

WABEF Support to Renewable Energy Development in Senegal

Moussa Ba,
Jean-Michel Médoc

Senegal, like many other countries on the planet and in the West African sub-region, is investing in renewable energies (RE) in view of the high dependence on oil and gas that make economic development of the country vulnerable. Thus, the Senegalese authorities are developing a policy based on the search for alternative solutions following the development of RE and diversification of sources of production.

To this end, the National Agency for Renewable Energies (ANER) was created to promote and develop RE: solar, wind, hydro and biomass. The objective of the government through its agency is to achieve an energy mix with 20% RE in 2017 including hydroelectricity. Solar energy plays a major role among these ambitions. In 2016 two solar power plants with a total capacity of 42 MW were connected to the national electricity grid, which, in January 2017, contributed to a 10% decrease in the price of the domestic kWh (the most expensive in the region). Four other solar power plants are under construction and their delivery is expected end of 2017 for a total capacity of 84.5 MW. This would increase the contribution of RE (solar + hydroelectricity) to 20% of the energy mix by end 2017.

Biomass is no less important as the development of biogas production begins. Indeed, the government's National Domestic Biogas Programme in Senegal (PNB-SN) aims to install 10 thousand domestic biodigesters by 2019, with a capacity of 8-12 m³, for 9500 rural households across the country. There will also be biodigesters with a capacity of less than 18 m³ for 500 school canteens and *Daaras* (Koranic Schools). A much higher-scale production capacity involves two private and one NGO in agro-industries (slaughter houses), and the National Office of Sanitation of Senegal, who is recycling sewage sludge issuing from the treatment of municipal waste water and faecal sludge.

WABEF and Senegal

In Senegal, many stakeholders are involved in the development of biogas. In addition to the Ministry of Energy and Renewable Energy Development, most of the ministries comprising the Senegalese Government are involved, along with their agencies, national programs, local authorities, inter-municipal groups, the Consular Chambers, etc. A strong synergy has been developed with PNB-SN, initiated by WABEF as a synergy between European-funded projects.

Biogas from slaughter houses

The Dakar abattoir recycles its waste (50 tons of a mixture of stomach contents, dung, blood and washing water per day) in a Thecogas biogas plant with a capacity of 4,000 m³, producing 1,000 m³ of biogas per day. This biogas generates 800 kWh per day and 1,700 MW of heat annually, covering 50% of the power and all the hot water needs of the abattoir. In 2015, the cost price of the kWh was 81 FCFA and it was sold at 101 FCFA. Daily, the equivalent of 80% of the intake is evacuated as a bioslurry. A litre of bioslurry is sold at 200 FCFA for volumes less than 1 m³. Beyond this, the price goes down to 50 FCFA/litre and even 7.5 FCFA/litre if all the daily production is bought (between 30 and 50 m³). Thecogas and the Biogas National Program are engaged in a standardisation process for bioslurry to provide farmers with a satisfactory cost/efficiency ratio fertiliser.

The potential exists for up-scaling of this technology at the Dakar slaughterhouse. To date, only one quarter of the wastes produced daily are digested. This reduces the daily power consumption from 2600 kWh to 1800 kWh. Treating all the wastes produced would allow the abattoir to further reduce its consumption by 1250 kWh per day. Even better, the slaughterhouse has an exclusive purchase contract at a preferential tariff of electricity, the biogas plant having exclusive access to the waste source. The Senegal Slaughterhouses Management Company (SOGAS) runs eight abattoirs around the country where this model could be developed.

In Saint-Louis, at a more modest scale, a unit of five floating dome digesters with a capacity of 10 m³ each is installed in this slaughterhouse thanks to collaboration between the NGO Le Partenariat and SOGAS. The unit produces 20 m³ of biogas per day sold to the surrounding households at the rate of 200 FCFA per m³ while the bioslurry is sold to market gardeners in the locality.

As a first step, a consultative workshop with stakeholders, school canteens and Koranic schools on sustainable development of a biogas market in Senegal was organized in partnership with PNB-SN and with the support of the Embassy of France in Senegal in 2015. Collectively WABEF and PNB-SN designed inventories of the development situation of industrial and domestic biogas in Senegal. This workshop



Thecogas Anaerobic Lagoon at the Dakar Abattoir. Photo: Léonce Sessou

To reach the national biogas (available methane) potential and the fertilising value, it is paramount to quantify the bio-wastes available. A methodological framework was developed for collecting and linking all the basic references needed to calculate the deposit and its potentialities. These included livestock, cultivated areas per district, ratios of production for manure and residual biomass, duration of production cycles, number of cycles per year to calculate the gross deposits, plus the time at barn for animals to reach the required deposits, and finally to reach the available deposit of bio-wastes. The valorisation or use ratios were obtained according to the practices of farmers from group interviews. This approach to the acquisition of the deposit has been illustrated by the quantification of organic residues from agricultural crops and livestock in Senegal.

engaged the actors in the path of the development of biogas in order to avoid sectoral approaches and allow a shared and integrated vision.

In addition, a research programme funded by PNB-SN and implemented by Institut Sénégalais de Recherches Agricoles (ISRA) and CIRAD began early 2016 and will run for two years. This research will acquire agronomic, energetic (Biochemical Methane Potential) and environmental (metallic and organic contaminants) references on bio-wastes that may be digested and on the bioslurry. To allow this research on the biogas potential of local bio-wastes, an automatic biogas (methane) potential test system deployed by CIRAD in the International Joint Lab “Ecological intensification of agricultural soils in Western Africa” at Centre ISRA/IRD of Bel Air in Dakar, Senegal. This facility, equipped with 15 parallel test lines, is of regional interest and the first local results are now available.

To meet the decentralised energy needs for populations and industries, as well as fertilisers, identifying the available bio-waste deposits for methanisation must be done. In Sénégal, bovine manure represents a potential deposit of

1,691,135 tons of DM/year. The importance of the quantities emitted and the control of this total gross production at 50% are the two important criteria which have guided the choice of the PNB-SN to consider this resource as the main substrate for the operation of domestic biodigesters. However, due to its irregular distribution, the high demand for substrates for operating year-round and the distribution of these devices, bovine manure is insufficient. In the second phase of its program development, the PNB of Sénégal has embarked on a multi-stakeholder partnership. ISRA and CIRAD will research alternative substrates for bovine manure, to ensure efficient and continuous use of household biodigesters subsidised by the programme.

Lessons learned

There is a need for more appropriate regulatory frameworks that provide incentives to various uses of biogas, and that engage local authorities. The level of maturity of biogas technologies and the associated technologies in the waste to energy and agriculture chain must be improved through the development of normative frameworks. In addition, relevant authorities, decision makers and practitioners need to have access to proper information and operational tools for the design of their project or business. Access to private and public funding's need to be enhanced and more specific. And this legislation, information and supports, needs to be adapted to, and available at, the sector and level of operation. There is a need to properly monitor technologies and policies and the level of maturity of innovation, raise awareness, inform and train while changing mind and behaviour.

In order to accompany the development of the sector, the conditions for setting up an institutional framework conducive to decompartmentalizing and developing synergy between institutions, sectors of the economy, civil society, practitioners and private organisations, should be brought together.

Moussa Ba
IAGU

Jean-Michel Médoc
CIRAD
moussa.ba@iagu.org