





Transformative Actions Program Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

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PALMAS SOLAR PROGRAM

DECENTRALIZED ENERGY FOR THE ECOLOGICAL CAPITAL

To improve its solar power capacity, the city of Palmas in Brazil adopted a strategy and in 2015 launched the Palmas Solar Program. Reaffirming the city's commitment to sustainable development, the program offers tax incentives for households and businesses to install photovoltaic panels and become small-scale energy producers. Through this program, the city expects to maximize the share of renewables in the energy mix and become a national leader in installed solar capacity by 2022.

Facts and Figures

Brazil was the ninth largest energy the world 2019, consumer in in an energy demand with increasing of 2.2 percent each year, much faster than the global growth of 1.2 percent (BP, 2019). Eighty percent of the country's electricity supply comes from renewable sources, out of which, 60.4 percent comes from hydroelectric dams in Amazonian rivers (IDB, 2019; IEA, 2019). However, hydropower has proven less and less predictable as the alterations in weather patterns resulting





Figure 1 – Map of the city of Palmas in Brazil. ©Google Maps, 2020

from climate change contribute to affecting the reliability of this source. Intensive droughts since 2011 have affected the stability of Brazil's energy supply, revealing an imminent need for diversification of energy sources (Correa da Silva et al, 2016). This situation led to an increase in the use of fossil fuel based thermal electricity, which resulted in the peak of CO_2 emissions in 2014 (Cursino, 2015).

Located in the northern region of the country, Palmas is the state capital of Tocantins. The city dates from 1989 and is now home to 306,296 inhabitants. Fast-growing and dynamic, Palmas needs to cater to an ever-increasing population, ensuring quality of life and economic opportunities, while preserving the environment. Aware of the limitations of hydropower, the city adopted a strategy to develop solar capacity, and in 2015, started working on the Palmas Solar Project.

The Ecological Capital's Ambition

Situated in the newly created state of Tocantins, built in an attempt to increase regional autonomy, Palmas is Brazil's youngest planned city. In the late eighties, urban planners intended for Palmas to be known as the *ecological capital*, joining quality of life and environmental quality parameters, and avoiding environmental degradation (Piccini, 2014). Nonetheless, the expansion of the city was way quicker and wider than foreseen, out of urban planners' control and putting pressure on the city's infrastructure.

Despite having seven hydroelectric plants over the Tocantins River with a capacity of 12.8GW, distributing energy towards the rest of the country, Palmas' electricity costs were amongst the highest in Brazil. Indeed, the Brazilian National Energy Regulation stipulates that the energy produced in each state goes to the national grid to be sold in public tenders to local distributors. However, this system fosters inequalities between states, since the more populated ones purchase more energy and hence access better energy prices, whereas less populated states, such as Tocantins, are left with higher energy prices.

In contrast, the city benefits from an exceptional solar resource potential, with an average daily radiation of between 2,080 kWh/m² and 2,153 kWh/m² (Piccini, 2014). Balancing out energy potential, costs, accessibility and environmental impact, the use of photovoltaic panels for electricity seems like the best alternative for ensuring affordable, reliable, sustainable and modern energy for all.

Regaining the original ambition of an ecological capital, accentuated by the context of the Paris Agreement, the city of Palmas reaffirmed its commitment to environmental preservation. Thus, the city

set the goal of maximizing the share of renewable energy in the local mix for commercial, domestic, and administrative use, aiming to become a national leader in installed solar capacity by 2022.

Financing the Energy Transition

The Palmas Solar Program was created by the Complementary Law nº 327/2015, in order to establish incentives for technological development, for the use and installation of solar energy and for the adoption of such systems by the City of Palmas. Initially, the goal was that all new buildings should generate their own solar energy. However, in the context of the Paris Agreement, Palmas decided to enhance its climate commitment and make their own more ambitious policy. Hence, the city now aims at shifting the entire electricity mix to solar power, attempting to achieve the largest share of renewable energy in Brazil. The program was translated into a municipal ordinance in 2015 and launched in 2016.

The program aims at encouraging private electricity consumers to produce their own solar energy. For this objective, the city offers a tax incentive for physical or juridical persons to install photovoltaic panels in their houses or businesses. In exchange, for a period of 5 years, users receive a discount of up to 80 percent in municipal taxes - the Property and Urban Land Tax (IPTU), which is paid by all property owners in urban areas in Brazil, and the Real Estate Transfer Tax (ITBI), regarding property sales.

The technology consists of decentralized solar photovoltaic systems connected to the state electricity grid. These provide energy to the final consumer, who can replace the expensive electricity from the grid with the electricity from the solar PV systems. The program also





creates incentives by injecting the surplus electricity generated from solar back into the electricity grid. This means that besides the tax discount, private users also have drastically reduced service fees, as the electricity they generate is discounted from their final bill. The dynamic is mediated by a *net metering* tariff system, which calculates the electricity flows in both directions and the difference between generation and consumption.

The local utility is thus a key actor of the program. Tocantins Electric Energy Company (CELTINS), the local concessionary for energy distribution, sets the technical norms of decentralized power generation. They are also in charge of maintaining the distribution infrastructure, for which users pay a minimal equipment cost.

In decentralized energy generation, the cost of the Solar PV panels is often borne by the consumer. In Palmas, banks can help private parties finance their Solar PV panels, such

as the Banco da Amazônia, the Banco do Nordeste or the Banco do Brasil (IUC, 2018). However, the nature of the tax incentive means that the city internalizes part of this cost, dedicating a part of its budget that would otherwise be municipal revenue. Anticipating this revenue frustration. Palmas increased the Property and Urban Land Tax (IPTU) before launching the program, including the Palmas Solar Project in the city's budget. Overall, 7.800.000 R\$ (1.449.275 USD) were invested in the solar energy market, which the city recovered during the first years of implementation.

Moreover, the city invested 50.000.000 R\$ (9.290.225 USD) in solar energy equipment in order to meet its own demand, including switching all schools to solar electricity and the construction of a mini solar plant to feed all municipal buildings. These funds were obtained through a loan from the public bank Banco da Caixa. The city is currently working with local companies for installing this capacity in public buildings.

BI-DIRECTIONAL METERING (WHICH ENABLES NET METERING)



Figure 2 – Decentralized photovoltaic system connected to the electricity network scheme. ©Proteus, 2017

Results

Results of the program came swiftly for Palmas. Currently, the installed solar capacity is 3,843.88 kWp. A cost-benefit analysis of solar power as a sustainable and economic alternative for households by the Technical and Scientific Congress of Engineering and Agronomy (CONTECC) evaluates that panels generate almost the totality of the electricity consumed in an average household, surpassing consumption in the months of January and February. This translates in a quasi-positive balance, meaning that electricity bills to the utility provider are minimal. According to the study, private parties achieved a return of investment on the panels in two years (Carneiro Guimarães et al, 2019). Furthermore, a study comparing the return of investment for households which benefited from tax discounts and households which did not, reveal that the use of tax incentives is a key accelerator or decentralized generation (Silva & Brito, 2019).

The take-off of the program was rather slow, with only 67 beneficiaries in 2017, the second year of implementation. In the next three years the number grew to reach 400 beneficiaries in 2020, a figure that is expected to increase in the following years.

The project also resulted in an **economic stimulus** for the city. As of October 2020, the city has granted tax discounts of 415,785 R\$, equivalent to about 72,399.83 USD. Over 20 local enterprises were created in the PV sector, which also represents an increase in the city's tax collection, compensating the costs of the subsidies granted. Simultaneously, the purchase power of the private parties who save on energy expenditures and taxes is reinserted into the local economy through consumption.

Last but not least, the city expects to see climate benefits regarding a **GHG emission reduction** of 16.000 tCO₂ and the improvement of air quality, reducing dependency on hydropower and working towards biodiversity and environmental preservation.

Figure 3 – Mayor Cinthia Ribeiro in Smart City Expo World Congress @FNP, 2019

Lessons Learned

The co-benefits of clean energy go wellbeyond environmental impacts. As discussed in the results, energy savings can catalyse the local economy, opening new markets and increasing competitiveness. Such economic gains can be reinvested by the local government in order to achieve more ambitious policy-goals.

Decentralized energy generation leads to a win-win situation. Consumers do not only generate savings in their private economies, but they also gain stable energy supply and freedom from the adversities linked to power provision, such as energy cuts or increment of electricity costs. The city benefits from a more active economy and from working towards the goal of becoming a solar power leader in Brazil. Finally, the energy utilities alleviate the pressures in energy demand while still playing an active role and collecting maintenance fees.

Reaching to the most vulnerable population is a challenge. Lower-income households are those who could benefit the most out of decentralized energy generation, reducing their service expenditure. However investing in PV panels represents a challenge for this group of the population. According to the city, working together with private banks is necessary in order to develop payment schemes that cater to these needs and hence ensure that all families can take part in the energy transition.

"Cities need to understand that the gains from investing in renewable energy strategies are always far more significant than what you might put in, in the first place. Every benefit given by the local government comes back to the city in a different way".

Jean Miranda, Executive Secretariat of Resource Capitation and Renewable Energies

Success Factors

Coordinating energy strategies and municipal income is the key. The Palmas Solar project is legally inscribed as part of the municipal budget. Adapting the tax system required Palmas to modify the law. For the city, this was a necessary step that also allowed giving a juridical emphasis to the energy strategy and ensuring that the program is sustainable over time. Moreover, the program is in line with the National Energy Strategy (PDE) and Nationally Determined Contributions (NDC) goals. It is mediated by the National Agency for Electric Energy (ANEEL), which guarantees national support to the program.

Considering the local energy capacity and energy consumption through feasibility studies is necessary in order to ensure that households can generate the energy they consume and that recovering the investment is possible. Partnering with local universities and engineers, Palmas conducted simulations and evaluated the potential and risks, making implementation safer and more straightforward. Studies are also conducted post-implementation to evaluate results and set the way forward.

It is beneficial to keep an open mind. The program is open-ended, setting seasonal objectives that allow for greater flexibility regarding emerging needs. Indeed, the city officials periodically evaluate achievements and limitations, which helps to identify the missing links and establish complementary projects in line with the Palmas Solar Program. Moreover, project leaders have demonstrated to be receptive to recommendations aiming to improve the concept further.

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The 100% Renewables Cities and Regions Roadmap project facilitates the energy transition by raising local awareness on renewable energy sources, showcasing how local and national governments can create coordinated enabling frameworks and policies, exploring access to public and private sector finance, and building local renewable energy projects to address electricity, heating and cooling.

The Transformative Actions Program (TAP) is a global initiative led by ICLEI to support local and regional governments transform their low-emission and resilient development infrastructure concepts into mature, robust and bankable projects ready for financing and implementation.

The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI – Local Governments for Sustainability and funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) through the International Climate Initiative (IKI).

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