

Case Studies

II. Case Studies

II.1 Benin



II.1.1 Benin's climate change and energy profile

Benin's energy situation is characterized by an energy balance in which biomass represents 58% of primary energy in 2017, followed by 37% of hydrocarbon imports, 2% of coal, 1% of natural gas and 2 % of electricity through thermal plants. (DGRE, SIE-Benin, 2021¹). In 2020, the rate of national access to electricity, is estimated at 36.5% at the national level (10.4% in rural areas and 64.9% in urban areas) and increases by 2.49% between 2016 and 2020². Benin relies on electricity imports for a significant

part of its energy supply and in 2018, the electricity access rate in Benin was 33.2%. These relatively low figures indicate a total absence of motorization both in the production and processing of agricultural products.

The household fuels sub-sector occupies an important place in Benin's environmental and energy policy. There are several reasons for this:

- The harvesting of wood to meet the energy needs of populations, particularly urban populations in the form of charcoal, the significant contribution to the disappearance and degradation of forest resources,
- Its importance in urban-rural relations,
- The multiplicity of public and private actors concerned and,

1 BENIN.- Chiffres clés 2021 : Bilans énergétiques et indicateurs 2016 à 2020. Cotonou : SIE, DGRE, 2021.- 26p. <https://direction-energie.gouv.bj/telecharger-chiffres-cles>

2 Idem

- Links with many other sectors (agricultural, forestry and energy policy, legislation, regulations and taxation, gender relations, decentralization, etc.).

Apart from biomass, we note this characteristic of strong dependence on imported petroleum products for the transport sector, industries and for the production of electricity which, also, depends just as heavily on imports from neighbouring countries.

The development of renewable energy sources has enabled Benin to implement several projects and programs since the 1990s. However, the significant potential of renewable energy resources remains very poorly exploited (solar, wind, hydroelectricity, agricultural and animal biomass).

In fact, with reference to the National Policy for the Development of REs, it has been noted the use of renewable energy technologies at a large scale is not yet a reality due to institutional, regulatory, technical, economic and organizational barriers to their development. This development of REs has not been a priority so far and has not been integrated into the legal and regulatory framework of the energy sector and other related sectors such as agriculture, the environment, town planning or even the business environment.

Apart from the large hydroelectricity of the Compagnie Electrique du Bénin (CEB), there is no large electricity production infrastructure based on renewable energy connected to the SBEE (Société béninoise d'énergie électrique) network. About 2% of localities have been electrified by mini solar power plants and 6% by solar PV kits. Energy services such as water heating, solar drying or even motive power for various activities (irrigation, pumping, grain milling, etc.) are very poorly developed. Micro-hydroelectricity, wind power and modern biomass applications are very rare or even non-existent.



Situation of Renewable Energies

Despite the country's immense potential, Benin does not yet experience large-scale use of renewable energy technologies. A vigorous policy will be necessary for the exploitation of renewable energy resources which are more or less sufficiently known. The country's potential is as follows (PONADER³):

3 BENIN.- Politique nationale de développement des énergies renouvelables (PONADER).- Cotonou : Bénin, 2020.- 20 p. <https://direction-energie.gouv.bj/documents/politique-nationale-de-developpement-des-energies-renouvelables-2020.html>

Hydroelectricity

Several studies (UNDP, ABERME, TECSULT-ACDI, IED) confirm the hydroelectric potential of sites in two favourable areas. However, their characteristics (high intermittency, low flow rates, lack of demand for proximity and inaccessibility, among others) in addition to competition from the interconnected network (nearly half of the developable sites are in the immediate vicinity (<2km) of the current high voltage network, the furthest being approximately 15 km away) restricts the profitability of the implementation.



Solar

From Table 1 earlier, the potential of solar energy is available with a share of 20% of total RE resources. The solar radiation in Benin is between 3.5 and 5.5 kWh/m²/day going in an increasing direction from the south towards the center-west and the north with a strong component of diffuse radiation compared to live. Thus, for an installed capacity of one kWp, the annual producible is estimated at 1560 kWh in the north, 1460 kWh in the center and 1400 kWh in the south (in wetlands). Large-scale electricity production (thermal or photovoltaic) would therefore be ideally located in the north and centre-west. The trend around the world tends to confirm that solar photovoltaic (PV) technology is now a viable option for the supply of electricity.



Wind

The wind measurements available in Benin indicate that only the coastal strip has an appreciable potential and wind speeds with a constant frequency throughout the year. These speeds, measured between 10 and 12m from the ground, vary from 4 to 6 m/s in the coastal zone and from 1 to 2 m/s in the north of the country. Despite the weakness of these different speed levels, studies have shown that they are favourable to the construction of small wind turbines. Some specialists rightly point out that the possibilities of off-shore wind turbines off the coast of Benin are insufficiently explored.



Bioenergy

Benin has a large potential of agricultural residues, which currently remains untapped and is largely burnt in the fields like in most countries. Biomass has a rather marginal contribution to electricity production within the West African Economic and Monetary Union (WAEMU) member states. It is mostly exploited in self-generated electricity units only. For example, only around 1% of the electricity produced in WAEMU in 2018 is obtained from biomass energy (DGRE, SIE-Benin, 2021).

However, in 2008, WAEMU carried out a feasibility study for a pilot unit for decentralized electricity production by gasification of agricultural residues (UEMOA, 2008). This study has shown that Benin has biomass energy resources whose exploitation can contribute to curbing the repeated crises in electrical energy. Indeed, according to WAEMU, 70% of Benin's GDP production is based on agricultural raw materials for the clothing and food industry.



Moreover, according to studies carried out by the city of Cotonou, the city generates more than 700 tons of garbage per day. This existing potential could allow the installation of a power plant with a minimum capacity of 5 MW by biochemical means from household solid waste.

In 2017, bioenergy provided 46.2% of final energy consumption in Benin. The wood energy potential resides in private and state plantations, protected and classified forests, natural plant formations and old fallows. More than 90% of biomass is provided by wood fuels, i.e. wood and charcoal from Beninese forests.

Vegetable waste (agricultural and forestry), animal waste and household waste also constitute a considerable potential in biomass that can be recovered in different forms of energy.

Many crops that can be used for biofuels are present in Benin. Mention may be made of sugar plants (sugar cane, sweet sorghum), starch plants (maize, cassava, wheat, potato), cellulosic materials and oilseeds (palm, soya, groundnut, *Jatropha curcas*). Experiments in the laboratory and in the field have been carried out and the policy envisages retaining sugar cane, cassava and the *Jatropha* plant as the basic materials for a possible biofuel strategy.

Although many initiatives have been developed for the use of biomass for the production of energy and then dropped in the past, in 2012 a strategy followed by an action plan has been developed and the government clearly stated its vision to “make biomass energy in general, and biofuels in particular, a factor in reducing energy dependence in Benin, with a positive effect on economic growth, the environment and people’s access to basic energy services”. In line with this vision, the project “Promotion de la production durable de biomasse électricité” was launched in 2017 for a five-year period⁴.

In 2020, this target has been reiterated in the National Policy for the Development of REs to “ensure the sustainable recovery of biomass energy for the production and use of biofuels”. Thus, the government is thus considering using biomass as RE and CSOs should get prepared from their point of view.

Energy and climate change in Benin

Like many African countries, Benin has experienced rapid urbanisation. This has resulted in increased energy consumption and greenhouse gas emissions (IPCC, 2007). A World Bank study on “Air quality in Cotonou” (2007) reports a daily emission of about 83 tonnes of CO₂, the majority of which is attributable to motorised two-wheelers.

The energy challenge is therefore twofold. On the one hand, Benin’s energy dependence on external imports of energy and fuel must be reduced; on the other hand, the development of clean and/or renewable energy sources must be promoted. Benin’s electricity supply comes mainly from the Akossombo dam on the Volta River (Ghana) and the Nangbeto dam on the Mono River (Togo). Because of its dependence on externally produced hydropower, the energy sector is vulnerable. Climate change could indeed lead to a decrease in hydroelectric production. Increased frequency and intensity of storms and rising sea levels pose a significant risk to infrastructure. Extreme events and rising sea levels could damage an already fragile power grid and bring the entire country’s economy to a standstill.

Benin is geographically well positioned to use clean energy. The southern part of Benin, under the influence of the Atlantic Ocean, is characterised by a high availability of wind and tidal energy. The northern part of Benin, more influenced by the Sahelian climate, has a high potential for solar energy.

On the other hand, there are opportunities to produce hydroelectricity in the country. Thus, 35 potential sites for hydroelectric power stations have been identified by the Communauté Électrique du Bénin (CEB) since 1984, of which five (5) have been deemed to be priorities: Adjarala on the Mono, Kétou, Olougbe and Assanté on the Ouémé and Batchanga on the Pendjari.

In addition, with 8,000 hours of average annual insolation, Benin’s radiation balance offers enormous possibilities for the development of solar energy. The longest periods of sunshine are observed between January and April in the Sudanian and Atacorean regions, from 10°N. Further to the need to develop autonomous energy sources, there is a need to manage household energy consumption. The consumption of petroleum products and firewood leads to greenhouse gas emissions, which are responsible for

4 SATOGUINA, Honorat ; KOUTCHIKA EHINNOU, Romaric.- Evaluation à mi-parcours du projet Promotion de la biomasse électricité au Bénin.- Cotonou : UNDP, 2019. 153p. <https://erc.undp.org/evaluation/documents/download/15295>

climate change. Stricter regulation of these energy sources could be envisaged while facilitating autonomous electrical installations. This could even have a positive effect on prices.

The example of Ouagadougou is interesting in this regard. The city has banned the introduction of firewood. This is supported by a hard pricing policy towards gas. It is now half the price of gas in Cotonou, even though some of the gas found in Ouagadougou is imported from the port of Cotonou. It is known that rising incomes and global population growth are two factors in the increase of CO₂ emissions linked to energy consumption (IPCC, 2007). The notion of ecological footprint has emerged in recent years as an important tool for monitoring sustainable development policies. Benin must improve its energy performance and prepare its economy for the increasing scarcity of conventional energy sources.

II.1.2 – Existing policies and laws including the country's NDC and national, regional and local legislation relating to climate change and energy

Renewable Energy policies and laws

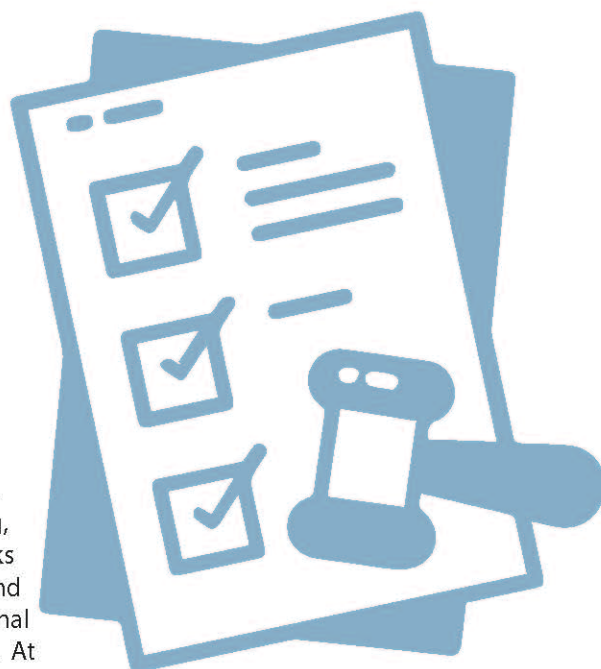
Benin has two basic laws on electricity:

- The Benin-Togo Electricity Code of 2003 based on an energy agreement concluded between the two countries in 1968;
- and the 2006 Benin Electricity Code that governs only the electricity sector in Benin and complements the Benin-Togo electricity code⁵.

However, in 2020, given the low exploitation of renewable energy sources and the lack of large-scale use of renewable energy technologies as part of the contribution to the reduction of greenhouse gas emissions, the country decided to somehow update its policy strategy and instruments and adopted the National Policy for the Development of Renewable Energy for 2020 - 2030 (PONADER)⁶. This ten-year policy aims to take measures and put in place planning, orientation, coordination and monitoring-evaluation frameworks for actions linked to the development of renewable energies, and intervention mechanisms to make the existing and future institutional and legal frameworks adequate, harmonious and complementary. At the institutional and regulatory level, the search for greater harmony and synergy of intervention concerns several actors, including the State, its branches, the Electricity Regulation Agency (ARE), the decentralised authorities and the populations who are the main beneficiaries.

The implementation of PONADER should lead to the following changes:

- In the short term: (i) improved knowledge of resources, (ii) capacity building of actors and (iii) promotion of renewable energy resource technologies;
- In the medium term: reduction of Benin's dependence on energy imports
- In the long term: access to the largest number of the population at the lowest cost to energy services based on RE and contributing to sustainable development while promoting socio-economic activities in the rural world through modern energy.



⁵ https://are.bj/wp-content/uploads/2017/09/LOI-N-2020-05-PORTANT-CODE-DE-LELECTRICITE-EN-REP-DU-BENIN_1.pdf

⁶ BENIN.- Politique nationale de développement des énergies renouvelables (PONADER).- Cotonou : Bénin, 2020.- 20p. P5 <https://direction-energie.gouv.bj/documents/politique-nationale-de-developpement-des-energies-renouvelables-2020.html>

1994
Benin ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994.

Even if it is too early to assess the state of implementation of the PONADER, a new government-driven dynamic can be observed in the electricity sector during the last few years in line with the PONADER. In this regard, several projects have been developed including the 25 MW Forsun Project funded since 2021 by the French Agence Française de Développement (AFD) and the four (04) solar power plants of 50MW to be funded from 2022 by the Consortium Greenyellow / Egnon Consulting, an independent power producer (IPP).

Although the PONADER may be questioned with regard to the objective of using biomass as RE or for the production of biofuels, its ownership by the various actors and their commitment to achieving at least some of the strategic objectives of this policy are of paramount importance for its successful implementation. Indeed, the awareness of the importance of renewable energy and political will are necessary to achieve the desired changes.

Climate change policies and laws

Benin became aware of the challenges of climate change very early and ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994. Since then, the country has been committed to the implementation of activities related to this convention. It has thus embarked on the development, adoption and implementation of several policies, laws, strategies and response programmes. Thus, it has defined its priority actions, standards and mechanisms for environmental protection and management.

At the policy level, one of the important instruments defined is the National Development Plan 2016 - 2025 adopted in 2018. This law aims to combat climate change and its negative effects and consequences and to increase the resilience of living communities.

On the legal front, a law was passed in 2018 regulating climate change in the country: law N°2018 - 18 of 06 August 2018 on climate change in the Republic of Benin⁷.

In terms of climate finance, Benin has created the National Environment and Climate Fund (FNEC) accredited by the Green Climate Fund (GCF).

Other most recent climate policy instruments include:

- Third National Communication on Climate Change, 2019⁸
- Benin's updated Nationally Determined Contribution to the Paris Agreement (NDC), 2021⁹
- Benin's National Climate Change Adaptation Plan, 2022¹⁰

II.1.3 Overview of opportunities and barriers

The PONADER is a great first for Benin and constitutes a major participatory challenge. It can only be met with the contribution of all actors at various levels (public sector, private sector, institutions of the Republic, civil society organisations, social partners, Interprofessional Association of Renewable Energy Specialists, Technical and Financial Partners, Universities, etc.). To achieve the government's vision in this area, that of "making renewable energies the priority source of sustainable and optimal satisfaction of national energy needs by 2030".

The main challenges for the PONADER and hence the whole country are

- the need for a roadmap for renewable energy development
- the need for a formal institutional and regulatory framework to promote the

⁷ <https://climate-laws.org/geographies/benin/laws/law-no-2018-18-regulating-climate-change-actions>

⁸ BENIN.- Troisième communication nationale du Bénin : à la Convention-cadre des Nations Unies sur les changements climatiques. Cotonou : Benin, 2019. 272p. https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/39685271_Benin-NC3-1-BENIN_TCN_2019.pdf

⁹ BENIN.- Contribution déterminée au niveau national actualisée au titre de l'Accord de Paris.- Cotonou : DGEC, 2021.- 74p https://unfccc.int/sites/default/files/NDC/2022-06/CDN_ACTUALISEE_BENIN2021.pdf

¹⁰ BENIN.- Plan national d'adaptation aux changements climatiques du Benin.- Cotonou : DGEC, 2022.- 175p. https://unfccc.int/sites/default/files/resource/PNA_BENIN_2022_0.pdf

development of renewable energies¹¹;

- the need for popular acceptance and massive adoption of renewable energies (PV and wind);
- the need for adapted equipment for the integration of renewable energies into the electricity networks;
- the need to put in place a financial mechanism to accompany the development and adoption of REs at the community level.

II.1.4 Points of Action for local civil society organisations

- Raise awareness on energy saving among the population to ensure better knowledge of the benefits of REs and RETs, hence their adoption
- Sensitize on and promote adoption of REs
- Advocate and promote the benefits of REs, including promotion of street lights for popular ownership of REs
- Promote clean cooking with improved cookstoves as a credible alternative to reduce the consumption of firewood and charcoal.
- Advocate for the participation of NGOs and CSOs in the development and implementation of power plants, in order to ensure local acceptance, the introduction of local content and commitment and ownership of the local communities
- Organize policy dialogues to promote participation of all actors (in particular local authorities and CSOs) to take into account the concerns of local populations
- Advocate for the establishment of a platform for multi-actor dialogue, to ensure awareness raising, information sharing and ownership
- Advocate for the development of local competencies for installation and maintenance, to ensure the development of sufficient and reliable qualified local workforce
- Advocate for the development of legislation (on land, tax, loan) to encourage the use of solar energy

Recommendations to local authorities could include:¹²

- Commitment to energy independence by diversifying Benin's clean supply sources.
- Definition of preferential rights (e.g. in terms of equipment cost reduction or subsidies for people who adopt RETs) in housing for instance for renewable energy technologies.
- Development of legislation for building to encourage the large adoption of solar energy
- Set or increase taxes and reduce subsidies for fossil fuels
- Develop an efficient and clean public transport system.



11 Such as the agencies for the promotion of REs created in countries like Senegal (ANER) or Mali (ANADER), etc.,

12 BOKO, Michel ; KOSMOWSKI, Frederic ; VISSIN, Expedit, W.- Les enjeux du changement Climatique au Bénin.- Cotonou : Konrad Adenauer, 2007. 72p