

**Assessment of Economic and Environmental Modeling Capabilities in Mexico**  
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**Purpose**

This paper reports the first effort by the Pacific Northwest National Laboratory (PNNL) to assess, on the behalf of the U.S. Environmental Protection Agency (EPA), the skills and infrastructure present in the economic and environmental modeling community of several developing countries, including Mexico, China, India, South Korea, and South Africa. This first report in the assessment focuses on the results of a questionnaire circulated at the “U.S.-Mexico Economic and Environmental Modeling Workshop,” convened in July 2005 in Mexico City. The workshop was hosted by the new Centro Mario Molina, or the Molina Center for Energy and the Environment, which was recently established by Mario Molina, a Nobel laureate, to apply science in Mexico to help improve the environment. EPA funded the workshop as part of a series to develop intellectual capacity for economic and environmental problem solving in developing countries. PNNL organized the effort and provided technical assistance to EPA.

The purpose of the workshop series—and for this assessment—is to help policy makers make investments to improve economic-environmental modeling capabilities and, especially, for the international economic and environmental modeling community to make judgments about the most useful opportunities for cooperation and collaboration. It is EPA’s intention to continue and expand this assessment.

**Methodology**

We gave questionnaires to 32 (non-randomly) selected, high-level experts in Mexico who were familiar with both the issues of economic and environmental modeling in the country and the intellectual capacity and infrastructure for carrying out the work. We provided the questionnaire in a folder of workshop materials. Verbal requests were made to return the survey, which was returned in a way that protected anonymity. Twenty of the 32 persons returned the survey. Given the small sample size, the results presented should be considered descriptive, not inferential, statistics.

Half the questions were presented in a format requesting the participant to indicate strength of agreement or disagreement to a statement. The questions were carefully crafted to avoid “positive bias,” the tendency for respondents to agree with positive statements, by providing similar statements made in the negative. The other half of the survey required estimating the capacity for modeling by filling in a blank, for “number of modeling teams” for example.

The survey questions are reproduced in Tables 1 and 2. The results for the first part of the survey—Table 1—are summarized in Figures 1-4; these figures represent the combined results of the “positive” and “negative” survey questions. Table 2 includes the survey questions and compiled results for the second part of the survey.

### **Detailed Findings**

A general opinion of American participants in the U.S.-Mexico Workshop on Economic and Environmental Modeling was that Mexico possesses intellectual and model capacity that is comparable to that of the international community, including Japan, Europe, and the United States. This opinion is supported by the responses of the Mexican experts we surveyed. In contrast, however, the strongest single response we obtained from the modeling survey is that the Mexican government provides very little support for Mexican modelers and model development. This attitude found voice also in question-and-answer sessions in the workshop itself, especially in a “policy discussion” session, in which a repeated criticism is a perceived “lack of continuity” in support. This lack of support manifests itself not only in funding for outside experts, but in funding of Mexican civil servants and the ability of the government to review and to serve as a “client” (even non-pecuniary) for model results.

Additional findings included the following, perhaps unsurprising results. A majority of experts believe that Mexican economic and environmental modelers possess high skill levels. A strong majority of experts believes that the Mexican government fails to support economic-environmental modeling. Experts disagreed more or less evenly on whether Mexican infrastructure, broadly defined, was adequate to meet the nation’s economic-environmental modeling needs. Significantly, experts found computing equipment to be generally adequate to the task, but that lack of data is a major impediment. Also, a small majority of experts believes that Mexico’s economic-environmental modeling capabilities are insufficient for its policy-making needs and commitments.

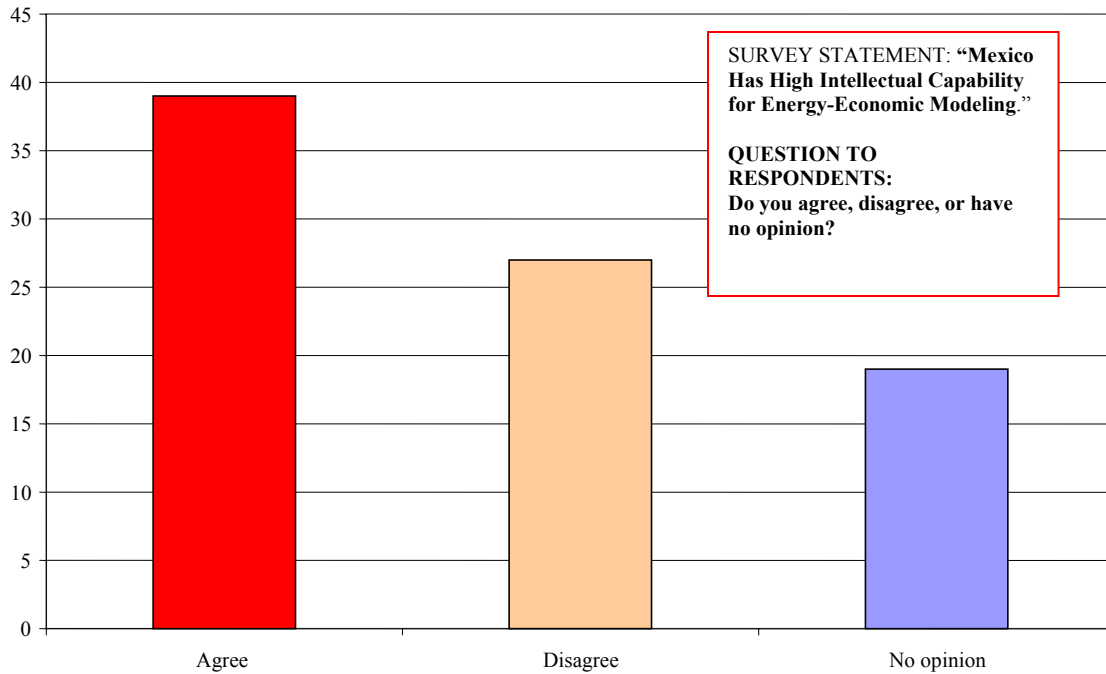
It is notable that experts were more mixed in their opinion whether economic-environmental modeling per se was anywhere sufficient for policy making, inside or outside Mexico. We interpret this result as meaning that half the Mexican experts believe modeling is “scientific” and half do not, meaning there is a healthy skepticism about modeling, which we believe to be part science and part art. Nevertheless, Mexican experts expressed even less confidence in their own nation’s capacity to provide policy-relevant and useful modeling results. This result stands in marked contrast to these same experts’ opinion that Mexican modelers include a sufficiently high-level of intellectual capacity. We can speculate that these mixed results are not so much a contradiction, but are consistent with the belief that the government of Mexico provides far too little support for economic- environmental modeling. To paraphrase the result, Mexico has highly qualified modelers, but they get little or no funding from the government and their work is insufficient for satisfying the policy-making needs of the Mexican government. This conclusion is consistent with the impression created by the interventions of several experts in the policy-making session at the workshop. It should be noted that all but one of the surveys was returned before that session took place.

The second half of the survey (presented in Table 2) asked for specific numerical responses to questions about modeling capacity. The chief results from this part of the survey can be most simply summarized in the following key points:

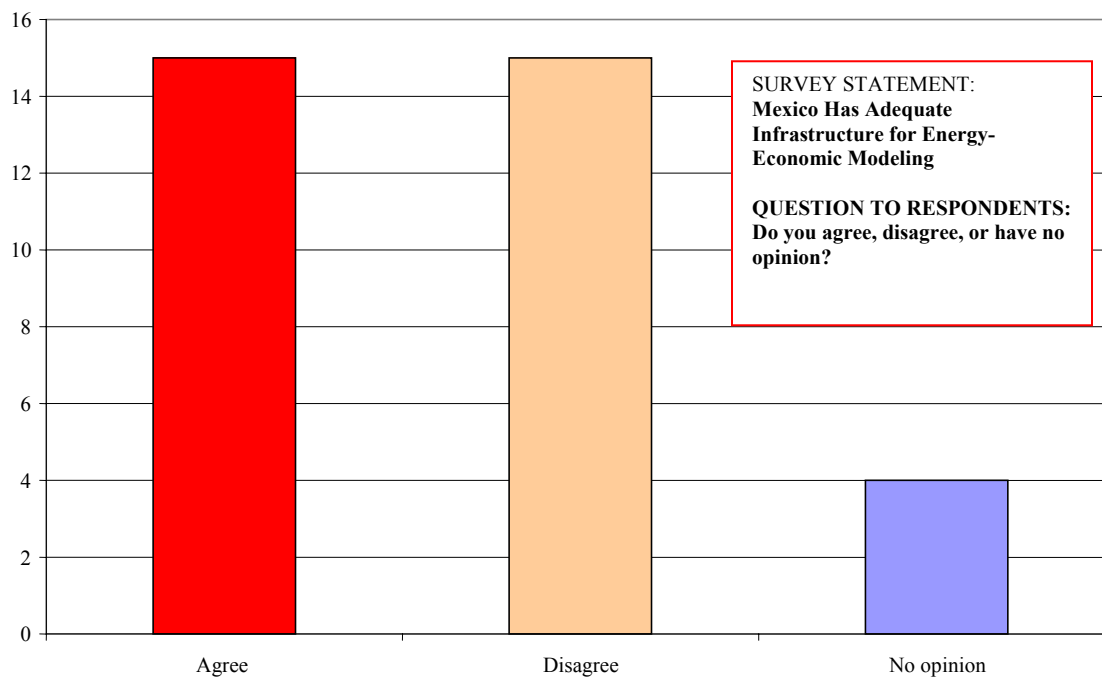
- Mexico has 3 or 4 “top-down” modeling teams (Mode = 3; Mean = 3.9).
- Mexico has 3 “bottom-up” modeling teams (Mode = 3; Mean = 2.5).
- Mexico has 2 “issue specific” modeling teams (Mode = 2; Mean = 2.3).
- Mexico has 2 “non-CO2 ” greenhouse gas modeling teams (Mode = 2; Mean = 2.2).

The experts could identify—even without naming them—only 2-3 university programs providing graduate education in modeling, only 2-3 peer-reviewed publications in economic-environmental modeling each year, and only 3 or so international organizations collaborating with Mexico on economic-environmental modeling.

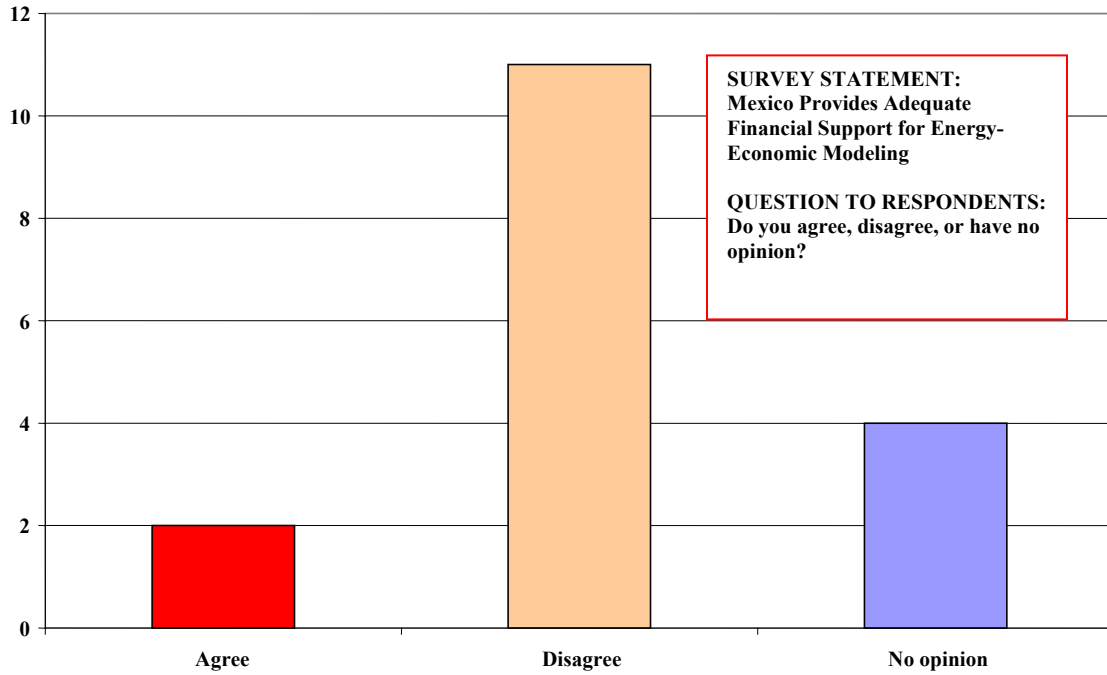
**Figure 1: When asked whether Mexico has the intellectual capacity to perform economic-environmental modeling, expert respondents said “yes.”**



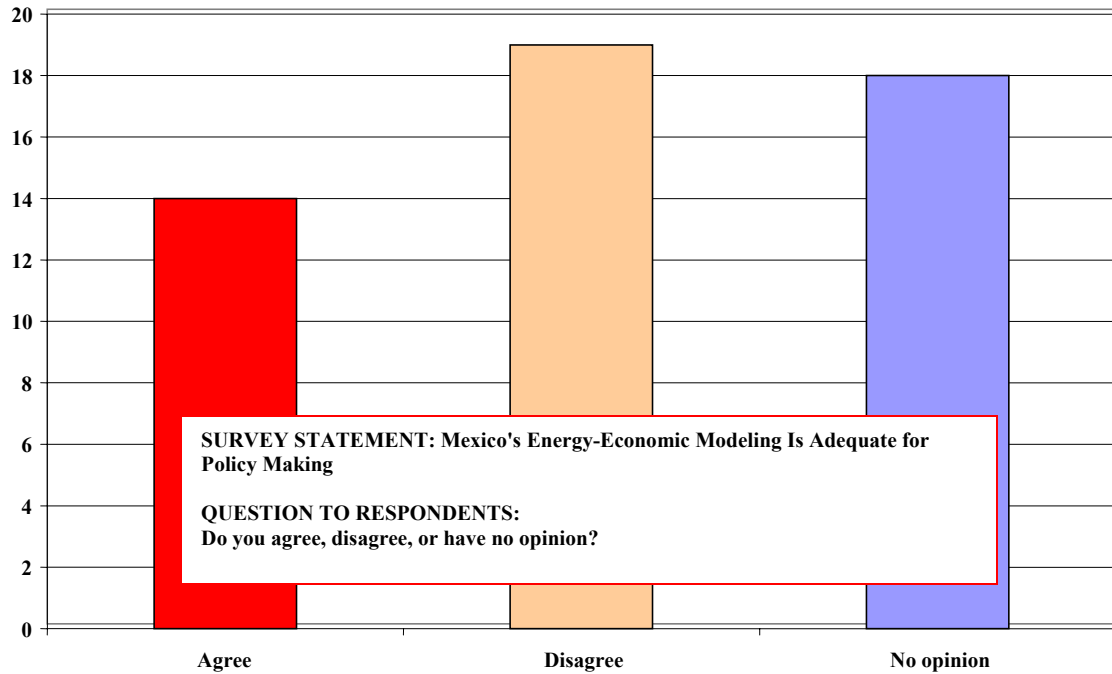
**Figure 2: When asked if Mexico possesses adequate computing and data collection infrastructure to conduct economic-environmental modeling, experts' responses were mixed, agreeing that computing was adequate, but not data collection.**



**Figure 3: A clear majority of Mexican experts surveyed believe that funding for economic-environmental modeling in their country is inadequate.**



**Figure 4: Respondents are divided in their opinion whether economic-environmental modeling is adequate for making policy decisions.**



**Table 1: This table shows the first of two parts of the survey, as presented. In the cells where respondents could mark, “Strongly Agree.....Strong Disagree,” the total responses to each question has been tallied.**

<b>Survey of Mexican Economic-Environmental Modeling Capacity</b>					
<i>Please indicate whether you strongly agree, agree, have no opinion, disagree, or strongly disagree with the following statements:</i>					
<b>Statements:</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>No opinion</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
<i>[PLEASE MARK ONE CELL IN EACH ROW WITH "FILL" LIKE THIS:]</i>					
Mexico has several highly qualified economic-environmental modeling teams.		11	2	4	
Energy-economic models used in Mexico are not adequate to guide policy making for climate change.		4	6	6	1
Energy-economic models used in Mexico compare favorably to European, U.S., and Japanese models.		6	4	7	
Mexican policy makers do not find economic-environmental models credible (they do not "believe" the results).	1	5	6	5	
The Mexican government provides significant financial support for economic-environmental modeling.		2	4	7	4
Mexican experts apply a sufficient peer-review process for economic-environmental modeling.		4	6	5	2
Mexico-based peer-reviewed journals devote sufficient space to publishing methods for and results from economic-environmental models.		1	7	8	1
Mexican economic-environmental modelers are not required to undergo sufficient professional training.				12	5
Mexican economic-environmental modeling is adequate to meet Mexico's international climate change policy commitments.	1	1	6	8	1
Economic-environmental models should be used only as a guide to policy making and should not be relied on as "scientific" in nature.	2	4	1	9	1
Many Mexican modeling experts are working in Mexico in addition to those listed in the agenda for the 11-12 July 2005 U.S.-Mexico Economic-Environmental Modeling		4	6	6	1
Access to adequate computing capacity is an impediment to economic-environmental modeling in Mexico.	1	2	2	9	3
Data limitations are not a serious impediment to economic-environmental modeling in Mexico.		3	1	11	2
Mexican economic-environmental modeling is more oriented to top-down or macroeconomic modeling than it is to bottom-up modeling with technological detail.		8	4	4	1



<b>Table 2: Survey of Mexican Economic-Environmental Modeling Capacity—Specific Capabilities</b>		
<i>Please give your “best guess” estimate for each category by marking one cell in each row. (Give a range, if you prefer.)</i>		
<b>Indicators</b>		
<b>How many teams of Mexican economic-environmental modelers are you aware of in Mexico?</b>	<b>MODE</b>	<b>MEAN</b>
- Top down model teams	3	3.9
- Bottom up model teams	3	2.5
- Issue-specific model teams (e.g., transportation)	2	2.3
- Modeling teams who address Non-CO2 greenhouse gases	2	2.2
<b>How many peer reviewed articles on economic-environmental modeling are published (in total) each year by Mexican specialists?</b>	2	3.1
<b>How many Mexican modeling teams utilize a high level of technological (engineering) detail in the models they run?</b>	4	2.6
<b>How many degree programs in Mexico train graduates in economic-environmental modeling?</b>	2	1.3
<b>How many public and private clients sponsor economic-environmental modeling in Mexico?</b>	2	1.8
<b>How many international organizations collaborate with Mexican researchers in the field of economic-environmental modeling?</b>	3	3.1