# GHANA

## ENERGY

# Growth, electrification and emissions : a fine balancing act

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GHANA

# Growth, electrification and emissions : a fine balancing act

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**With an average growth of 5% since 2013, Ghana has one of the most dynamic economies on the planet. The Ghanaian rate of electrification is one of the highest in Sub-Saharan Africa and the country became an exporter of electricity in the late 2000s. These results were obtained without increasing emissions in the electrical sector. On the contrary : they have significantly reduced since 2013. How has the country managed to balance an economic growth, an improved electrification rate and yet a drop in emissions? Can this high level of performance last?**

# Key takeways

Emissions from the Ghanaian electricity sector stood at 2.71 million tons of $CO_2$ in 2017 compared with 3.52 million in 2013. Meanwhile, electricity production has gone from 12.9 to 14.1 TWh;

A drop in carbon intensity of electricity can be explained by the development of gas-fired power stations, boosted by the discovery of local resources and a recurring shortage of electricity. However, hydroelectricity, the country's main source of decarbonated electricity, is not being developed;

The Ghanaian electricity sector is being redeveloped after years of major difficulties. The poor financial health of public businesses places the onus of developing the country's major renewable resources on private investments. Despite ambitious objectives and incentive policies, renewable energy generation, excluding major hydraulic installations, remains negligible. However, several projects are underway concerning solar, wind and wave farms;

The role of local governments in the production of energy is limited, they can mainly intervene via their economic development missions by supporting the electrification of local activity areas;

Civil society, and especially women, is as opposed as it is advocating by mobilizing against coal-fired power plant projects, while having an important role in training and sensitizing the population on energy issues.

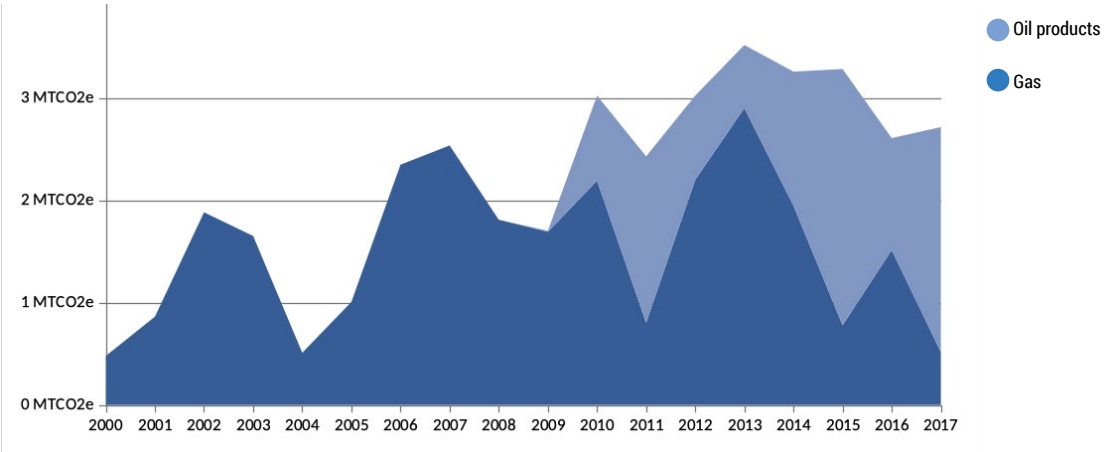
**CONTENTS**

## 1 – Declining emissions despite economic dynamism

**• A DROP IN EMISSIONS SINCE 2013 •** In 2017, Ghana emitted the equivalent of 14.93 million tons of $CO_2$ equivalent ($MTCO_2e$) (Enerdata, 2019) or around 0.53 tons per inhabitant. This level places Ghanaians under the average for Sub-Saharan African inhabitants (0.85 $TCO_2e$/inhabitant) (World Bank). In the same year, the production of electricity and heat was responsible for the emission of 2.71 $MTCO_2e$ in Ghana (figure 1). Greenhouse gas emissions (GES) linked to the energy sector, excluding electricity, were negligible (Enerdata, 2019).

**FIGURE 1**

EMISSIONS LINKED TO THE PRODUCTION OF ELECTRICITY AND HEAT FROM BURNING FUEL – *Source : enerdata – 2019*



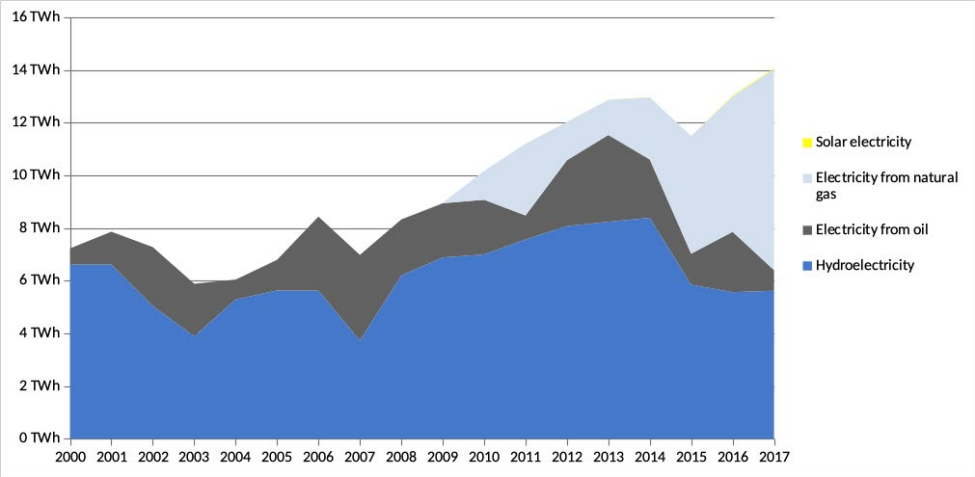

**Energy-related emissions increased in the 2000s until they reached a peak of 3.52 $MTCO_2e$ in 2013. They have been dropping ever since.** This decline is in stark contrast with the country's economic dynamism. Since 2013, the economy has been growing on average by 5 % a year. In 2017, it even reached a growth rate of 8.1% (World Bank) notably due to industry which grew by 16.7%. Ghana was then the second most dynamic country on the planet in terms of industrial growth (CIA World Factbook, 2019).

During that period, the rate of electrification also rapidly increased : it went from 43.7 % in 2000 to 64% in 2010 and 79% in 2017 (World Bank, 2019). Today it has one of the highest rates in Sub-Saharan Africa. However, traditional biomass (wood, charcoal, agricultural residues…) still play a major role with regards to Ghanaian energy consumption, particularly in rural areas. It represents almost 40% of the total energy consumption compared with approximately 13% for electricity (Government of Ghana, 2019).

**• DETERMINING FACTORS FOR DEVELOPMENT •** Economic growth and progress, regarding the installation of electricity, translate as an increase in electricity production. This went from 7.2 TWh in 2000 to 10.2 TWh in 2010 and 14.1 TWh in 2017 (Enerdata, 2019). **This decoupling between growth and electricity production on the one hand, and GES emissions from the electricity sector on the other, is possible due to the development of the Ghanaian energy mix.**

**FIGURE 2**

ENERGY PRODUCTION BY SOURCE – *Source :* enerdata – *2019*




Historically, Ghanaian electricity production came from two main hydroelectric power stations, Akosombo and Kpong, and any remaining electricity production came from diesel or fuel powered thermal power plants. The country does not possess a coal-fired power station.

**The introduction of independent producers (IPP) and the discovery of off-shore gas reserves in 2007, led to new natural gas-fuelled power plants being built, a fuel which emits less than petroleum products. The capacity of this installation was multiplied by 6 in 10 years, going from 183 MW in 2008 to 1202 MW in 2018.** This puts the Ghanaian electrical power grid in a position of overcapacity : the available power is almost twice as much as the maximum demand (Asumadu-Sarkodie, 2019).

Renewable production, however, contributes very little to limiting Ghanaian emissions. Hydroelectric power has gone from 1180 to 1580 MW with the inauguration of the Bui Dam in December 2013, but it has not had a significant effect on production. Besides hydroelectricity, photovoltaic solar energy is the only renewable energy source present in the Ghanaian energy mix. Solar production, which was inexistent until 2013, has experienced a rapid increase : it doubled in 2018 and reached 47.5 MW. However solar production remains negligible : it represented only 0.2% of the country's electricity production in 2017 (Enerdata, 2019).

## 2 – The energy policy : a complicated situation with multiple objectives

**• AN ELECTRICITY SECTOR BEING REDEVELOPED •** Despite progress made in electrification, for over a decade Ghana has experienced unpredictable and extremely unpopular periods of selective power cuts. These power cuts, which mainly appeared from 2007 onwards and were locally nicknamed *dumsor*, had major economic consequences with a drop in productivity in the manufacturing sector estimated at 10% (Abeberese, 2017) which led to the bankruptcy of several small and average-sized businesses (Ackah, 2015). The discontentment culminated in 2015 with a campaign on social networks (*#dumsormuststop*) and a protest held on May 16th 2015 in Accra (PeaceFM, 2015). Despite an improvement, there are still power cuts, demonstrated by the fact that more occurred in 2019 (Ghana Summary, 2019).

**FOR A BETTER UNDERSTANDING**

## ORGANIZATION OF THE GHANAIAN ELECTRICITY SECTOR

The legacy of the dumsor years weighs heavily on the Ghanaian electricity sector's current situation. The power cuts, as a result of insufficient electricity production, were due to several reasons : poor hydraulicity and hydrocarbon supply shortages from Nigeria in 2012 and 2016 (Oxford Business Group). To resolve this, the Ghanaian government finalized contracts with independent producers which led to a rapid development of the electricity power grid, which has now reached a level of overcapacity. This period also left public operators in poor financial health and so the sector is being redeveloped.
Ghanaian electricity production hinges on two public operators and a network of independent producers. The Volta River Authority (VRA), one of the original producers, is entirely State-owned. It supervises the hydroelectric factories Akosombo (1020 MW) and Kpong (160MW) and it developed a network of coal-fired power stations in the surrounding areas of Tema and Takoradi through the course of the noughties. The Bui Power Authority (BPA), jointly financed by public capital and Chinese investments, manages the operation of the Bui hydroelectric power station (400 MW). Some of the main independent producers include Takoradi International Company (2330 MW), Cenpower (340 MW) and Karpowership (450 MW). Others are specialized in the production of solar energy, such as BXC Energy and Biotherm which each own 20 MW.

Electricity transmission is managed by the public operator GRIDCo. Three different businesses are in charge of distribution. The Electricity Company of Ghana (ECG) only covers a third of the country in the south but it distributes 90 % of Ghanaian electricity. The rest of the country is served by the Northern Electricity Distribution Company NEDCo, a subsidiary of VRA, which mainly distributes to individual clients. A private company, Enclave Power Company, sells power to commercial and industrial clients in the Tema free zone.

The regulation of the electricity sector is controlled by the Minister of Energy through the Public Utilities Regulatory Commission (PURC). The latter is notably in charge of managing quality, promoting competition and fixing tariff regulations. As for the Energy Commission, it advises the government and issues licenses to operators in the sector.

**TEXT BOX 1**

**The financial health of distributor Electricity Company of Ghana (ECG) deteriorated during the dumsor years, so much so that it compromised the stability of the whole sector**. Major losses (almost 25% of the volume bought from producers was not sold), an excessively low-price list compared with costs, an insufficient recovery rate and the accumulation of outstanding debt from public services put the ECG in long term deficit. This poor performance was detrimental to its liquidity and prevented it from accumulating arrears with regards other operators from the sector, notably the public bodies Volta River Authority (VRA) and GRIDCo. The sector's increased debt was estimated at 2.4 billion dollars in 2017.

In 2015, the Ghanaian government committed to cleaning up the sector. The government signed up for the *Millenium Challenge Corporation* (American public aid), an aid program amounting to 500 million dollars with the ECG concession agreement as one of the disbursement conditions. A concession agreement lasting 20 years came into effect in early 2019, notably predicting that Ghana would remain a main shareholder of the renowned company Power Distribution Services Ghana Limited, and the electricity tariff would be fixed by PURC, the sector's regulator.

The government also proceeded to issue 500 million dollars of debentures to eradicate the debt of public operators. This loan will be reimbursed by a levy on petroleum products (Energy Debt Recovery Levy), the equivalent of 6 cents per litre of petrol. Similarly, the restructuring of the VRA's debt allowed interest rates to be revised downwards. Regarding both the economy and climate, the efficiency of this clean-up plan could not be evaluated long term.

**• HIGH-LEVEL RENEWABLE OBJECTIVES WHICH UNTIL NOW HAVE BEEN THWARTED •** Ghana has great potential for producing electricity using hydraulic, solar, wind and biomass methods (Gyamfi, 2015). Resource development was identified from as early as the noughties as a way to balance out Ghanaian electricity production and continue producing electricity. The Strategic National Energy Plan 2006–2020 set a renewable energy production objective (not including the major hydroelectric energy sources) to 10% of the mix, an objective confirmed by the 2010 National Energy Policy. With a share of around 0.5% in 2018, it is now clear that this objective will not be reached.

**This delay can be explained not only by the imprecision of objectives, a lack of financing, insufficient transmission and distribution infrastructures, but also by the coexistence of competitive objectives.** In particular, it was rapid electrification, an integral element of the Ghanaian energy policy since the 90s, which was reaffirmed with the National Electrification Scheme in 2010. This plan aimed to supply electricity to all of the urban areas containing over 500 adults in 2020 (Obeng-Darko, 2019).

**FOR A BETTER UNDERSTANDING**

### SUPPORT MECHANISMS FOR RENEWABLE ENERGY?

The 2011 law on renewable energy (Renewable Energy Act or RE Act) has the objective "of controlling the development, management and use of renewable energies to produce heat and electricity effectively and sustainably". It implemented a framework designed to encourage the development of renewable energy. This framework is based on three main measures : a guaranteed feed-in tariff, a purchase obligation and transmission or distribution grid connection agreements. The Feed-in-tariff or FiT helps protect those leading renewable projects against the change in electricity prices. The feed-in-tariffs are fixed for 10 years and then reviewed every two years.

In virtue of the renewable energy purchase obligation, or the REPO, electricity purchased from the grid system operator and large consumers must include a small amount of renewable electricity. If this percentage is not reached, a financial penalty is applied.

Finally, the law obliges grid system operators to enter into connection agreements with renewable project leaders. These agreements ensure the produced electricity is sold to the producer's desired clients, however connection to the grid is the producer's responsibility.

*Source : RE Act*

**TEXT BOX 2**

Ghana has recently updated its renewable energy objectives. The Renewable Energy Master Plan published in February 2019 anticipates rapid development of these energies to reach an installed capacity of 1,363.63 MW in 2030 compared with 42.5 MW [1] in 2015. A significant part of this development should be done off the grid or for self-consumption. 269 MW are reserved for supplying electricity to a thousand communities. Intermediary objectives itemized by field are also fixed for 2020 and 2025.

1 – Hydroelectric installations over 100 MW are not counted

**TABLE 1**

THE MAIN OBJECTIVES OF THE RENEWABLE ENERGY MASTER PLAN.

| A | Reference 2015 | 2019-20 | 2020-25 | 2025-30 | Total 2030 |
|---|---|---|---|---|---|
| Solar farms | 22.5 MWc | + 130 | + 195 | + 100 | 447.5 MWc |
| Wind farms | 0 MW | + 0 | + 275 | + 50 | 325 MW |
| Hydro < 100MW | 0 MW | + 0.03 | + 80 | + 70 | 150 MW |
| Wave energy | 0 MW | + 5 | + 0 | + 45 | 50 MW |
| Microgrids | 13 units | +73 | + 114 | + 100 | 300 units |
| Improved households | 800,000 | + 500,000 | + 500,000 | + 1,200,000 | 3,000,000 |

The plan hopes to invest 5.6 billion dollars, 80 % of which comes from the private sector. Besides the support mechanism put in place by the 2011 law on renewable energy, these investments benefit from measures such as fiscal incentives, i.e. : import duty exemptions on components designed to produce renewable electricity, import duty exemptions and VAT exemptions on other essential on-site equipment required for projects up until 2025, etc.

At the same time, Ghana looks to develop interconnections with neighboring countries to sell its production : a 225 kV power line was introduced between Ghana and Burkina Faso in December 2018, and the 330 kV coastal line connecting Accra-Lome-Porto Novo is being developed, as well as a line between Ghana and the Ivory Coast. Ghana is a member of the West African Power Pool, an initiative by ECOWAS, designed to unify the region's electricity market.

## 3 – The development of renewable energies relies on private operators

Since the market opened up at the end of the 90s, the Ghanaian government has regularly relied on the private sector to improve the functioning of the electrical system, notably to diversify the energy mix and to supply the country with electricity. This approach is continued today with the ECG concession agreement and the introduction of competition with regards marketing electricity envisaged for 2023 (CBN, 2019). Strategies implemented by private bodies and the incentive framework put in place by public powers will play an important role in achieving Ghanaian energy and climate objectives.

**Resorting to the private sector has partly been a success but it has also had perverse effects. The stabilization of the Ghanaian electrical system has relied on the rapid development of new production plants from private investments**. These investments were facilitated by long term electricity purchasing contracts. Between 2014 and 2017, the government signed "take or pay" contracts with three private energy engineering companies and 43 electricity supply contracts (power purchase agreements). This strategy helped to put an end to electricity shortages, but it also overestimated the country's needs : the power installed is now almost twice the amount that is required. In this context, take or pay contracts turned out to be particularly costly as they stipulate that producers are to be paid whether the electricity is used or not. This plan costs Ghana around 500 million dollars a year (Asumadu-Sarkodie, 2019).

Furthermore, new projects are almost exclusively focused on gas-fired power stations. These new infrastructures allow emissions to be reduced short term by substituting fuel oil, but they risk restricting the country to a long-term dependence on fossil energies.

**• LARGE AND SMALL-SCALE SOLAR PROJECTS • Taking into account the financial situation of public bodies, Ghanaian renewable objectives are achieved through private investments. This is notably the case for solar energy : even if the number of installations remains low, the Energy Commission has issued licenses for 52 businesses to set up solar farms** (UNEP, 2016). Several of these projects are being carried out and are often combined with larger scale economic development projects. This is the case for the Takoradi industrial park, for example, set up by WestPark Enterprises and which will be powered by a 100 MW solar farm built by Siemens (Afrik21, 2019) or a 174 kW off the grid installation set up by German company Redavia to power a fish treatment factory belonging to the Movelle Company (Afrik21, 2019). The use of solar energy is also planned as an economic alternative to power airports (Energy Ghana, 2019) and institutions (Government of Ghana, 2018).

**Effort has also been made to encourage investments from individuals with regards to solar energy to reduce electricity demand and transmission needs on the grid.** The Rooftop Solar program has thus been designed to support residential installations with a power of up to 500 W either with a subsidy or a direct supply of solar panels. The rest of the installation, such as the battery and inverter, remains the responsibility of the user and must be installed before assistance is granted. This is subject to the condition that all of the bulbs must be replaced by LED bulbs and that the installation must respect the quality criteria established by the Ghana Standards Authority. In addition, it must be installed by a professional certified by the Energy Commission (Energy Commission). Despite these restrictions, the program, which was launched in 2018, plans to install 200 MWp [2] of residential solar power.

**• PAVING THE WAY FOR INNOVATIVE PROJECTS •** Ghanaian economic entities are also taking an interest in innovative pathways and the development of solutions and services adapted to a local context. These projects often involve the collaboration of Ghanaian businesses and foreign entities, such as companies or research centres.

**Producing electricity from biomass, for example, can be optimized for agricultural residues available on site**. Cocoa pods are a particularly abundant resource : for every kilogram of cocoa produced, 10kg of waste is thrown away and Ghana is the world's second producer. A project is underway with the University of Nottingham to study cocoa pods from cocoa trees cultivated in Ghana to exploit them for electricity production. A cooperative model has also been proposed to make use of this waste for rural electricity projects (Bioenergy Insight, 2019). Projects making use of cassava residue also exist (Afrik21, 2018).

**FEEDBACK EXPERIENCE**

## FIRST WAVE ENERGY CAPACITY INSTALLED IN VOLTA ESTUARY

Wave energy consists in producing electricity from the movement of the waves. The World Energy Council estimates that this sector could produce 10 % of the world's annual demand for electricity, but it is only in the early stages of development.

The 2019 Renewable Energy Master Plan has given Ghana an ambitious objective in this field which is already underway – to produce 50 MW by 2030. In 2016, the Ghanaian business TC's Energy, in partnership with the Norwegian specialist Seabased, installed 6 convertors in the Volta

2 – Megawatt peak measuring the production of a solar installation in standard conditions of sunshine and temperature. Under real conditions, this level of power is rarely reached.

estuary. This pilot plant has made the project feasible and an agreement was signed in 2018 to set up a 100 MW energy plant (Renewable Energy Magazine, 2018). If it all goes according to plan, this project will be one of the biggest in the world : in 2018, the capacity installed worldwide, with all marine energy combined, only amounted to 529 MW (IRENA, 2019).

TEXT BOX 3

**Finally, new electricity marketing models are creating opportunities for local businesses**. Ghana Electrometers, for example, has requested 800,000 smart metres since it was set up in 2003. These metres create pre-payment solutions and are often used in developing countries to facilitate the payment of electricity bills.

During the years of the energy crisis, several companies, in particular SMEs, encountered great difficulties due to a lack of solutions, which would have allowed them to reduce their consumption or produce their own electricity. Besides the development of a technical proposal, the deployment of new solutions also involves supporting economic entities with the transition. In September 2019, the Association of Ghana Industries and the German cooperation launched a service designed to help factories with their projects in energy efficiency and renewable energy. It will carry out observations to maintain a database of solutions which can be used in the country and is to play an independent, intermediary and advisory role for businesses (All Africa, 2019).

FOR A BETTER UNDERSTANDING

### THE IMPACT OF CLIMATE CHANGE ON THE GHANAIAN ELECTRICITY SECTOR

It is predicted that climate change will make two thirds of north Ghana hotter and more arid, whereas the south will see a higher level of rainfall. According to the Energy Commission, this change is already having an impact on the electricity sector. In the north, where the main hydroelectric installations can be found, the increase in temperature will reduce the volume of runoff and it will increase water loss due to the evaporation of lakes which will thus lead to a decrease in production. In the south, episodes of heavy rainfall will damage the infrastructures, notably the grid and access routes to the power plants. The rise in temperature will also lead to a greater loss of electrical transmission. Coastal installations featuring high voltage lines and thermal power plants are also in danger due to the sea levels rising, storms and erosion.

*Source : Energy Ghana, 02/09/2019*

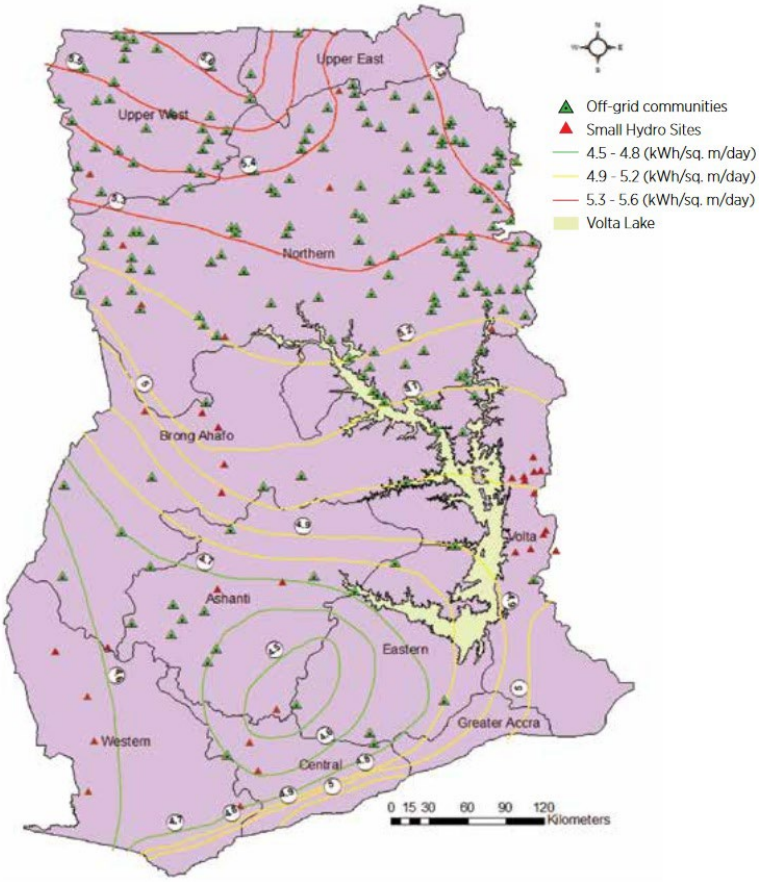
TEXT BOX 4

## 4 – Limited room for manoeuvre for local governments

Ghana has 10 regions and around 200 local governments (6 metropolis, 56 municipalities and 154 districts), along with 1,000 domestic, political and administrative structures. The Ghanaian constitution grants local governments with a budget of at least 10 % of the gross domestic product (Commonwealth Local Government Forum).

**FIGURE 3**

OFF THE GRID COMMUNITIES, SMALL HYDROELECTRIC INSTALLATIONS AND SUNSHINE – *Source : IRENA, 2015*




Adding climate into the decision-making process is encouraged with regards the budget and regulations, for example the Ghana Local Government Act (Act 462). However, the application of these regulations is heterogeneous and varies according to several factors which other local entities are interested in, notably with regards to protecting the environment (Musah-Surugu, 2018).

Protecting the environment is a shared responsibility on a national, regional and local scale. However, the action of authorities in the electricity domain is limited. This expertise is almost entirely on a national scale (Commonwealth Local Government Forum). **Local governments can intervene in this domain by collecting taxes on certain resources, notably biomass (Kimathi & Partners, 2019) or by setting goals for economic development, for example, by supporting the development and installation of electricity in local areas of activity.**

**FEEDBACK EXPERIENCE**

## A COMMUNITY PROJECT ON ATIGAGOME ISLAND

70 households in Atigagome, an island on Lake Victoria, had electricity installed thanks to a mini-grid powered by a hybrid solar-battery-diesel production. The system, with an initial power of 22.5kW, also served the island's commercial and artisanal activities. It is part of 5 pilot projects set up in 2016 within the framework of the Ghana Energy Development and Access project (GEDAP), supported by the World Bank.

The mini-grids can reach a capacity of 1.5 MW. The diesel generator is used as a supplement if solar production is insufficient, allowing an excellent supply of electricity – greater than that of urban areas frequently affected by selective power cuts. This solution is particularly suited

to island communities where connection to the public grid is a far-off prospect. Over half of Ghanaians living on islands or in lakeside areas still do not have access to electricity. However, the regulatory framework for these projects remains to be clarified. These projects are the responsibility of the Ministry of Energy which plans to transfer them over to one of the Ghanaian public electrical engineering companies. There is still no sustainable solution to maintain these installations or the relations with the user communities.

*Source : World Bank, 2017*

**TEXT BOX 5**

The city of Accra is an exception : a signatory of the *Global Covenant of Mayors on Climate and Energy*, it has established a carbon accounting system, notably via the CDP. In September 2018, the city held an initial workshop to develop a strategy on reducing emissions (Accra Metropolitan Assembly, 2018) which prioritized targeting energy efficiency, renewable energy and cooking energy in the informal sector (C40, 2016).

## 5 – A proactive civil society for access to sustainable energy

After over a decade of energy crisis, civil society is extremely sensitive to power cuts (Ghana Summary, 2019) and to a rise in tariffs (ESI Africa, 2019). However, associations are rallying together with regards to climate matters, from local organizations (Friends of the Nation, Abibiman Foundation, etc.) to members of international networks (Greenpeace, 350 Ghana Reducing Our Carbon, etc.). 350 Ghana campaigned against the construction of a coal-fired power station planned to be built in the west of the country in 2014 (Modern Ghana, 05/06/2014). Despite an agreement signed in 2014 with the Chinese Shenzhen Energy Group, the project was postponed. This association is also devoted to raising awareness and providing training on renewable energies (Internews Network, 26/05/2019).

**FEEDBACK EXPERIENCE**

### THE POWER QUEENS

Ghanaians are traditionally associated with managing communities through "queen mothers" chosen by the oldest family (Obeng, 2002). This institution has inspired the Power Queens, an association founded in 1988 to help women integrate and build a career at the heart of the Electricity Company of Ghana.

Alongside unions and other organizations, the association helps to promote gender equality at the heart of the ECG and other entities in the electricity sector, in particular the Ministry of Energy. Most of the progress relates to the working conditions of women (separate toilets, suitable works clothes, etc.). Furthermore, the Power Queens have played an integral role in training women both at the heart of business and outside of work. They have also encouraged young women to undertake technical studies.

The association currently has over 1,500 members and it goes beyond tackling matters relating to the country's energy policy : it recently made a stand for an ECG reform and it even denounced illegal connections to the grid.

*Source : Ghana Power Compact, 2017; Energy Ghana, 2018*

**TEXT BOX 6**

**Local think tanks have also been active with regards to energy matters. This is the case for the African Centre for Energy Policy (ACEP) based in Accra or the Imani Centre for Policy and Education for example, which in 2018 called for the government to invest more in renewable energy (Business Ghana, 2018).**

**TABLE 2**

A FEW ACTIVE ORGANIZATIONS IN GHANA'S ENERGY DOMAINS – *Source : IRENA, 2015*

| | |
|---|---|
| **Board of education** | |
| The Energy Centre, KNUST | Research, development, demonstration and training in technological fields, policies and energy management |
| University of Energy and Natural Resources (UENR) | Science training, technologies and the management of energy and natural resources |
| Council for Scientific and Industrial Research (CSIR) | Implementation of public policies regarding scientific research and development |
| **NGO** | |
| KITE | Studies and analyses of energy policies, supporting renewable energy projects |
| Association of Ghana Solar Industries (GSI) | The promotion of the Ghanaian solar industry, developing standards and training |
| Energy Foundation | Promoting energy efficiency, energy saving and renewable energies |
| New Energy | The development and implementation of energy projects |
| CEESD | The development of technological solutions to fight climate change, energy insecurity and environmental degradation |

Ghana has a forum where different organizations from the civil society can gather and meet economic world players and public organisations regarding energy and climate matters. Examples of this include Africa Climate Week, held in March 2019 (The North Africa Post, 2019) or the Ghana Energy Summit held in July 2019 (Ghana Business News, 2019)

**Conclusion**

Despite significant progress in people's access to electricity and the recent reductions in GHG emissions linked to electricity production, the Ghanaian electricity sector is not stable. The end of the *dumsor* years, and paradoxically, an excellent climate performance, are due to the rapid and costly development of new gas-fired power stations. A continued drop in emissions involves reducing this production but two factors can stop investments in the production of alternative energies such as solar, wind or hydroelectricity : the country is currently in a situation of overcapacity and its public bodies must be redeveloped. The success of Ghana's energy transmission therefore relies on a clean-up of the electricity sector, the renegotiation of contracts with independent producers and the development of new gateways towards neighbouring countries and communities which are still poorly serviced. Several of these measures can only be carried out with the participation and support of non-state bodies, notably businesses, communities and NGOs.

## REFERENCES


### DATA BASE :

• CIA. (2019). The World Factbook. [online]

• Enerdata. (2019). Global Energy & $CO_2$ Data.

• IRENA. (2019). Renewable energy statistics 2019. [online]

• World Bank (2019) Data.

### REPORTS :

• Abeberese, A. B. & al. (2017). How did the 2012-2015 power crisis affect small and medium manufacturing firms in Ghana? International Growth Center. [online]

• Ghana Power Compact. (2017). Social and Gender Integration Plan. [online]

• IRENA. (2015). Ghana Renewables Readiness Assessment. [online]

### ACADEMIC ARTICLES :

• Ackah, C. (2015). Electricity Insecurity and Its Impact on Micro and Small Businesses in Ghana. ISSER – University of Ghana.

• Gyamfi, S. & al. (2015). Improving electricity supply security in Ghana—The potential of renewable energy. Renew. Sustain. Energy Rev. 2015, 43, 1035–1045

• Musah-Surugu, J. I. & al. (2018). Mainstreaming climate change into local governance : financing and budgetary compliance in selected local governments in Ghana. Development in Practice, 28(1), 65–80. doi :10.1080/09614524.2018.1398717

• Obeng, S. & al. (2002). Women's Voices in Akan Juridical Discourse. Africa Today, vol. 49, no. 1, 2002, pp. 21–41.

• Obeng-Darko, N. (2019). Why Ghana will not achieve its renewable energy target for electricity. Policy, legal and regulatory implications. Energy Policy. Volume 128, Pages 75-83

• Asumadu-Sarkodie, S. (2019). Lessons to be learnt from Ghana's excess electricity shambles. The Conversation. [online].

### PRESS AND COMMUNICATIONS :

• Accra Metropolitan Assembly. (10/09/2018). Accra to develop Climate Change Action Plan. [online]

• Afrik21. (25/07/2018). GHANA : Two youths produce energy from cassava. [online]

• Afrik21. (28/02/2019). GHANA : Siemens to supply solar energy to potential Takoradi industrial park. [online]

• Afrik21. (05/07/2019). GHANA : Redavia installs off grid for Movelle company, agri-food supplier. [online]

• All Africa. (17/09/2019). Ghana : AGI Launches Energy Service Centre. [online]

• Bioenergy Insight. (07/03/2019). Cocoa beans to power Ghanaian farms. [online]

• Business Ghana. (26/09/2018). Govt urged to commit more resources into renewable energy. [online]

• C40 Cities. (27/10/2016). Mayors Voices : Accra Mayor Alfred Vanderpuije on data-driven climate action planning. [online]

• CBN. (17/06/2019). Private companies to start selling electricity in Ghana by 2023. [online]

• Commonwealth Local Government Forum. The Local Government System In Ghana. [online]

• Energy Ghana. (15/10/2018). 'Power Queens' embraces ECG privatisation. [online]

• Energy Ghana. (02/09/2019). Climate change threat to power supply – Energy Commission. [online]

• Energy Ghana. (27/06/2019). Ghana considers the use of solar energy at airports. [online]

• ESI Africa. (21/01/2019). Ghanaians told to ignore speculation of 60 % electricity tariff increase. [online]

• Ghana Business News. (10/07/2019). Ghana Energy Summit opens. [online]

• Ghana Summary. (03/04/2019). Delay in fuel delivery, others; cause of 'dumsor' – Energy Ministry. [online]

• Government of Ghana. (10/10/2018). Government institutions to be hooked onto solar power soon. [online]

• Internews Network. (26/05/2019). 350 G-RoC Organizes Renewal Energy Workshop as part of their "Friday For Climate" Advocacy. [online]

• Kimathi & Partners. (2019). Electricity Regulation in Ghana. [online]

• Modern Ghana. (05/06/2014). 350 Ghana Reducing Our Carbon (G-Roc) Raise Voice Against Coal Plant Establishment In Ghana. [online]

• Oxford Business Group. "Ghana to use local natural gas to fuel new thermal power generation projects". [online]

• PeaceFM. (16/05/2015). "Thousands Turn Up For #Dumsormuststop Vigil". [online]

• Renewable Energy Magazine. (21/03/2018). Ghana To Be Early Adopter of Wave Power with Seabased. [online]

• The North Africa Post. (18/03/2019). Ghana holds investment forum at Africa Climate Week. [online]
• World Bank. (18/07/2017). Island communities in Ghana get electricity–at last! [online]

## LEGAL AND POLICY DOCUMENTS :

• Embassy of France in Ghana (Septembre 2017). Note – Le secteur de l'électricité au Ghana. [online]
• Energy Commission. Application Form for Rooftop Solar Programme Residential. [online]
• Government of Ghana (2019). Renewable Energy Masterplan. [online]
• UNEP. (2016). GE-TOP Ghana Strategy Proposal – Realizing solar PV projects in a cross-border power supply context. Geneva : UNEP. [online]