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THE POTENTIAL FOR PROSUMAGE-BASED SOLAR POWER GENERATION IN COLOMBIA

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Overview

Colombia is currently facing a manifold challenge to secure reliable and affordable energy supply. First, fading oil and gas resources put the country's energy system in a vulnerable situation (UPME 2015). At the same time, the advance of climate change is increasing the frequency of extreme weather patterns such as El Niño (Cai et al. 2014) or La Niña (Cai et al. 2015). As the floods in 2010 - 2011 (Hoyos et al. 2013) and the droughts in 2015 - 2016 showed, the impacts on everyday life, such as reduced agricultural yields or a more vulnerable energy situation due to hydropower's dominance, in Colombia's energy matrix (Zapata et al. 2018). On another dimension, the country's growing population and poverty alleviation efforts depend on expanding the access to affordable and reliable energy supply.

With this in mind, the continued development and implementation of new laws to foster RES such as wind or solar power and tackle climate change (e.g., law 1715 of 2014), demonstrate Colombia's intention to provide a diversified electricity mix and a reliable energy system for the entire country while enabling a low-carbon energy transition. While Colombia's Nationally Determined Contribution under the Paris Agreement mainly focuses on emissions stemming from deforestation and changes in land-use (Government of Colombia 2015), this paper offers valuable reflections on the role of PV, specially prosumage systems, to fully de-carbonize the power sector, as a stepping stone for a low carbon transformation of the economy and the society. At the same time, it highlights the potential of prosumage schemes as a policy option to fulfil several of the goals to which Colombia has committed to under the framework of the SDG agenda and the Paris agreements.

The term prosumer describes an energy consumer producing electric energy and feeding it into the grid, combining the words producer and consumer. Prosumage describes a system able to store electric energy in addition to consuming and producing it. Prosumers and prosumage systems depict a societal shift towards multilateral economic interactions driven by information and new technologies (Schill, Zerrahn, and Kunz 2017). As Green and Staffell (2017) show with their analyses on prosumage systems in the UK, the primary goal of prosumage is not energy autarky but rather a tool to increase and optimize a household's consumption and save money. Reaching self-sufficiency would require largely oversized PV-panels and storage systems to compensate lower production during the winter. Therefore, these systems largely depend on the political and regulatory framework to guarantee their profitability (ibid.).

Our paper focuses on the energy market of RES, especially on solar power. A new set of rules are in place, and it is now up to examine if under these circumstances PV and prosumage are a profitable option for Colombia. For this analysis, a qualitative and quantitative approach to investigate their potential is used. In particular, to answer the research question: "Are small-scale PV or prosumage systems for households profitable under the current regulatory framework of Colombia".

Data and Methodology

Our paper showcases Colombia's potential for solar power, more specifically, prosumage systems for households. With the goal of engaging in an in-depth analysis of the situation, it carries out a review of relevant literature on the intersection between climate and energy policy, as well as their interaction with the SDG agenda and the current status quo in Colombia. The paper continues then with a qualitative approach including interviews with different experts and a quantitative approach modeling the current circumstances for prosumage in Colombia. The prosumage model used in this analysis was created by Eissler et al. (2017) and has already been used to evaluate business opportunities of prosumage systems for different locations, such as India or Germany.

Preliminary results

Looking at our study's results, we see that the lack of substantial financial aid and high equipment prices are some of the barriers currently leading to a rather unattractive investment situation. According to the experts consulted, the tax incentives offered so far are not sufficient. Moreover, the national interconnected electricity system (SIN) is still

dominated by a few major players making it difficult for smaller ones to enter the market under the current circumstances. Furthermore, the advantages of a diversified energy market have not been recognized by the public, thus making it difficult to increase the pressure on political stakeholders for further progress in the regulations. Nevertheless, our results confirm that the implementation of net-metering represents a major change in the regulatory framework. Additionally, our prosumage model examines these insights from a quantitative perspective and concludes that the most profitable system configurations only include ordinary PV systems and no storage technology. While there is a common trend between all the regions surveyed, our results suggest that larger cities (especially those close to Colombia's Caribbean ports) have the most important potential to tap on the advantages of prosumage. Our study also discusses the difference between off-grid areas (ZNIs) and areas connected to the SIN. Concretely, the focus is set on cities such as Bogotá and Barranquilla, as well as the region of La Guajira, in northern Colombia.

Preliminary conclusions

Our survey underlines an array of different possibilities to accelerate the energy transition in Colombia. With the recently elected government and incoming new regulations, the topic will continue to gain importance and open new options for investors and other market players in the industry.

We identified that a series of main hurdles that make it harder to tap the potential of prosumage systems in Colombia. First, there are the costs stemming from the lack of knowledge and expertise on PV technologies in the labor force. Second, the insufficient support to renewable energy expansion by government entities, as well as lacking clarity on the regulatory framework that new market players (especially small ones) are facing. This regulatory framework includes a rather weak education system in terms of creating awareness of the causes and impacts of climate change, as well as on the education necessary to come up and deploy solutions. Finally, we see the logistic costs of deploying PV in Colombia's interior, as well as the access to financial capital as key hurdles that need to be reduced to expand the role of PV in the energy mix.

The implications thereof invite Colombian decision-makers to complement existing policy instruments with additional support measures for RE expansion. We identify a potential balance between PV and storage installation that maximizes the internal rate of revenue for participating households and thus, an attractive path for how policy support could lead to a win-win situation. In it, the reliability and affordability of energy supply can be increased, the climate impact reduced and the public hand unburdened.

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