DISTRIBUTED PHOTOVOLTAIC POWER GENERATION: POSSIBILITIES, BENEFITS, AND CHALLENGES FOR A WIDESPREAD APPLICATION IN THE MEXICAN RESIDENTIAL SECTOR

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Overview

Mexico plans to implement a national program to support the adoption of distributed photo-voltaic generation (DPVG) among qualified households. The main objectives of this program are to reduce the burden of substantial federal energy subsidies and increase the share of renewable energy sources used to generate electricity. In this study we assess the current conditions under which the Mexican residential electricity sector operates, and quantify the potential effects that the massive adoption of DPV systems would have on household expenditure and welfare, subsidy reduction, pollution and water resource usage. Based on the positive results in terms of both economic and environmental effects, our study provides a significant support for further design and implementation of a DPVG program based on a redefinition of the current regressive subsidy scheme.

Methods

In this paper, we provide a comprehensive assessment of the current conditions under which the Mexican residential electricity sector operates. Using the characterization of Mexican households and simulating a scenario of massive DPV system adoption, we measure the potential subsidy savings and the benefits to residential users. Also, from an environmental perspective, we estimate the reduction in air pollution emissions and water resource usage associated to the simulated scenario. Finally, we provide some policy suggestions about how the current electricity consumption subsidy could be (partially) converted into a DPV system adoption subsidy, standing up for an integral selection mechanism aiming to target the poor in an accurate way.

About 90% of Mexican energy consumption comes from fossil fuels, including most of the electricity generated in the country. Mexico is the 13th largest Greenhouse Gas (GHG) emitter in the world and the second in Latin America -only behind Brazil-, contributing with approximately 1.4% of the global GHG emissions (Damassa et al., 2015; Mexico Gobierno de la Republica, 2015). Among the current and expected consequences of climate change that directly impact on the country, we find more frequent and severe hurricanes and tornados, extended droughts that affect the quality and quantity of water resources, adverse effects on agricultural activities (which also put at risk food security), and drastic coastal flooding and erosion episodes.

The country's environmental goals, in accordance with the Intended Nationally Determined Contribution affirmed at the climate summit held in Paris in 2015 (COP-21), require that 35% and 43% of domestic energy should come from renewable sources by 2024 and 2030, respectively. Meeting that goal is likely to require, among other steps, significant changes in the current electricity generation mix. The Mexican Energy Reform (December, 2013) opened an important window to introduce renewable energies in this sector, particularly solar energy.

To be more concrete, electricity generation explains more than 20% of total GHG emissions in Mexico. The residential sector, in turn, accounts for 25% of total electricity consumed. In this context, taking advantage of the fact that more than 75% of the country has an isolation greater than 5 kWh/m2/day, seems to be a very promising energy and environmental policy opportunity. Other countries, such as Germany and Spain, are currently recognized as the world leaders in installed PV systems. However, Mexico's solar potential resources are far superior and could be considered among the largest in the world (see, for example, SENER (2016)).

On the other hand, the federal government through the state-owned electricity company (Comisión Federal de Electricidad, CFE) promotes excessive residential electricity demand by subsidizing more than 98% of Mexican households. The residential tariff structure consists of a multiple-block scheme and incorporates different regional marginal prices which are linked to average temperatures -i.e. high temperature zones afford lower marginal prices. The fiscal burden associated to the electricity consumption of the residential sector has consistently increased during the last decade and currently represents more than 0.5% of the GDP. Moreover, given the universal and uniform application of this subsidy, the tariff scheme magnifies the inclusion error, wasting valuable resources. All this happens in the context of a country where poverty and inequality are significant social problems.

As a result, an ambitious plan aiming to deploy distributed photo-voltaic systems (DPV) among qualified households -i.e. those able to adopt solar technology in their rooftops- could help solve some of the challenges that Mexico is currently facing. A household adopting a DPV system would be ideally grid-connected so it could purchase electricity when the system is not producing enough power, or sell electricity when it over produces.

Results

The potential advantages include: first, a reduction of the fiscal burden (which today represents a figure of more than 5 billion of USD per year). Second, the DPVG program could bring significant GHG emissions savings by reducing traditional fossil fuel electricity generation (helping Mexico to comply with the energy and environmental goals). Third, it could make possible to avoid costly future investments in traditional electricity generation, transmission and distribution since households adopting DPV systems would be grid-connected.

Conclusions

The implementation of a massive DPVG program in the Mexican residential sector would bring more gains than losses. That is true both in economic and environmental terms. Even though residential users are quite heterogeneous, we can identify patterns that are common to most of them. Hence, from the perspective of a representative user (e.g., the average user), the initial investment outlay is more than compensated by the reduction in traditional energy expenditure (i.e., CFE electric bill).

In that context, the current electricity consumption subsidy plays a negative role since for many users it is more attractive to continue paying low energy prices than afford a costly capital investment necessary to install a DPV system. Even for a vast group of households that has an estimated positive net present value from the DPV system adoption, the corresponding payback period could be too long to justify such an investment. The situation would be quite different if electric prices reflected the actual (true) opportunity costs of generation, transmission, and distribution. In that case net present values and IRR would be higher, and the payback period would be considerably shorter. However, returning to opportunity cost pricing seems not to be an option under the current political situation. Moreover, a social tariff scheme that correctly target the poor and excludes high-income households from the subsidy is not even discussed. In that context, a partial transformation of the electricity consumption subsidy to a DPV system adoption subsidy could be an alternative.

From the government perspective, each household adopting the PV technology represents a reduction in the subsidy account. This fact opens a real and concrete possibility. It would be possible to implement a mechanism through which the government replaces the current electricity consumption subsidy with a (temporal) DPV system adoption subsidy. In this setting, residential adopters would not suffer from the negative financial effect implied by the costly capital investment during the transition, and the government would simply transfer the resources from one subsidy account to another. In the medium- to long run, all agents involved would benefit from this policy.

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