



# ENERGY ASSESSMENT IN LINGUÈRE AND RANÉROU-FERLO DEPARTMENTS

INCLUDING A CASE STUDY OF VÉLINGARA-FERLO MUNICIPALITY  
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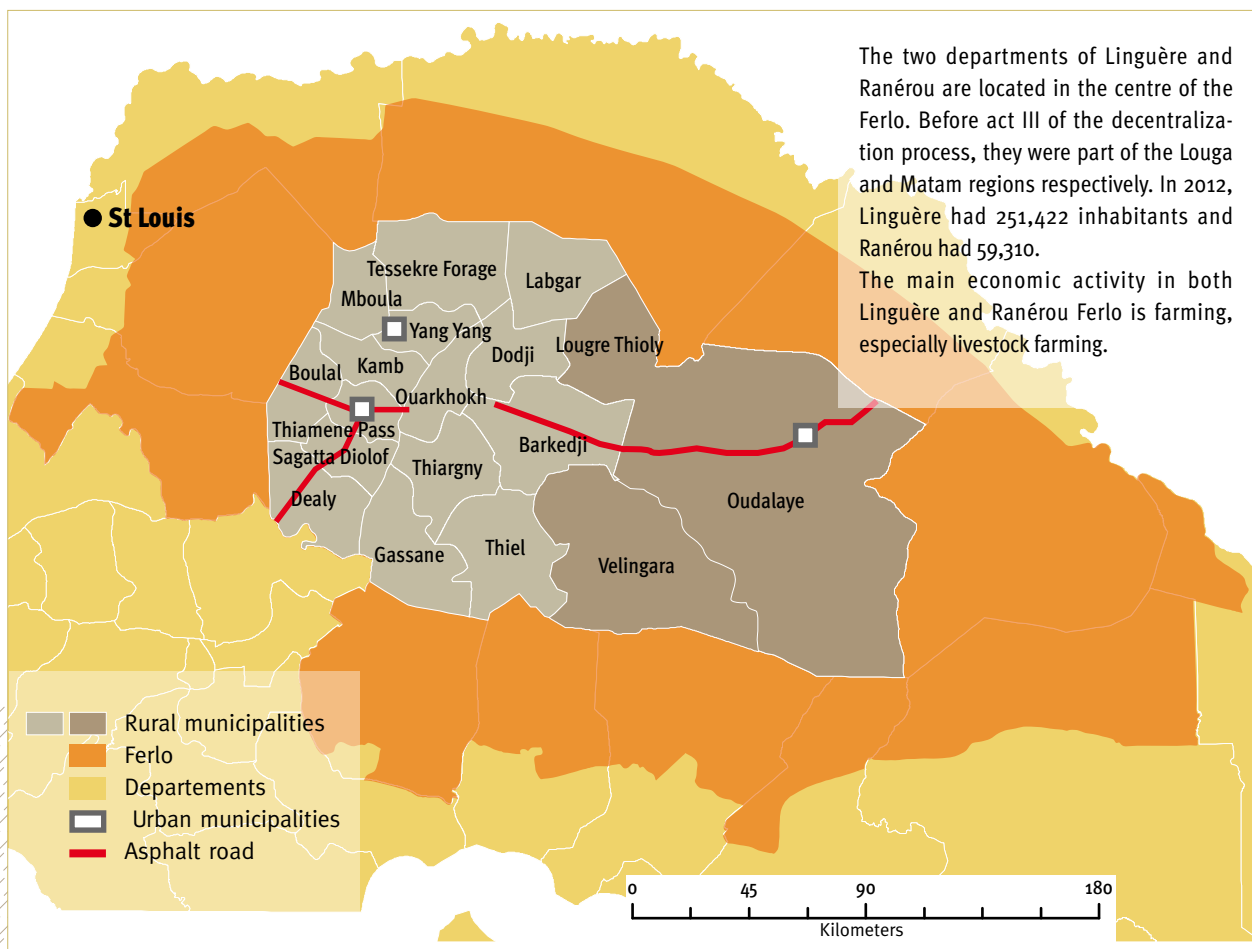


# ENERGY IN LINGUÈRE AND RANÉROU DEPARTMENTS

Energy is not only the leverage essential for our economic development and comfortable life, but also the primary source of the greenhouse gas that is damaging our environment. Environmental changes weaken the ecosystems of which people are an integral part and on which access to renewable energy also depends.

It is worth looking in detail at these antagonistic effects of energy, especially in the most fragile areas. The current situation must be described, but account must also be taken of future demographic and economic changes. Understanding the whole energy picture helps to provide elements for inclusion in development scenarios, whether in the form of constraints or opportunities, subject of course to sharing this knowledge with all stakeholders and inhabitants of the area.

## ■ TWO DEPARTMENTS IN THE HEART OF THE FERLO



## ■ WHY RURAL ENERGY IS IMPORTANT

### ■ Getting a good grasp of the types of energy involved

*Definition: Energy reflects a system's capacity to produce effort or transform itself (change of state)*

*All action consumes energy!*

There are three types of energy:

#### Primary energy

Total energy that can theoretically be extracted from the source used.

Examples of sources: wood, solar radiation, oil



Raw wood

#### Final energy

Energy actually supplied to the user.

Examples of vectors: electricity, diesel, charcoal



Electricity meter

#### Useful energy

Energy actually used for the required purpose.

Examples: turning an engine shaft, heat supplied to simmer a pot



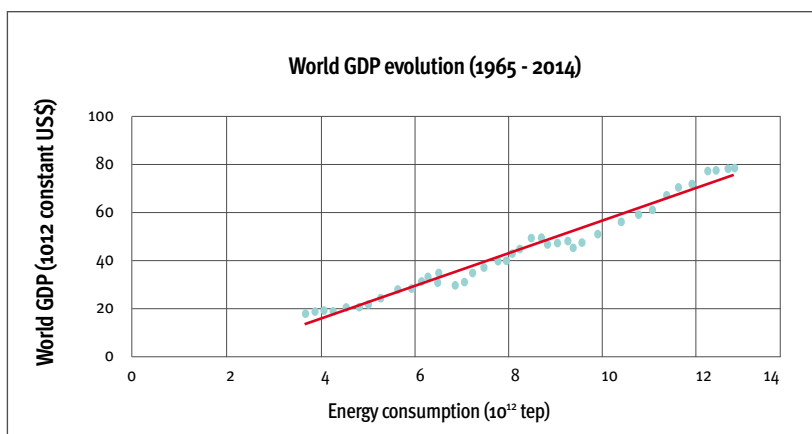
Simmering pot

Two properties must be taken into account when describing energy: its long-term availability and its quality. The first relates to whether or not the energy source is renewable and the intensity of offtake. The second is related to and dependent on the type of energy and use. A consumer of charcoal will be mindful of water and earth/dust content and the size of the charcoal blocks. A consumer of electricity will expect the right voltage, no interruption in supply and service at the required times.

## ■ Energy and development are closely linked

The **production of goods and services**, the activities of the secondary and tertiary sectors, especially with the advent of **information and communications technology**, and **job creation** are all made possible by the use of energy.

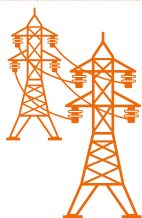
This is statistically significant on a global scale. The diagram opposite shows changes in global wealth and changes in global energy consumption. The two curves follow each other, clearly showing to what extent they are interrelated.



Change in global GDP in constant US\$ (2015) in relation to energy consumption in toe between 1965 and 2014 (source: World Bank, BP)

## ■ What price energy?

The diversity of energy sources results in just as many diverse situations in terms of energy pricing. In Senegal, a quick comparison of the cost of electricity gives us the following:



### Situation 1

an individual Senelec customer (including subscription and VAT for the higher income groups)

**Cost per kWh**  
between FCFA 116 and 133



### Situation 2

a family or economic operator using a small generator (taking account of the price of fuel, maintenance and regular servicing of low-quality generators)

**Cost per kWh**  
between FCFA 600  
and 1000



### Situation 3

a mobile telephone charge-up, billed at FCFA 100 - 200 (classic mobile with a 6 Wh battery)

**Cost per kWh**  
between FCFA 15,000  
and 30,000



### Situation 4

Purchase of a small AA battery

**Cost per kWh**  
between FCFA 100,000  
and 200,000

This comparison shows us that **the rural consumer is obliged to pay much more for his or her electricity** than someone who has access to the national grid.



## ■ The consumer looks for high-quality service even at higher cost

### What do people prefer?

#### The answer seldom varies:

Charcoal with even consistency in dense, rather than crumbly and damp, pieces. Ease of cooking is worth more than the time spent sorting out the charcoal from the dust.

### What do economic operators prefer?

Electricity that does not fail suddenly and unexpectedly, with voltage that will not damage their computers or machinery. The same conclusion is reached systematically: where the quality of electricity is poor, consumers turn to generators or solar panels.



**High-quality energy is therefore appreciated** even if its unit cost is higher. Quite simply because the service actually supplied will cost less.

## ■ Energy, a timescale of several decades

Energy projects take time. Setting up a power station, whatever the type of energy, means having engineers available to design it, a business to install it, a structure to operate it (a company or co-operative) and technicians to deal with servicing and maintenance. Putting the energy supply chain in place takes several years. The station will also have a very long lifetime.



When considering a new energy facility, it is essential to take account of **changes in demand** over a long period of time. In **countries experiencing strong demographic growth** such as Senegal (+ 3%/year), that's a major challenge!

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## ■ ENERGY AT THE SERVICE OF ECONOMIC DEVELOPMENT

### ■ Operators concentrated in administrative centres or towns, but influencing a wider area

Economic operators cluster in rural economic centres, i.e. urban municipalities or the administrative centres of rural municipalities, or villages which have an important market (louma). Their equipment may use energy (thermal or electric) or not; everything depends on their level of development and the quality of the product offered.

*Example: Tailor is a term that may be applied to an itinerant tailor on a bicycle who does repairs but it may also describe someone equipped with embroidery or over-sewing machines who has several employees or apprentices.*

Apart from the population of the town, these operators target customers throughout the nearby rural area who come to town at least once a week on market days.



## ■ Particular, demanding consumers

Economic or «productive» operators use expensive equipment which is cost-effective so long as it operates properly and is not damaged by overvoltage or inoperative due to undervoltage.

Three examples of equipment found in rural areas:



Welding station



Sewing machine

Technical constraints must be borne in mind when electricity is used:

- The equipment may need **single-phase current** (classic supply with a socket holding 2 or 3 plugs: live, neutral and possibly earth) or three-phase current (the socket holds 4 or 5 plugs: 3 live, one neutral and one earth);
- **Power demand** is higher and requires power production or cabling accordingly: in the same way as an electric kettle can cause tripping or melting of a domestic installation designed for lighting, a carpentry workshop machine can trip the local grid of an entire village.
- Electricity meters measure **useful electricity** (known as active energy), but electrical systems also consume what is known as **reactive energy**. This reactive component has consequences for the grid, line losses and, in the final analysis, **efficiency**.



Bread kneading machine

If these **specific features of economic operators are ignored when designing a grid** for a given area, it is highly likely that meeting their energy demands will be technically impossible and that their connection to the grid will, on the contrary, reduce its capacity to operate smoothly. Taking this on board will have **a cost in terms of investment**, because it means designing a larger system.

## ■ The case of boreholes

In the sylvo-pastoral zone of the Ferlo, boreholes provide water for both households and livestock. The borehole as such comprises a submerged pump and a source of electricity (a generator where there is no Senelec connection). The borehole supplies a water tower, which in its turn supplies water to the network made up of tanks, drinking troughs, hydrants or individual installations.



The water tower

Boreholes in the administrative centres of departments are heavy energy consumers. For example, the borehole at Vélingara operates for between 20 hours per day (in the hot season at transhumance time) and 10 hours per day (in the rainy season). It uses up to 100 litres of diesel per day in the high season, meaning a fuel bill of something like FCFA 2 million per month!

Many economic activities cluster around the borehole, benefiting from access to water but above all from the economic dynamism generated by such access. It is therefore useful to take account of these **clusters of income-generating activities** when looking at access to productive energy and ways of **pooling energy investment costs**.



Borehole pump



Water tank

## ENERGY WITHIN A RURAL FAMILY

### Energy for cooking

A family generally uses two or even three different sources of energy for cooking. This «energy mix» primarily involves wood with charcoal and, to a lesser extent, gas and more occasionally biogas. The mix varies depending on the area: urban municipality, administrative centre or village.

Some field data:

	Consumption of wood for cooking	Consumption of charcoal for cooking		Consumption of gas for cooking
Linguère Department 251,422 inhab.	35,200 tonnes wood/year	5030 tonnes charcoal/year	i.e. 30,180 tonnes wood equivalent	681 tonnes of gas/year
Danérrou-Ferlo Department 59,310 inhab.	11,030 tonnes wood/year	1570 tonnes wood/year	i.e. 9420 tonnes wood equivalent	35 tonnes of gas/year

- In remote villages, **wood is the primary source of cooking energy**. It is gathered from the surrounding area and, in 7% of cases, purchased.
- In administrative centres, more than 90% of households use wood, combined to a greater or lesser extent with charcoal. Half of them habitually buy their wood from resellers. A reseller will travel **between 1.5 km and 12 km** to gather the wood, depending on area.
- In towns (urban municipalities), 93% of wood is purchased. Almost one third of families mainly use charcoal combined with gas and therefore no longer use **wood**.

The **decline in trees and forest** in the Sahel is one of the most symbolic indicators of the desertification affecting this region. The two main factors that have precipitated this situation are repeated droughts and overexploitation of forest resources. And yet more than 80% of the energy consumed by rural Sahelian households comes from wood and is essentially used in cooking food.

Nevertheless, there is no doubt that, in isolated rural areas, **alternatives to wood for cooking are still scarce**. As a result, wood represents the only available resource. Sustainable forest management is therefore vital to ensure that this resource can be renewed. Use of more economical biomass technologies is another way of reducing local consumption.

Having said this, analysis shows us that use tends to change with gradual urbanization. Charcoal and gas begin to take over. Population growth scenarios simply confirm the assumption that these fuels will become much more widespread in urban areas at the expense of firewood. In addition, average consumption per person is higher in small compounds, taking all energy sources together. It will therefore be a huge challenge in future to **think again about modes of energy use and improve the energy efficiency** of kitchens.

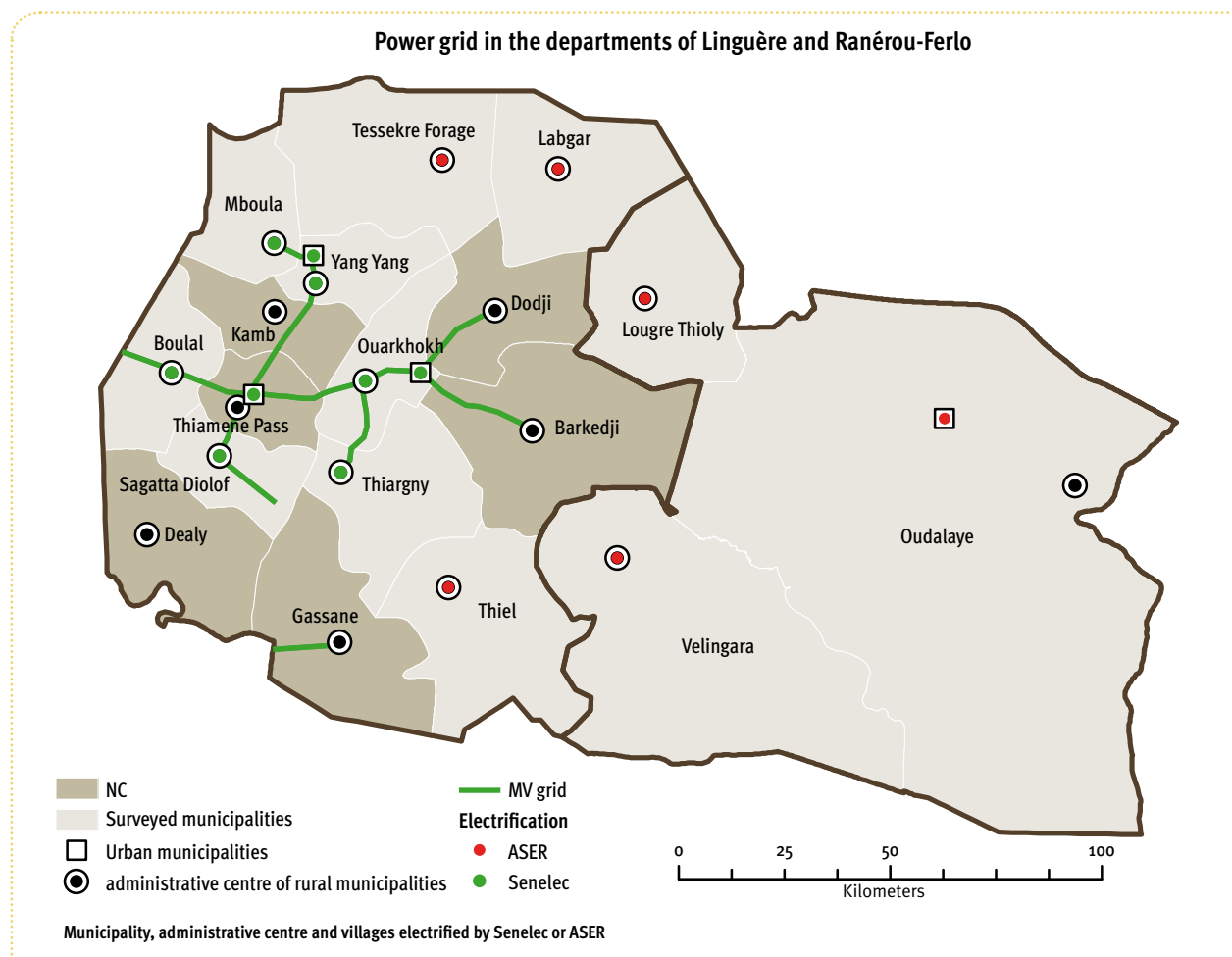
Finally, it can be seen that **people are paying more and more for their energy**, including wood. This indicator is interesting in that, as soon as a resource has a price, it becomes **easier to raise awareness of more efficient uses and techniques**, because these have direct repercussions on household expenditure. Forest regeneration activities, which require labour and equipment, can then become profitable.



## ■ Electricity for compounds

This is the main service rural people want. Individual or group discussions systematically reach the same conclusion: access to electricity is the number one felt need. This is not just a matter of personal comfort (lighting, TV or refrigeration), but a social and health issue (e.g. for vaccine conservation).

Electricity grids, whether connected to the national Senelec grid or operating independently, are nevertheless uncommon in either department.



People connected to the Senelec grid (24h/24) consume an average of 3 kWh per day. It is interesting that this consumption varies sharply according to what appliances the household has (excluding lighting) but not according to household size.

Two relevant figures in these Senelec areas:

- A television consumes between 0.3 and 0.7 kWh per day
- A refrigerator will consume 2 - 4 kWh per day

## ■ IN CONCLUSION

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### ■ An area ill-served with energy

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In comparison with other wooded or mountainous areas, the Ferlo is a region with **few energy resources**. Apart from solar power (average radiation  $H_h=6130\text{Wh/m}^2/\text{day}$ ) and wind power potential in some areas such as the North-West, it does have access to wood energy resources, although these are vulnerable, the by-products of livestock farming and, to a lesser extent, crop residues.

In the past, however, there was enough wood to justify exporting it beyond the departments, for instance to the town of Touba. Exports are now prohibited from Linguère department.

These observations about the area's vulnerability lead us to think that:

1. An energy mix is needed to remedy the inadequacy of any one type of energy
2. Discussion should be undertaken with other areas which have an energy surplus
3. The available stock of renewable energy should be maintained and increased

### ■ The lack of a pilot project prefiguring the energy future

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Each area has its own features and the energy responses for the one will not be the same as for its neighbours. Techniques must be adapted to each economic and social context.

Adaptation of techniques cannot, however, be decreed but needs testing and observation. A biogas project will affect the livestock sector. So will a borehole. Sedentarization of a herd will have impacts on vegetation cover. Conversely, a reforestation project in a pastoral area will need to take the impact of transhumant herds into account. These are the challenges for a pilot project which must, **in a real-life situation, trigger chain reactions and work out the corrective measures needed.**

### ■ A web of competent, complementary stakeholders to rely on

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But there is no need to start from scratch. Apart from its natural resources, the Ferlo can draw on a range of local operators: skilled technicians in some places (borehole manager, technicians dealing with individual solar kits) and experienced technical services, such as the Water and Forestry Service present in all rural municipalities.

Finally, the city of St Louis and, above all, the secondary towns bordering the Senegal River, a boom area for agriculture, which are **economic magnets that attract seasonal migrants or people seeking training**, must come into the reckoning.



# PROSPECTIVE SCENARIO: THE EXAMPLE OF THE ADMINISTRATIVE CENTRE OF VÉLINGARA-FERLO MUNICIPALITY

## ■ The rural municipality of vélingara-ferlo

Vélingara-Ferlo is a rural municipality in Ranérou-Ferlo Department, with around 20,000 inhabitants in 2015 spread amongst 100 villages or hamlets

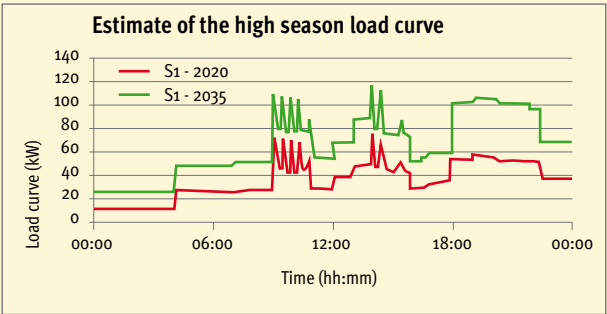
Localisation de la commune rurale de Vélingara-Ferlo



## ■ Electricity demand in the next 20 years

A simulation of population and domestic and productive consumption (including the borehole) helps to estimate the following load curve for the dry season, which corresponds to peak electricity demand in the administrative centre of Vélingara-Ferlo (due to the borehole and the activity of the shops dependent on it).

This represents energy demand per day of 935 kWh in 2020, and 1630 kWh per day in 2035.



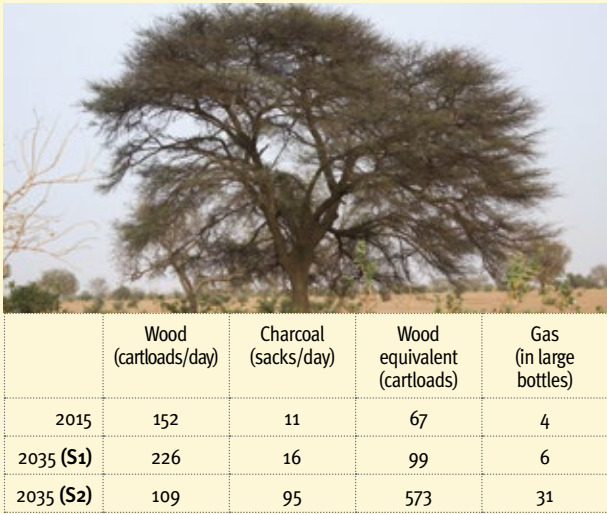
## ■ Wood and charcoal demand

While the basic assumption for electricity is grid coverage, one of the challenges in the case of biomass is the type of energy consumed, especially the choice between wood and charcoal.

Two scenarios are tested:

- **scenario 1**, in which consumption parameters remain the same (only demography changes),
- **scenario 2**, which assumes that the inhabitants of the administrative centre will tend to move closer to urban behaviour patterns (gradually introducing more charcoal and gas into their energy mix).

In comparison with the current data collected, this gives estimates of:



Scenario 2 sees an explosion in demand for charcoal and consequently for wood.





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