Biomethane for Electricity in Mexico: A Prospective Economic Analysis

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1. Motivations underlying the research

Mexican's new administration (2019–2024) has changed priorities from supporting a competitive electricity market and giving priority to renewable energy sources (RES) to bringing the energy industry back under government control. However, nonconventional RES in Mexico have made some progress during the recent years, contributing 10% of the total generation in 2019. In the case of bioenergy, it contributed with 0.54% of the total supply. Biomass can be converted to electricity in several ways, and the most used in Mexico is direct combustion, followed by biogas generation for either combustion or electricity. However, the alternative – transforming biogas into biomethane (BM) and selling it to current and future natural gas (NG) power plants – is not used in the country. NG is the main fuel used for electricity generation in Mexico and the country imports more than half of the NG required to satisfy domestic demand, and the electricity sector claims most of that. This dependence on foreign NG could be alleviated by sustainable domestic BM production, which could use the same infrastructure as NG and be stored in salt caverns and aquifers. In this sense, BM is different from other RES because it would compete with imported NG rather than domestic electricity production.

On the other hand, known production costs in Mexico are still very high, while market NG price projections are significantly lower for the next years. However, it is well documented that new renewable energy industries significantly reduce processing costs in the medium and long term.

In this context, this paper carries out a normative analysis of the welfare and environmental impacts of first- and second-best policies to incentivize BM domestic production to substitute part of the NG for power plants, in the presence of import dependency and externalities in the NG-for-electricity market, comparing them with outcomes obtained under current policy.

2. A short account of the research performed

This work constructs a stylized partial equilibrium model of the NG/BM for-electricity sector in Mexico to undertake the mentioned normative analysis. This optimization model simulates the formation of simultaneous equilibrium by maximizing the social surplus derived from production and consumption of a set of products related to the NG/BM-for-power subject to material balance equations and resource availability. The social-surplus function includes the NG for-power market in Mexico as well as the excess of supply of NG from the rest of the world.

Electricity plants are the direct consumers for this analysis. The model considers BM from the organic fraction of municipal solid waste and activated sludge from municipal wastewater treatment facilities. These two sources are confined at significant amounts, with a constant flow to specific sites, which makes them viable for medium-term implementation. For projections, BM and NG are assumed to be perfect substitutes to generate blended NG/BM-for-power.

The socially optimal scenario for Mexico considers the effects of imposing a commensurable carbon tax on emissions from NG. This policy provides a normative benchmark for comparison of the extent to which the mandate to blend BM in NG and status quo policies are second best in terms of their social welfare outcomes and differ in the incentives they provide for NG/BM mix, production, and consumption decisions relative to the first-best policy.

Results show that under the status quo policy, there is no BM production and Mexico imports most of the total NG required for the electricity sector. Under a mandate policy, total NG/BM demand

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decreases slightly given that BM producers would not produce a larger amount because they are not able to bear production costs. Under the carbon tax policy scenario, total NG demand declines further while BM demand increases and reaches the highest level of all three scenarios – up to 2.8% of the total projected NG/BM demand in the country. This first-best policy yields the largest total social welfare and NG producers get the lowest welfare gains due to the carbon tax. The mandate policy reports higher welfare than the status quo, basically explained by the larger environmental damage under the latter policy.

3. Main conclusions and policy implications of the work

Externalities due to GHG emissions from NG consumption and not-value-added residue disposal are key welfare justifications for intervention by the Mexican government in the NG-electricity market. Results show that BM can generate about 6,000 GWh per year, which can incentivize domestic industry when building the plants and job creation will be permanent and intensive. It is thus paramount that any policies the country implements to promote BM be seen as sustainable.

Nevertheless, selecting the status quo policy scenario reflects the value the government places on revenues from the national electricity company, which is the main NG consumer, and indicates the low priority given to environmental goals. A mandate policy targets slightly more environmental and BM producer gains than the status quo, but significantly less than a first-best policy.

Key assumptions made in this analysis are that i) there will be a considerable reduction in BM processing costs in the medium and long term; ii) that competitive market conditions will prevail; and iii) that conditions in the NG market can be predicted with reasonable certainty. Hence, government should also promote policies to help assumptions i) and ii), such as investing in the biotechnology researching sector and fostering conditions for market competitiveness and spillovers from other activities.