV team and the experts in charge of the costing exercise, all based in INECC that allowed the process to flow without major complications.

**OVERCOMING BARRIERS /
CHALLENGES:** —————

**WHAT WERE THE MAIN BARRIERS /
CHALLENGES TO DELIVERY?**

INFORMATIONAL:

The comparability of results among sectoral measures was a challenge faced, as each calculation was done by a sectoral expert based on particular sectoral information.

Furthermore, the availability of and the access to relevant sectoral information needed for the estimation of costs proved to be challenging.

CAPACITY:

The costing process demanded time and human resources which were not available within INECC at that time.

**HOW WERE THESE BARRIERS /
CHALLENGES OVERCOME?**

Variables, parameters and indicators were standardised for all sectors as to provide consistency and allow for comparability among them. Inter alia, exchange rates, price indexes, population projections, discount rates were uniform among the eight sectors analysed.

All estimations were based on official national and international sources, the latter validated by experts. When information was not available, clear assumptions were taken and explicitly stated for traceability and further analysis. Information was collected through direct coordination with the relevant sectoral entities (ministries or other official organisations) and complemented through the DPPs.

Hiring a team of PhD candidates who were responsible for the costing process for each sector and supervised by a senior expert, with all of them working full-time based within INECC premises, has strengthened the capacities of CGCV during the period in which the exercise was conducted.

LESSONS LEARNED: —————

- **REGARD THE COSTING EXERCISE AS A LEARNING EXPERIENCE:** From a general perspective, the process of cost estimation of the 30 mitigation measures has generated valuable learning curves in cost estimations that can be taken into account in future updates, either for these same measures (while updating macroeconomic conditions) or, most importantly, for new mitigation measures.
- **PROVIDE SUFFICIENT SPACE AND TIME FOR THOROUGH RESULTS:** Providing space and time during the process to validate preliminary results of the estimated costs and collect inputs was a valuable investment to achieve more solid and agreed final results.
- **HIRE SPECIALISTS TO CONDUCT THE SECTORAL DIAGNOSIS:** A specifically dedicated environmental economists team solely devoted to the effort allowed for a thorough sectoral diagnosis which is vital to identify information gaps and key stakeholders to collect data.
- **ENSURE TRANSPARENT OUTPUTS FOR TRACEABILITY AND FURTHER USE:** Transparency in the assumptions made during the analysis is fundamental for update, replicability and traceability of the outputs.



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HOW TO REPLICATE

- THIS PRACTICE:** ————
- **DEVELOP SOLID MITIGATION MEASURES WITH CLEAR BOUNDARIES** and their associated mitigation potential. Complement these measures with an early establishment of key parameters (period of analysis, exchange rate, fuel prices, discount rate, etc.).
 - **DEFINE CLEAR AND DETAILED TERMS OF REFERENCE OF THE SCOPE OF THE PROJECT AND STUDIES TO BE CARRIED OUT:** It might require a difficult and complex negotiation process between the organisation providing the funds and the public entities that will lead the process. However, such a process will provide a solid foundation for the execution phase.
 - **INTEGRATE LOCAL SPECIALISTS IN THE COSTING EXERCISE PROCESS:** Promote the integration of local specialists in specific topics such as the modelling of costs. It is expected that these experts will remain linked in some way or another to climate issues in the country.
 - **MAINTAIN A CONTINUOUS DIALOGUE WITH PRIVATE, ACADEMIC AND PUBLIC STAKEHOLDERS:** This will ensure that all relevant inputs are collected for the costing exercise.

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FURTHER KEY

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CASE STUDY

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CASE STUDY

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