Distributed photovoltaic generation in Brazil

Technological innovation, scenario methodology and regulatory frameworks

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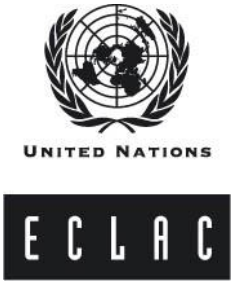

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Introduction

The Brazilian energy sector has reached a paramount point in its history and has the potential to transform the livelihoods of thousands through innovative, fair energy policies. Since electric power distribution is highly centralized and strictly regulated by the state, it is critical to understand what kind of prospects exist for the diffusion of micro and mini solar photovoltaic generation in Brazil. In this study, we implement a scenario analysis and describe our process constructing the two scenarios: baseline and alternative. Later, we present a model that estimates diffusion rates based on assumptions established in each of our scenarios. However, scenarios are just one part of the puzzle, and one must recognize the key role of ANEEL and its choices. Regulating the energy sector is important because distribution is either an unrecoverable or stranded cost[1](EIA, 2000) and Brazil's economy has grown exponentially in the last couple of years, causing the solar industry to become a natural monopoly. Overall, the regulator must not only act to prevent abusive prices and guarantee quality of service, but also pursue the guarantee of economic and financial balance in electricity distribution concessionaires.

In Brazil, electricity distribution concessionaires are subject to the regulation of the Brazilian Electricity Regulatory Agency (ANEEL). In simplest terms, ANEEL applies an incentive-based regulation built upon the price cap methodology to its distributors. The regulator seeks to establish the efficiency level of revenues to the distribution concessionaire and efficiency-sharing metrics. Therefore, the study of the impacts of the micro and mini generation diffusion on distributors also requires an analysis of the basic guidelines of the current electric sector regulation.

1 In general, unrecoverable or stranded costs are historic financial obligations of utilities incurred in the regulated market that become unrecoverable in a competitive market. Stranded costs are also known as stranded investments, stranded commitments, or transition cost. In addition, transmission to competition is also considered an unrecoverable cost.

Agents in the Brazilian power sector are divided according to the activities they perform: generation, transmission, distribution, and commercialization. This division is designed to increase competition in generation and commercialization segments. It also regulates power distribution and transmission, natural monopolies that are regulated by the Brazilian government. The current power system is based on giant power plants connected by high-voltage electric transmission lines to substations located near populated areas. From these substations, electric power is distributed through local wiring by distribution agents.

Since the future of clean energy accessibility highly depends on policies created by the Brazilian government and ANEEL, we chose to utilize a scenario analysis methodology for strategic planning. First, we considered a baseline methodology, where trends in politics and social protection remain consistent for the next couple of decades. Then, we considered an alternative scenario where new policies incentivize the use of solar energy via tax exemptions, financing, and installation programs.

The first section of this paper describes the current state of the Brazilian power sector, detailing current legislation and initiatives related to solar energy. It also discusses advances in solar technology, the transformation of the Brazilian economy, and the main social challenges for public schools, businesses, hospitals, and lower income families who could greatly benefit from installing solar panels on their homes. Then, we provide some insight to technical characteristics of photovoltaic panels and an explanation and justification of our methodology. The methodology section also includes models for diffusion rates and payback calculations and a detailed look into each scenario. The second part of the paper discusses technical and regulatory frameworks of the power sector in Brazil, and what should be done to improve current policies.

A. Literature review: Brazil's electrical sector and economic transformation

Figure 1
Installation Capacity of Solar DG in Brazilian states
(kWp)