B-REED

"Alternative energy sources and decentralized entrepreneurship: opportunities and obstacles to their expansion in Brazil"

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Abstract

This policy paper discusses the opportunities and obstacles to small-scale renewable energy production through decentralized entrepreneurship in Brazil. The most important issues such as regulation, authorization, taxing, incentives, financing and organization are analyzed for different categories of energy potentials (small, mini, micro and pico). The paper also describes the current situation and discusses developments necessary to improve the market for small energy entrepreneurs.

Background

This paper is the result of the first policy support activity developed by the Brazil Rural Energy Enterprise Development (B-REED) project.

B-REED seeks to develop or strengthen small-scale enterprises that use clean or efficient technologies to meet the energy needs of populations under-served by conventional means. B-REED is focused on North-eastern Brazil, although it may selectively evaluate projects in other regions.

B-REED is a partnership between the United Nations Environment Programme (UNEP), the UNEP Risoe Centre on Energy, Climate and Sustainable Development (URC) and the non-profit investment company E+Co. Implementation partners in Brazil are Instituto Eco-Engenho (IEE) and Instituto de Desenvolvimento Sustentavel e Energias Renovaveis (IDER). Funding mainly comes from the United Nations Foundation.

The B-REED approach offers small energy entrepreneurs a combination of enterprise development services with early stage capital. B-REED also works with financial institutions, non-governmental organizations and governments to facilitate the successful integration of clean energy technologies into local markets and communities.

In the case of federal, state and local governments, B-REED intends to help them to enable a favourable environment for the development of clean energy enterprises. To this end

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B-REED performs policy support activities, small in nature but targeted at filling critical gaps at just the right moment.

The first policy support activity focused on how to integrate small rural energy enterprises in the implementing regulation of Law 10.438 and related legislation. This activity included support to energy entrepreneurs on policy issues, stakeholder consultations, a policy workshop and the development of this policy paper. On-ground activities were developed by the local expert Afonso Henriques with support from IDER, IEE and E+Co Brazil. Overall coordination was provided by URC.

1 - Introduction

Renewable energy sources in Brazil are indeed the basis of the country's power supply, where hydropower plants provide most of today's generation. On the other hand, programs such as PROALCOOL (Brazilian Alcohol Program) have placed the country in an outstanding position regarding substitution of oil fuels by biomass. Therefore, this paper will not focus on the introduction or expansion of renewable energy sources, already firmly rooted in the country. It intends rather to discuss alternative ways of small-scale energy generation, "alternative" meaning not just appropriate technologies but also decentralized management of these sources. Decentralized management is understood here as the action, private or not, of small-sized agents, distributed throughout the country, to promote business for the construction, operation and maintenance of energy producing facilities, or for related services such as financing and commercialization.

For a better understanding, energy potentials are analyzed under four categories: small (PA), mini (MA), micro (μA) and pico potentials (πA). These categories were set mainly according to power output, following definitions widely accepted within the Brazilian electric sector. The most important issues such as regulation, authorization, taxing, incentives, financing and organization are discussed for each of these categories. The analysis also considers the current situation and the developments necessary to improve the market for small energy entrepreneurs.

2 - Small Energy Potentials (PA)

This paper considers small energy potentials (PA) those having a net power output between 1 and 30 MW. Net power output is defined as the power available at the outlet of a generating system (electrical power), at the axis of a machine (mechanical power) or as heat delivered by the systems (for example as steam or hot gases).

PA potentials were formerly the basis of the Brazilian electric sector, but its expansion through the construction of large hydropower plants and power lines caused a general discarding of small hydros. Small hydropower plants were typically run under public service concession or for self-production. Until the 1930s, concessions that combined private initiative and municipal participation were very common. Afterwards the centralization of the authorization process empowered utilities at the expense of local initiatives, either public or private. Small hydro plants for self-production continued to expand due to insufficient distribution networks for universal supply. Noticeably, industries processing agricultural products on-site made good use of the enormous availability of energy in their surroundings.

Small biomass potentials were restricted to quite specific cases; even in the sugar cane industry, their use was basically for the production of heat.

The institutional environment created after 1995, mainly following the issue of Law 9.074, established a differentiated status for small-scale alternative electricity generation. Independent power and self-producers using alternative energy sources from 1 to 30 MW require authorization. Public service power plants continue subjected to concession, regardless of their size. Plants with capacity below 1 MW do not require authorization, but the responsible authority must be informed about their construction. The above comments apply to ANEEL (National Agency for Electric Energy). Other required authorizations or licenses, for example regarding use of water, are not included in this analysis.

The laws issued after Law 9.074 created a series of benefits exclusively for authorized plants. According to administrative principles, the public authority can only take action following what is established in the laws. Thus, plants not needing authorization cannot be granted the above-mentioned benefits, even if their capacity is under 1 MW. The main benefits the 'non-authorized' plants lose are the reduction of transmission costs, selling energy to consumers with demands below 500 kW, and subsidies from the CCC (Fuel Consumption Account) when supplying independent systems. The recent Law 10.762 partially reduced these restrictions for hydropower plants under 1000 kW by extending the first two benefits to them (see next chapter).

Regarding PAs, Law 10.762 now allows selling energy to consumers, or groups of consumers sharing the same interests de facto or de jure, with demands above 500 kW. This opens new business opportunities by putting together small consumers (for example in a condominium). However, there is an element of doubt in the law: benefits are only for authorized hydropower plants but wind turbines, solar heaters and biomass energy plants do not require such authorization.

Still talking about authorization issues for electricity services, there is a business opportunity for small power enterprises in isolated regions where supply is to be tied to demand. That is, besides the generating plant, these enterprises also need to set up a distribution grid. Such configuration can be categorized as a public service, requiring a concession or a 'permission' by tendering. Another alternative would be a sub-concession coming from the local concessionaire. The concept of 'permission' has been strongly criticized, and has happened in rare cases where rural electrification cooperatives already were providing public electricity services.

The alternative that seems viable in the medium term is the categorization of this distribution grid as for private use only. For this purpose, consumers would have to establish a cooperative or association, or even become partners in the small power enterprise. In the latter case, the grid would be set up exclusively as a means of transporting self-generated power.

The remaining authorizations and licences required for PAs involve complex and long bureaucratic processes. This is the case for environmental licences for small hydropower plants that usually take about two years. The environmental protection project demands about five times more work than the engineering project. In addition, the right to use water, to be granted by ANA (National Agency for Water) or a similar state agency, so far has no clearly defined criteria to facilitate entrepreneurial decision-making and provide a reliable basis for long-term investments. It is important to remember that, according to current legislation,

ANEEL's granting acts implicitly include the water grant by the responsible agency. However, the water availability may not be appropriate for the technical and economic feasibility of the project.

An issue that has been hindering the viability of small hydropower plants is that of maintaining the water flow at the deviated stretch. Environmental protection agencies demand very high flow values by following the multi-use criterion instead of environmental considerations. In fact, there is rarely a need for significant water use in the deviated stretch, so the required flow value may be greatly reduced. The agencies should set up environmental conditions for the biota, and let the entrepreneurs decide on the technical solution, which would be a better way of determining the remnant flow.

The business agents that have been considering PAs are mainly private entrepreneurs with good capacity for finding appropriate energy potentials but with limited investment capability, so they play the role of developers. A number of business agents are rural electrification cooperatives, mainly those located in the Southern part of Brazil; they already own a market but consider PAs as a strategy for expanding their business. Some construction companies have also searched for PAs with the aim of securing the market for their core business rather than generating power. Self-producers are not relevant to the PA category.

Usually developers seek to establish PPAs (Power Purchase Agreements) with end users. The essential point for the feasibility of PAs is the "bankability" (ability to obtain bank loans) which depends, besides the entrepreneur's credit situation, on a PPA with a low-risk company, either from the company's credit or production perspective.

The alternative mechanism which is expected to promote a widespread utilization of renewable energy sources is PROINFA (Program of Incentives to Alternative Energy Sources) created by Law 10.438 issued in 2002. PROINFA secures the purchase of energy coming from these sources, provided they are produced by IPP (Independent Power Producers).

The first paragraph of Article 3 of the Law prohibited power utilities to participate but did not require IPPs to be authorized producers. The latter meant that hydropower producers below 1 MW, not entitled to receive authorization, could participate in PROINFA in different ways. The same was in force for wind, solar and biomass energy generation at any power level. However, the recent Law 10.762 modifies the above conditions for IPP by re-adopting the original generic definition of IPP. This means, according to Law 9.074, that IPPs must be either concessionaires or authorized producers. Thus, non-authorized producers cannot receive PROINFA's benefits.

Although the Law does not state mandatory authorization for the generation forms previously described, the sale of energy coming from any of these sources requires ANEEL's authorization. So, IPPs must be authorized entities if not to produce at least to sell their energy (Article 26, Law 9.648). It is interesting to notice that self-production via PAs is not a good commercial strategy since advantages given by PROINFA are exclusive for agents that sell energy.

It should be noted that the subsidy foreseen within PROINFA is not exclusive to those selling energy to Eletrobrás. IPPs who sell energy to end-users are entitled to subsidies by the CDE (Energy Development Account) in the same conditions as the rest of producers. This

opens a significant market for PAs supplying energy directly to end-users. It is also important to mention that subsidies coming from PROINFA are exclusive for plants connected to the National Electric System (grid).

When referring to the second phase of PROINFA, Law 10.762 excludes the funding for subsidies due to IPPs, originally coming from the CDE. This account funds a number of subsidies, for example those for universal electricity supply and low-income consumers. This intentional omission creates uncertainty about the second phase of PROINFA and is an indication that the subsidy may even come from a surcharge to the tariff, besides the increase that CDE already imposed on consumers.

The BNDES (National Bank for Economic and Social Development) claims that credits for IPPs are significant. The reality is that few enterprises obtained loans from this bank. One of the main problems is the attainment and the credibility of the PPA. Programs such as PCH.com did not succeed because of high costs imposed by required guarantees (in this case by Eletrobrás). PROINFA tries to solve this problem by securing the purchase of energy from alternative sources. However, Decree 4.541/2002 establishes that Eletrobrás will only administer but not secure payments to IPPs. This is precisely the main hindrance for PROINFA's viability and thus for large-scale use of alternative energy sources in Brazil.

Law 10.438 authorizes the use of the RGR (Global Reversion Reserve) to finance alternative energy plants. But there is a dubious point in Article 23 of the Law: How should the term "small hydroelectric plants" (in short SHP) be interpreted? By observing Laws 9.427 and 7.990, it could be deduced that SHP are plants under 10 MW. Law 9.648 extends some benefits intended for SHP to plants ranging from 10 to 30 MW as long as they have characteristics of the small. This is yet another point of possible conflict between entrepreneurs and the public power.

It should also be noted that RGR funds are strongly committed to the process of universal electricity supply, in addition to funding subsidies for low-income consumers through concessionaires.

On taxing issues, it is generally recognized that the existing cascade of taxes is a bad economic signal. In the case of PROINFA, some IPPs supply specific end-consumers while others supply consumers of the national electric system. In the first case, the ICMS (tax on the circulation of goods and services) applies to the transaction between the IPP and the consumer, so the IPP will be able to discount the ICMS already collected at the time the plant was built from the tax payable, as long as the deferral conditions are respected. In the second case, ICMS collected at the construction time cannot be deducted, burdening the IPP. The intended tax reform aims at reducing this tax cascade significantly, which would improve competitiveness of IPP.

3 - Mini Energy Potentials (MA)

In the context of this paper mini energy potentials (MA) are those with net power outputs between 100 kW and 1 MW. MAs add up to an enormous potential throughout the country, but so far have not reached the realization level of PAs.

MAs are small scale and do not contribute significantly to public electricity supply by concessionaires. An exception is the Poços de Caldas city where the 500 kW hydro Véu das

Noivas had an important role in shifting the expansion of the local utility towards self-supply via small hydros.

Plants of MA size are very sensitive to study and project costs, besides their limited capacity to afford expenses on environmental compensations and connections to the grid.

The already mentioned practice of environment agencies and their centralization in state capitals have significantly increased study costs for MAs. These plants should be connected directly to the distribution grid at medium voltage level, avoiding the construction of transmission lines and transforming substations. The strategy should be to find the nearest distribution line and if necessary increase its capacity to carry the additional power. In this way MA would contribute to reducing losses, improving the voltage profile and increase reliability, besides the extension of the distribution grid itself.

In isolated systems MAs constitute a natural choice for supplying remote communities, or agricultural and industrial facilities. The appearance of several MAs supplying these loads was observed in the recent agricultural development of Mato Grosso where the typical entrepreneur is involved in industries, or grain producing farms with irrigation or processing. The cooperatives, mainly in the south of Brazil, are once more leading the alternative process of energy supply by building several MA plants.

The developers mentioned in the previous chapter have not been evident here because the profit margin is quite low and thus there is no room for intermediaries, either for developing sites or for selling energy. Self-production is almost the rule.

As indicated in the previous chapter, MAs do not need nor are they able to receive authorization. Furthermore, before the issue of Law 10.762 MAs were excluded from some of the benefits given to small hydropower plants, such as reduction in transmission costs. Unfortunately, the remaining restrictions are still in force and another very important one was created. MAs could apply for PROINFA by categorizing them as IPP since it was not necessary to be "authorized" for exploiting alternative energy sources of this size. But this is no longer the case: IPP as mentioned above must now be concessionaires or authorized entities.

The authorization for energy sale given to a MA may be interpreted as being enough to consider it an authorized IPP. In such a case, the MA can apply for PROINFA's subsidy, but it would likely have difficulties competing with larger power plants. The reason is that the economic values to be set up for different technologies within PROINFA will be mostly based on plants close to 30 MW, where economies of scale are significant. The actual opportunity within this incentive program is the direct sale to the end-user, which permits application for subsidy through the CDE. A wise strategy would be to transform a self-producer into an IPP and sell the power to a given consumer, with both the IPP and the consumer belonging to the same owners. In this way it would be possible to receive the subsidy and to deduct the ICMS collected at the time the plant was constructed. However, taxes such as CPMF[4] and PIS[5]/COFINS[6] are not deductible within this taxing context.

[4] Tax collected on financial businesses
[5] Tax for the Social Integration Program, collected on the company's gross revenue
[6] Contribution for social security, collected on the company's gross income

The "bankability" of MA projects is considerably harmed by their size which makes it almost impossible to negotiate directly with BNDES. The appropriate action is to approach intermediaries who will of course charge an additional fee. Also, these financiers are unlikely to be properly skilled for a specialized technical analysis and the result could be a high-risk assessment, quite natural for those lacking deep knowledge of the matter. Because of their inherent size, PPAs attained come from smaller-sized companies that have on financiers' view higher credit risks. As a consequence, financiers will require higher contribution of own capital or more significant real guarantees. When considered for self-production, MAs are fundable through corporate finance and depend exclusively on the performance of the associated main plant.

In principle it is also possible to fund the construction of MA plants with the RGR, although such resources are scarce at the moment.

There are a variety of technological options for MAs, notably for biomass potentials where gasification and direct combustion deserve mention. Despite their higher initial cost, low-head micro hydropower plants have the greatest potential provided they are placed in strategic locations close to consumption centres so that the length of supply lines is reduced. Wind power turbines have availability limitations as capacity factors are typically below 30%, thus requiring considerable complementation either from the grid or from auxiliary power units (usually large diesel engines).

4 - Micro Energy Potentials (μA)

Micro energy potentials (μA) as defined here have a net power output between 10 and 100 kW. This size fits self-production quite well. From the economic and managerial perspective, it is very unlikely that μA producers qualify for IPP. Nowadays, development of μAs is driven by demand which does not have any other viable form of supply as it is located very far from the conventional grid.

Since μAs do not need ANEEL's authorization and cannot be considered energy sellers, developers of these potentials enjoy a relative bureaucratic simplicity for implementation. A grant for water use is not necessary as it is insignificant and does not imply consumption. Although simplified, the environmental issue remains as authorization is subject to the discretion of technical staff at environmental agencies. In contrast to the potentials previously discussed, developers of μAs are representatives of, or are linked to, small or medium-sized manufacturers.

The main focus of analysis is the equipment as it is the higher cost component. Investors' decision-making is similar to the case of purchasing industrial equipment or an expensive commodity. The analysis includes technology, robustness, maintenance and mostly price.

There is plenty of space for new entrepreneurs in this area, mainly within the universal electricity supply programs set up by the present federal government. Isolated power generation aimed at supplying remote communities requires practices and technologies little known to conventional concessionaires. Therefore, there is a market niche for small-scale producers supplying local grids owned either by the concessionaire or the consumers' association.

Under the above scenario, biomass energy technologies seem the most appropriate because fuel is abundant and plants can be installed near to consumers, as opposed to small hydros. Wind energy in the μA range has been mostly used for pumping but could also partially substitute conventional fuels.

μA producers should not count on PROINFA's subsidies since they cannot be considered as IPPs. However, subsidies available for electricity supply universalisation (CDE, state contributions, etc.) may be used for this type of generation either through concessionaires, as a cross subsidy with other consuming classes or by direct contributions from the federal government.

Institutionally, it is easier for the government to subsidize small entrepreneurs or consumers than to transfer resources to a concessionaire. This is precisely the problem that the federal government is facing at this moment when aiming at universal electricity supply. It is necessary to set up procedures that separate services supplied by price, related to investments made by the concessionaire, from those provided on a cost-basis, which are quite subsidized.

5 - Pico Energy Potentials (πA)

Pico energy potentials (πA) are defined in this paper as systems with a net power output up to 10 kW. These potentials are intended for household units or small production/service workshops. πAs can also supply energy for public facilities such as rural schools or water well pumps.

The country has had many programmes aiming at dissemination of appropriate μA technologies. These programs have operated under a number of basic approaches. The first approach, mainly represented by PRODEEM (Program for Energy Development of States and Municipalities), is the installation of πA systems in schools and health care facilities without costs for the users. The second approach, applied by Fundação Teotônio Vilela in Alagoas, relies on micro-entrepreneurs financed by Banco do Nordeste. In another approach, applied for example by APAEB in Bahia, πA systems are supplied to members of cooperatives that will pay them back with products. An additional option, developed by some organizations (e.g. CAR in Bahia), is the donation of residential systems without any financial or labour obligation for the beneficiaries.

All these programs deserve merit for helping πA systems to mature by breaking paradigms. However, there are still huge difficulties to overcome, mostly:

1. The initial satisfaction of consumers' needs and expectations is followed by disappointment as they realize the power and energy limitations of πA systems.
2. Although normally subsidized, prices paid are higher than those for conventional rural electrification, which benefits from a huge volume of cross and direct subsidies;
3. The technology applied, mostly photovoltaic panels, is very simple from the user's perspective, but it does not yet have appropriate maintenance and operation. The distance to cities and the non-conventional equipment used in these systems make even simple corrective maintenance, such as changing a light bulb, very difficult to perform. Replacement of batteries is a crucial issue for the sustainability of the systems.

On the credit aspect, the experience that Banco do Nordeste had was financially speaking a bad operation. There is a large default from users to micro-entrepreneurs and, consequently, from these to the bank. Such default is partially explained by the reasons described above. If there is no evolution in the operation and maintenance methods, and a reduction in the costs of the systems, better financing through micro credit or guarantee fund will not be sufficient. An improvement in the systems to better cover the energy needs of households also deserves some thought.

The concept of micro-entrepreneur conceived in the Alagoas program does not seem to completely fulfil the needs of all actors involved. One entrepreneurial alternative would be to sell πA systems at stores specialized in credit sales of appliances. By combining credit and technical assistance, this option could transform πA systems in consumer goods of easy purchase, and at the same time transform owners of appliance stores into energy entrepreneurs.

It is also necessary to introduce into the πA category other technologies apart from photovoltaic systems. In some regions of Brazil it is feasible to use vegetable oil; in others hydropower may be an option.

Finally, formal and informal education systems such as technical and agro-technical schools, SENAI centres and similar institutions, may be the means for outreach, capacity building and even maintenance of πA systems. It should be noted that these institutions are geographically scattered, allowing decentralization of both technical expertise and management of governmental programs.

6 - Conclusions and recommendations

The following table summarizes the issues discussed in this paper. Issues are classified according to relevance for small energy enterprises and type of potential, with indication of public agents that should be mobilized.

PA	Small potentials	1 to 30 MW
MA	Mini potentials	100 kW to 1 MW
μA	Micro potentials	10 to 100 kW
πA	Pico potentials	up to 10 kW

Topic	General relevance	Relevance for B-REED	Most relevant potentials	Public agents to be mobilized
Authorization	Very relevant	Very relevant	MA, μA, πA	National Congress, ANEEL
Connection to grid	Relevant	Very relevant	PA, MA	ANEEL
Inclusion in PROINFA	Very relevant	Very relevant	μA	MME*
Access to CCC	Relevant	Very relevant	PA, MA, μA	ANEEL
Access to RGR	Relevant	Very relevant	MA, μA, πA, PA	MME, Eletrobrás
Access to CDE	Very relevant	Very relevant	MA, μA, πA, PA	MME, Eletrobrás
Tax reform	Relevant	Less relevant	PA, MA	National Congress
Fiscal incentives	Less relevant	Less relevant	μA, πA	Federal Government, States
Cross subsidies (grid-connected to isolated users)	Relevant	Less relevant	μA, πA	ANEEL, MME (CNPE**)

* MME (Ministry Of Mines and Energy)
** CNPE (National Council for Energy Policy)

Recommendations selected for further action are as follows:

1. There is a need for a taxing policy that encourages the manufacture of alternative energy equipment in Brazil. However, this policy should not promote the use of outdated equipment or lead to cost increases which ultimately are paid by end-users.

2. The subsidies via CCC for plants that supply energy in isolated systems has not been effective, and are not a correct economic signal. Such subsidies should be replaced by extending PROINFA to plants that supply energy to isolated systems.

3. Legislation should complement the changes already initiated by Law 10.762 as to applying equality in benefits and authorization procedures to small energy potentials regardless of the power range, assuring them the same status of authorized producers. Consequently, the benefits would be extended to all producers, including self-producers.

4. A simplification of procedures for connecting PAs and MAs to the grid is required, following past experience of national concessionaires on the considerable benefits that this embedded generation brings to the distribution system. Also, the transmission cost should acknowledge the benefits of this interconnection, which might even reach negative values (incentives) since the associated reactive power compensation at strategic points of the grid can displace considerable investment.

5. μAs and πAs must obtain appropriate conditions for connection to the grid. In many cases, lower voltage connection must be allowed.

6. The use of funds from the RGR must to a certain extent give preference to small-scale renewable energy potentials. It is not enough to consider such possibility in the law if there is no political decision to prioritize renewable energy production.

7. Tax reform is essential for PAs and MAs that have higher potential for independent power production. Moreover, μAs and πAs may require special taxing conditions (tax reductions) for reaching mature stages.

8. The direct subsidies granted by the government to grid-connected consumers must be extended to those who are supplied in non-conventional ways.

9. It is important to establish a mechanism that allows cross subsidies between different consumption classes within concessionaires, e.g. by creating a special class for isolated consumers.