Dual Plenary Session I

Electricity Access in Emerging and Developing Countries

The case of Mozambique

Monday, June 19th

11:15 a.m. - 12:30 p.m

Rationale for Universal Access

Access to reliable and unlimited electricity supply is a human right!

Mozambique has accepted the challenge to reach Universal Access in 2030

EDM has incorporated this challenge as one Key Strategic Objective

No development can occur without electricity!

Access was defined as "having electricity service of any kind"

"The future is electric"

Contents of the Presentation

- Introducing Mozambique and EDM
- Statistics of access
- Challenges and Opportunities

Question: can EDM, as an utility, meet the goal of sustainable access to all by 2030?

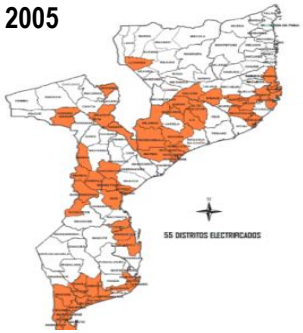
Universal Access by 2030

Electrification of Districts finished in 2015

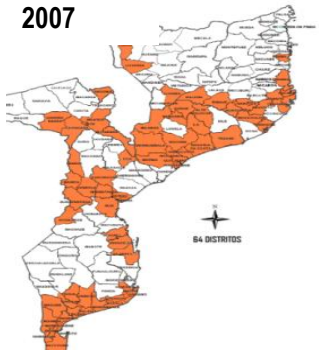
15 Districts Electrified

1977

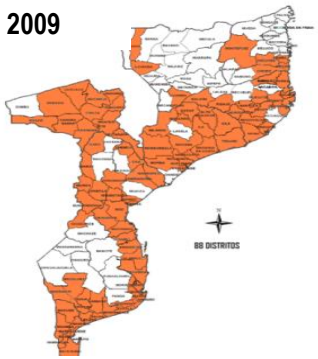
2005



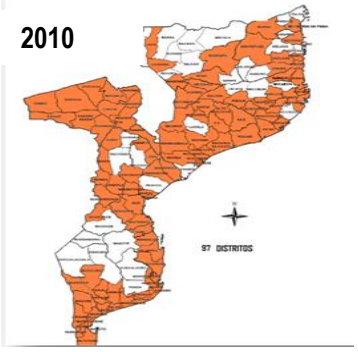
2007



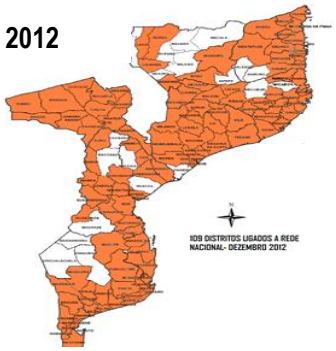
2009



2010



2012



2015

147 Districts Electrified

154 district capitals, of which 147 connected

Residential access in 2016: 26%

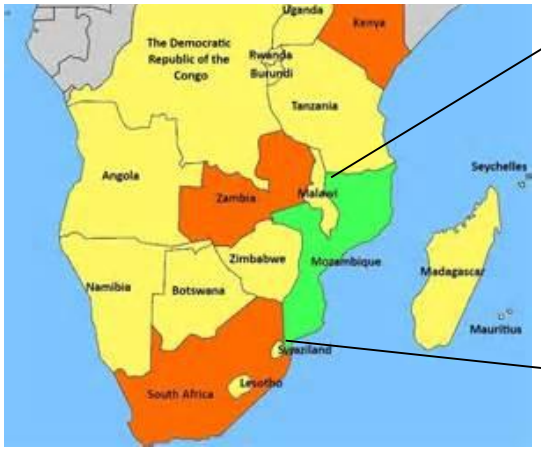
To achieve universal access by 2030, EDM will need to connect between 300 and 400 thousand households per year, at a cost of approximately 500 USD per connection. EDM is targeting to reach 3.7 million new connections on-grid and 1 million new connections off-grid, through mobilization of development funding and through partnerships with the private sector for innovative supply solutions.

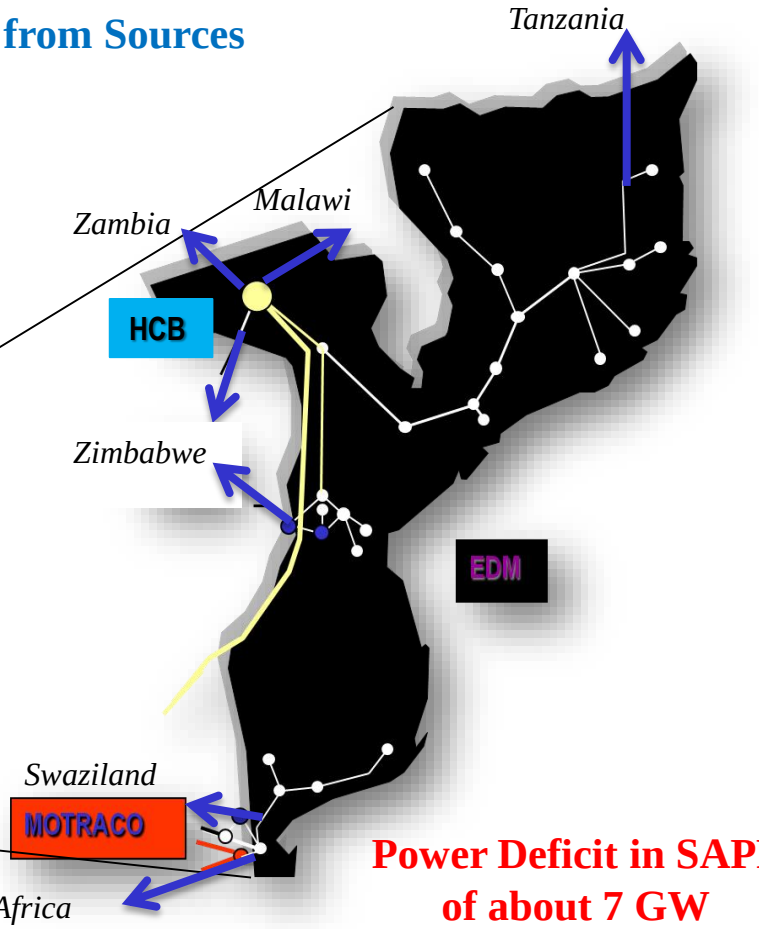
Power Corridors link resources and markets

<u>The African Challenge:</u> 1) Power infrastructure is underdeveloped, 2) Electricity supply is often unreliable, 3) Power costs are high, 4) Cost reflective tariffs are difficult to implement, 5) Access to electricity is low and unequal, 6) Large Markets distant from Sources

Mozambique has the following strengths:

- Diverse and large energy resources: hydro, coal, gas
- Border with 6 countries and narrow east-west territory, enabling the three main trading and power corridors
- Fast growing demand – mines and industries

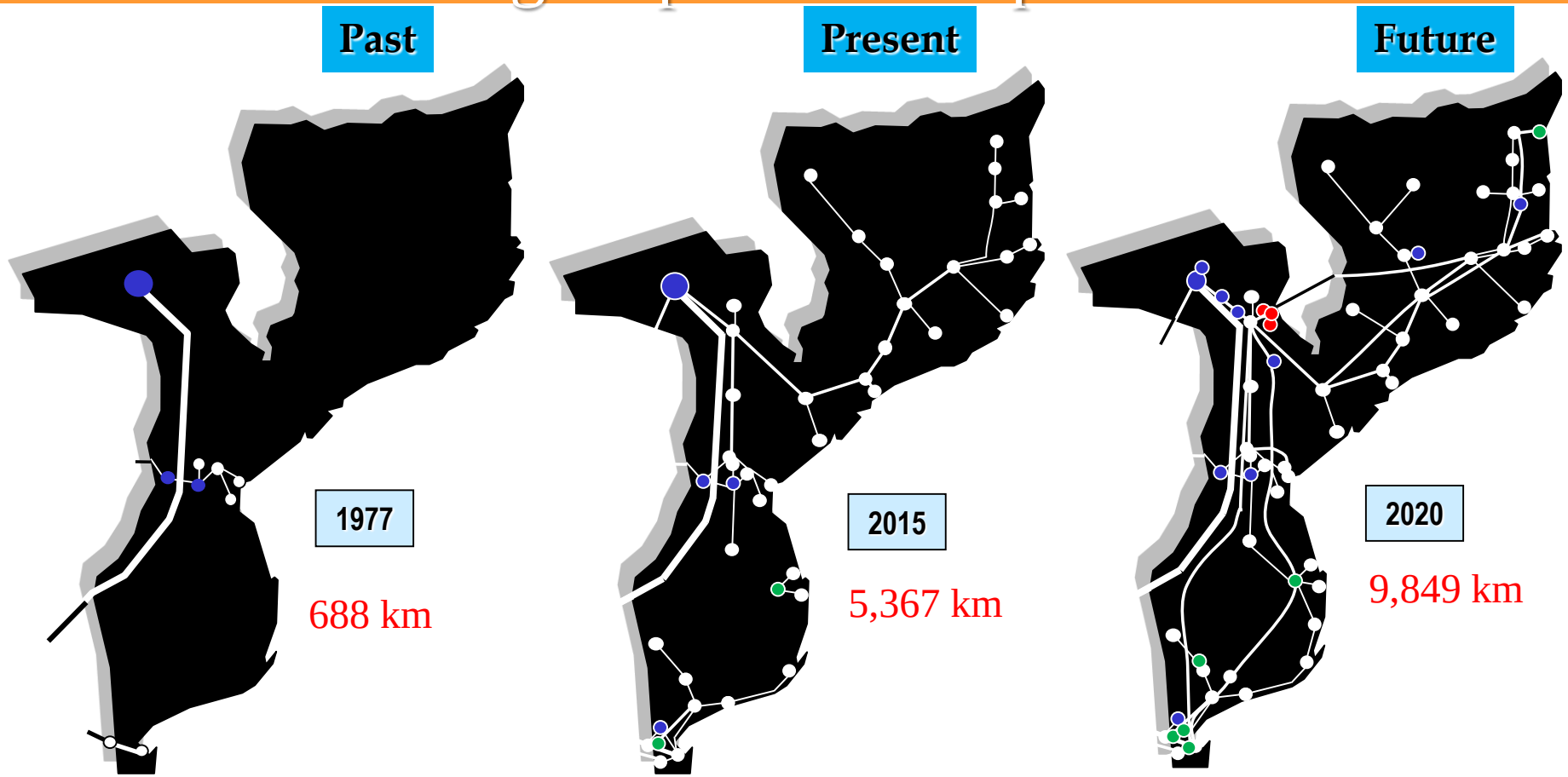




Power Deficit in SAPP of about 7 GW

EDM's Investment Portfolio 2018-2030 (8+ bUSD)

Light up Mozambique!



3 Provincial Capitals connected to RNT

All 11 provincial Capitals and 146 (96%) District Capitals connected to REN

New Power Stations and new Transmission Lines to respond to Demand growth

Conceptual approach / vision of growth

- **Design and structure investment programs** to ensure security and quality of supplies, the widening of access and the regional role as a generator and wheeler in SAPP

Investments

- **Promote and strengthen the domestic and regional energy markets**, to anchor the large investments needed to explore and utilize the natural resources and to industrialize the country and the region

Partnerships

- **Differentiate between social and commercial energy**, in order to explore the profitability components of the electricity business to the benefit of the company and the public sector, and focus public funding directly into the segments of society that need welfare assistance

Differentiation

- **Develop standards, procedures and regulations**, both within the company and in the sector, in order to achieve the highest quality and optimal management of resources, thus ensuring the highest possible affordability in the supplies for social and economic driven consumption.

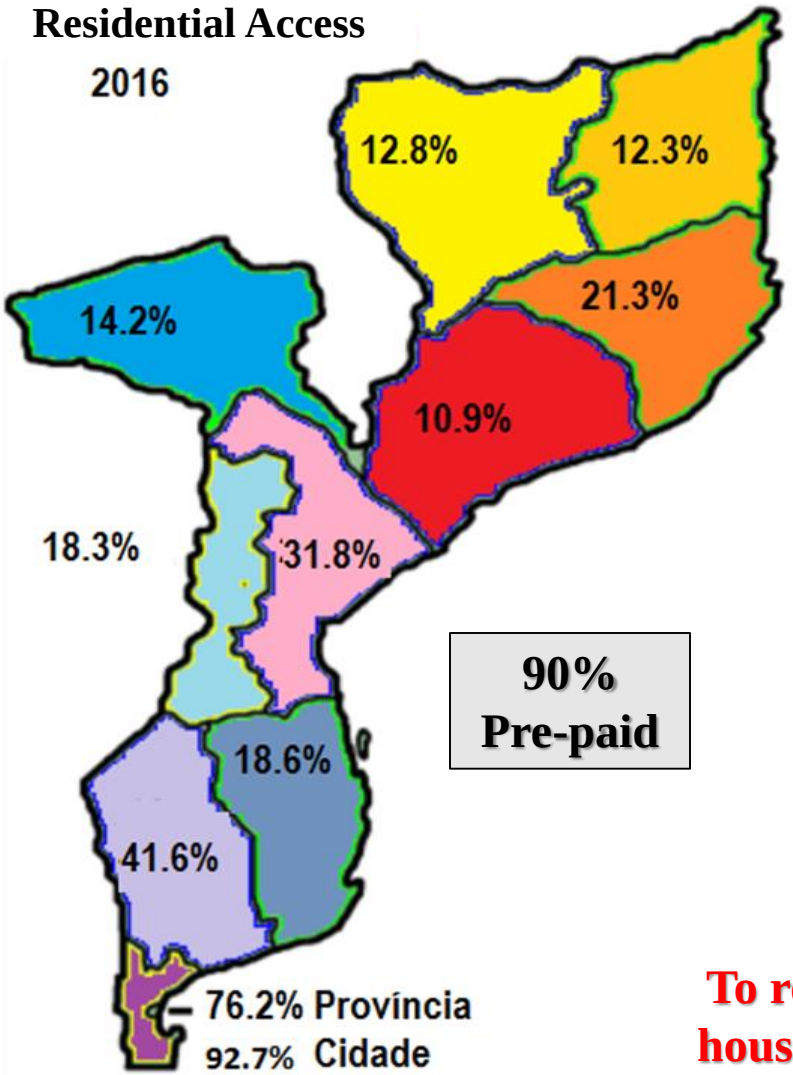
Quality Control

- Introducing Mozambique and EDM
- Statistics of access
- Challenges and Opportunities

Question: can EDM, as an utility, meet the goal of sustainable access to all by 2030?

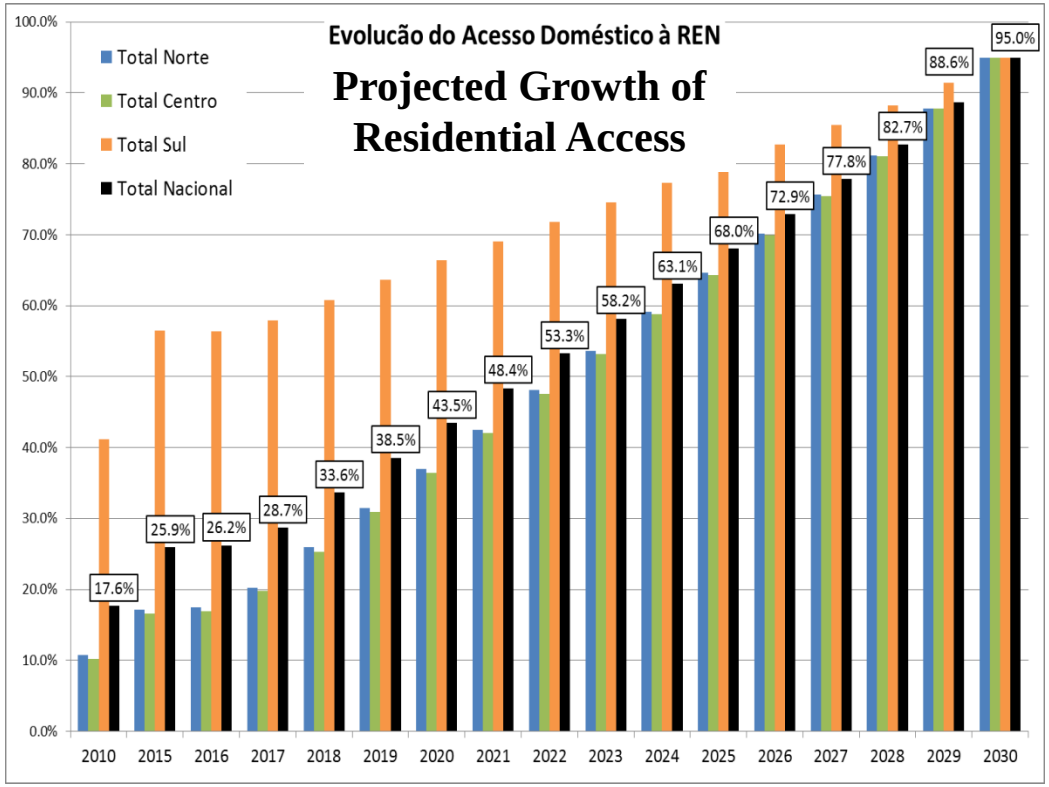
Residential Access: higher in urban settings

Moz Residencial: 91% Clients, 48% Energy



90% Pre-paid

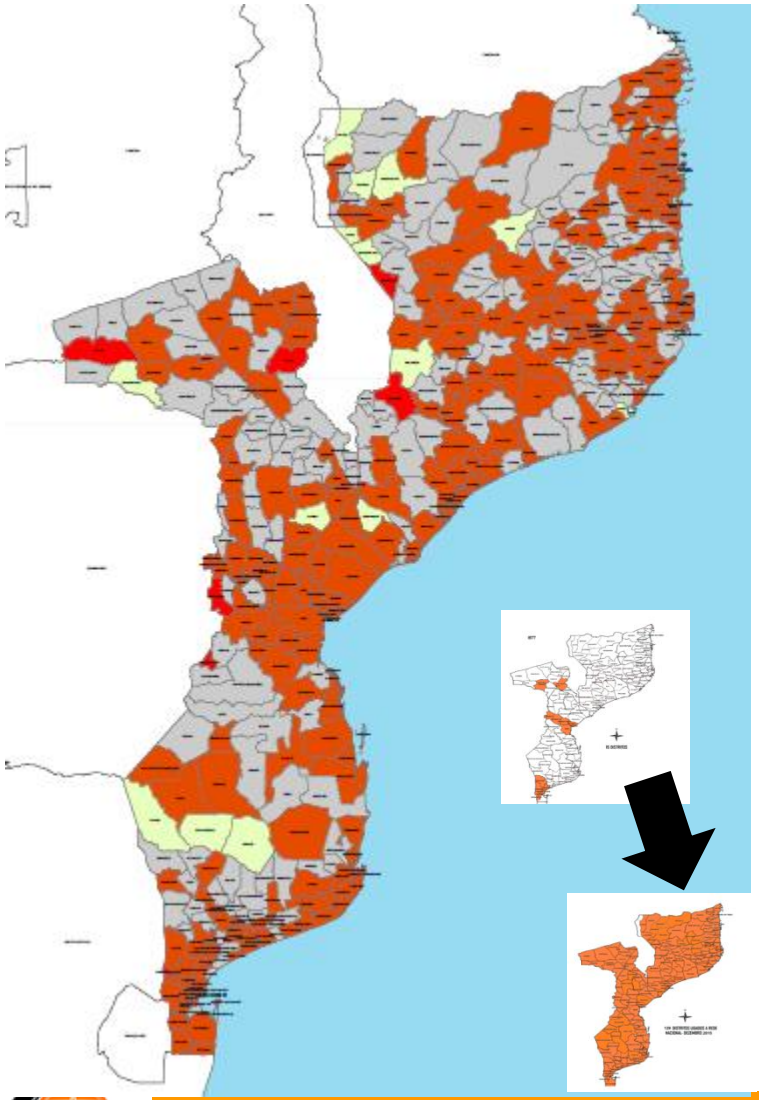
The lowest access rate in cities is 65%

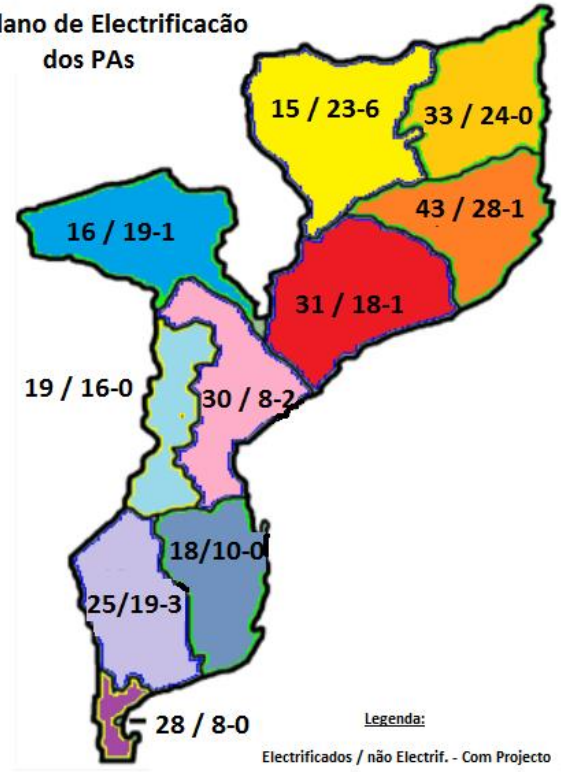


To reach Universal Access 2030, a total of 5.4 million households must be connected to an electricity source

Universal Access 2030

Electrification of Administrative Posts





Total 431 Administrative Posts, 258 (60%) are electrified other 14 electrification underway. 159 Administrative Posts (37%) remain, cost estimated at 650 MUSD

Proximity is not Access

The case study of Macaneta Beach

It is confirmed that:

- HHs headed by women are generally worse off than male's
- There is desirability of electricity as a lighting and modern source of energy
- Cooking energy is still mostly biomass.

A modern thermal source must be found!

- Time-to-connect after network "arrives" is longer for women than for men. Reasons:
  - Cost of new connection
  - Funds to build the wiring in the house
  - Capital to acquire electrical appliances
- Micro-credit too expensive
- Limited supply of affordable materials and services

Consumption per Household (grid-electrified)

	kWh/HH.year			Access Rates		
	2001	2006	2016	2001	2006	2016
North	1,369	858	791	2.5%	4.5%	17.5%
Center	2,309	1,235	1,050	1.9%	4.3%	17.0%
South	2,611	1,607	1,505	11.4%	18.1%	56.4%
EDM	**2,339**	**1,382**	**1,217**	**4.6%**	**7.9%**	**26.2%**

Consumption per HH reduces, as access rates increase

POVERTY LEVELS IN MOZAMBIQUE

From 18.4% Single Male to 59.4% Divorced Female

Challenges specific of Mozambique at Utility Level:

- All areas are Obligatory Supply Areas
- Uniform tariff system does not differentiate geographically
- Tariff reviews are subjected to Gov approval
- Centralized planning is insensitive to local particularities
- New connections are unprofitable for the first 2-5 years
- Poor urban planning facilitates losses and energy theft

- Introducing Mozambique and EDM
- Statistics of access
- Challenges and Opportunities

Question: can EDM, as an utility, meet the goal of sustainable access to all by 2030?

What are the hurdles?

What models will EDM take to provide access

"grid equivalent service" except for the cases where the connection cost per consumer and per kVA exceeds 2,000 USD/kVA, in which case off-grid electrification alternatives shall be considered

Average Electrification Connection Cost: 1,300 – 1,500 USD per connection

On-Grid Urban

Insufficient expansion corridors. < 5km

- Expensive insulated aerial and subterranean cables
- Fast growth of Offices and Services loads
- High quality requirements

On-Grid Rural

Large electrical losses < 30 km

- Mostly residential clients
- Low consumption customers
- Long expensive aerial lines

Off-Grid Rural

Slow decision in individual small solutions. > 30 km

- Dispersion and diversity of consumers
- Slow decision in individual small solutions
- Funding is too diverse and in small amounts

Planning and Financing issues

National Electricity Network

Master Plan for Electricity Infrastructure

- Project Finance for Large Gx & Tx Projects
- Public-Private partnerships structured as SPVs for large investments
- Concessional funding for critical infrastructure
- System reliability cannot be compromised
- Densification is preferred
- Vulnerability to currency fluctuations
- Strengthen Moz industry/services to anchor investments for access

Electrification for Access

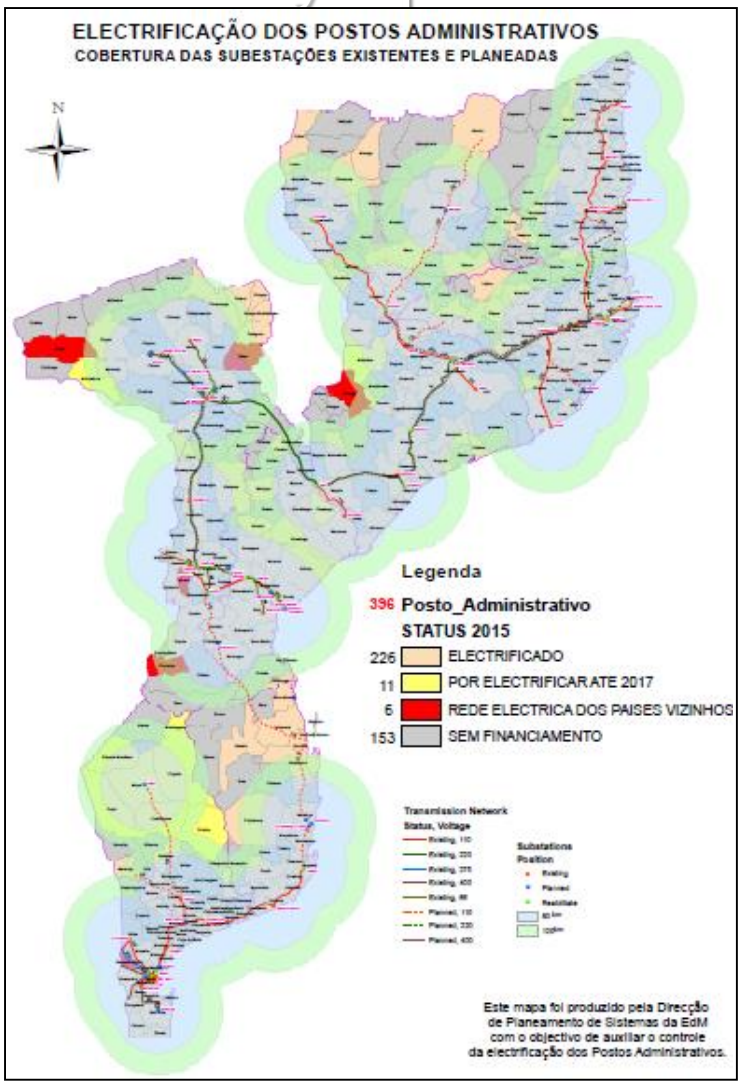
National Electrification Strategy

- Set up an Electrification (Escrow) Account
- Levy on electricity consumption to levy electrification – 5%
- Connection Cost subsidy – pay in installments
- Maintain Uniform Tariff (no geographic differentiation) on low voltage "small" consumers
- Maintain tariffs at cost reflective levels
- Enforce compliance with Energy Efficiency and Saving measures

Achieving universal access by 2030 for 33+ million people, outside 100 m radius of the existing national electrical network, will require about 6,530 Million USD

Processes: Nationwide versus Local

Utility operates with some centralized processes



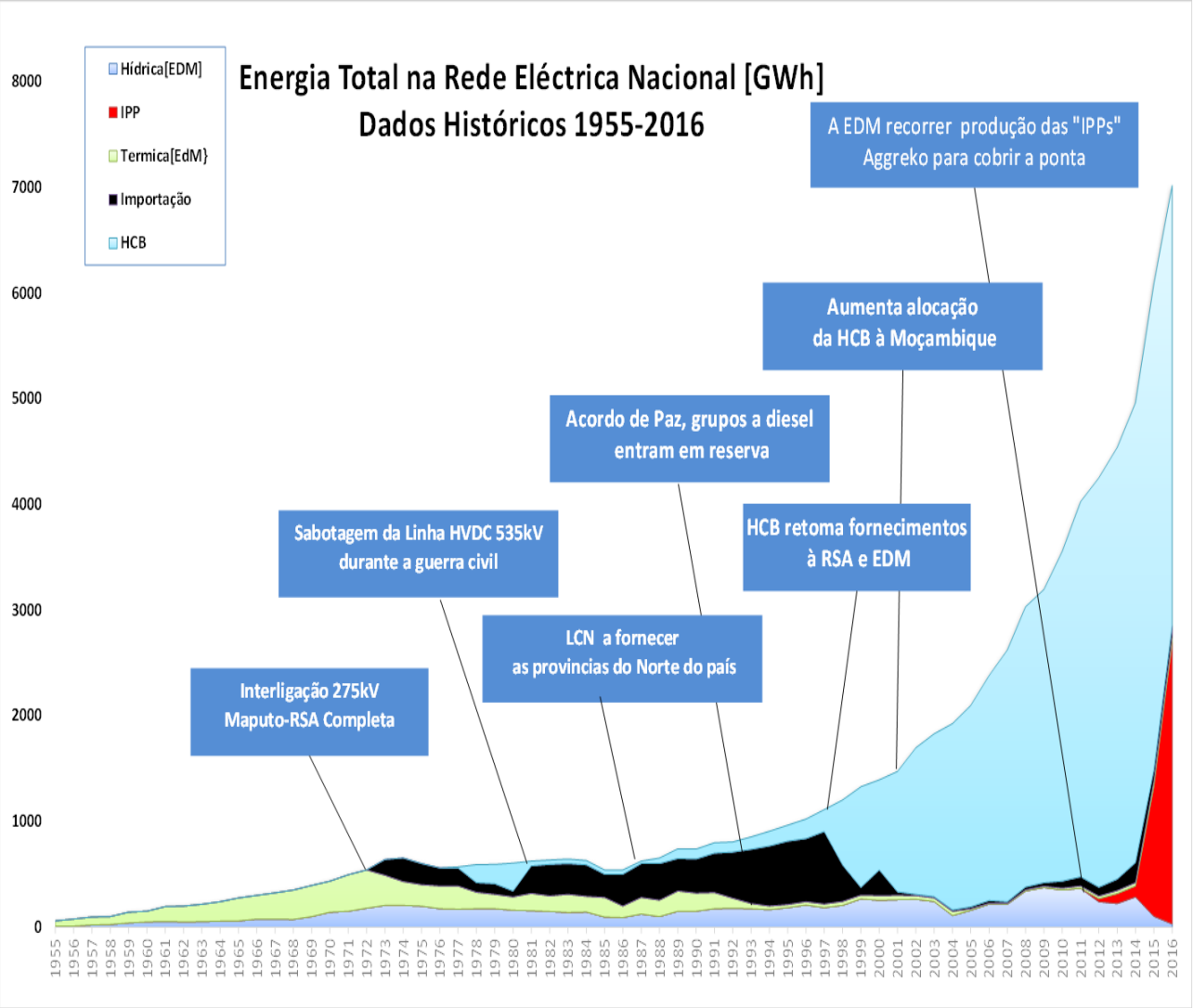
- Integrated planning allows for a selection of sites where off-grid solutions are cheaper: it is made based on the proximity of the national electricity network
- Private sector operators cannot offer off-grid solutions with competitive prices: public sector investments and leadership is needed to establish the “skeleton” of the supply chains and reference prices
- Local markets for materials, equipment and services are small and limited: the economy of scale of large companies can bring electrification costs down
- Normalization of services to clients reduces costs and increases predictability to customers: the widespread customer service stations or conventional supplies can also serve of-grid and alternative solutions to access

CENTRALIZATION REDUCES COSTS

EXTRA SLIDES IF NEEDED

Between 2006 and 2016

- Number of Clients increased from 415 thousand to 1.5 million
- Operational Cost Reduced from 242 to 114 USD per Client
- Export revenue increased from 5.4 to 219 MUSD
- Cost of Sales Increased from 26% to 77% (it is suffocating the company)



Technology: Solutions for Access

The utility has diverse technological resources

OFF-GRID CONNECTIONS ARE A TRANSITIONAL STATE TO ON-GRID

MICRO-ENERGY SOLUTIONS ARE COMPLEMENTARY TO ON-GRID

On-grid

Connection Charge

- Centralized Medium size or Large size source
- HV / MV networks
- LV network and connection wires
- Meter
- Centralized commercial management and controls

Mini-grid

Connection Charge

- Dedicated Small size source
- LV network and connection wires
- Meter
- Centralized or dedicated commercial management and controls

Energy Appliances

Loans & Rebates

- Dedicated source & self contained utility
- Distribution chain
- Retail

Solar Homes

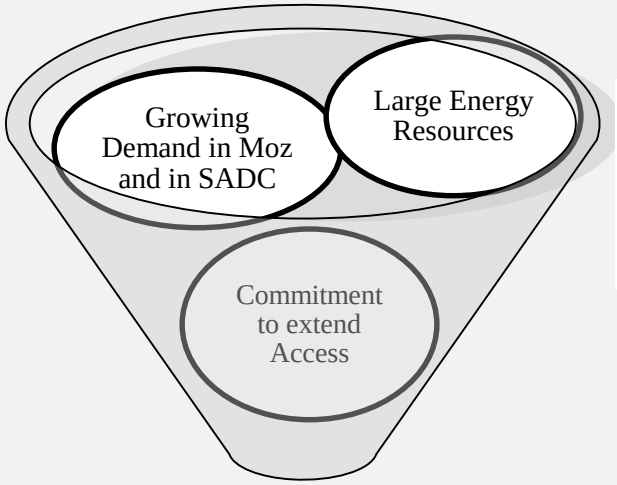
Connection Charge or Loans & Rebates

- Dedicated source and connection wires
- Distribution chain
- Retail or Centralized/dedicated commercial management and controls

OFF GRID IS SIMPLER AND MODULAR

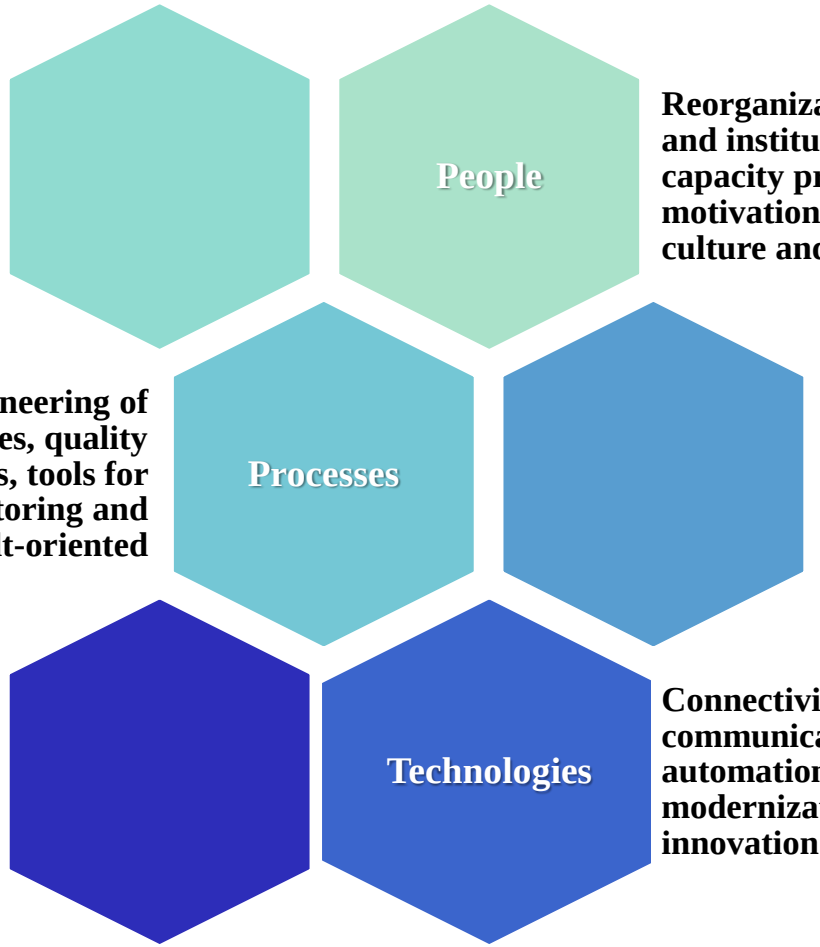
Vision for Transformation of EDM

The transformation is based in ethical and professional principles, such as transparency, team work, good performance, etc.



Vision of Transformation

Turn Mozambique into a Regional Hub and Reach Universal Access by 2030



Reorganization, training and institutional capacity programs, motivation, incentives, culture and ethics

Reengineering of processes, quality standards, tools for monitoring and controls, result-oriented

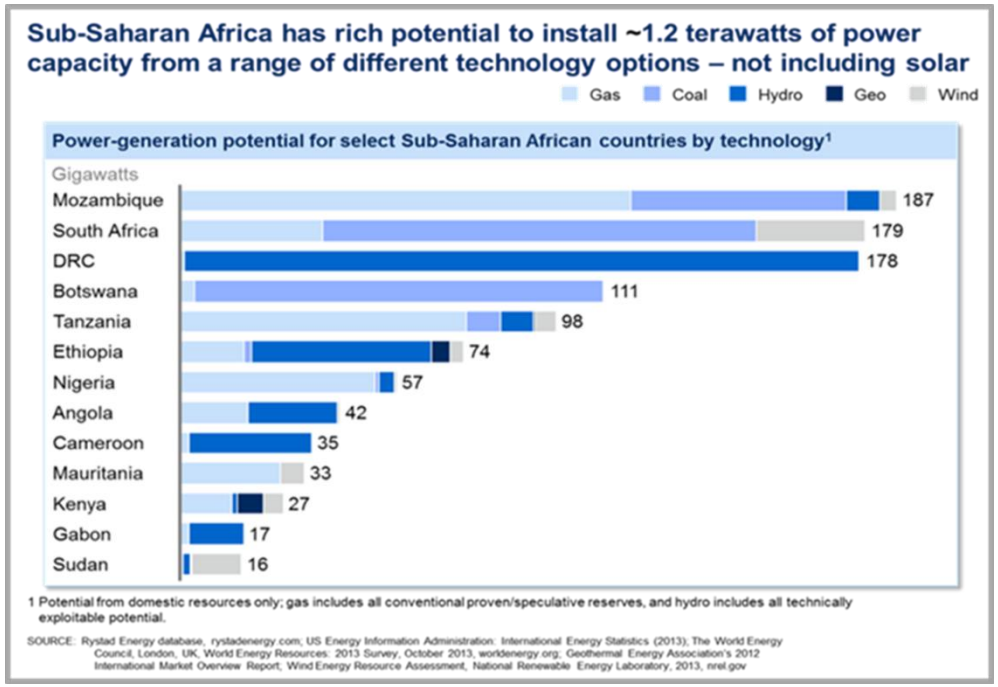
Connectivity and communication, automation and controls, modernization and innovation

THE PILLARS OF TRANSFORMATION

Energy resources are vast and competitive

Mozambique's energy resources potential include:

- **HYDROPOWER** - 18.000MW;
- **NATURAL GAS** - *o*ver 200 TCF**,**
- **COAL** -23 billion tonnes;
- **RENEWABLES** - 7.100MW, of which:
  - Micro, mini and small hydropower - 4.700MW;
  - Wind Power- 1.100MW;
  - Solar Power - 1.200MW;
  - Biomass Power -130MW



Mozambique has concluded a detail mapping of renewable potentials, the Renewable Energy Atlas

The Model of Growth under review

The Master Plan

- Upgrade the transmission and distribution networks expansion plans to accommodate new vision of a regional energy hub
- Include generation in the Master Plan
- Simulate for high stability and least cost solution
- Keep concept of power corridors as structural developments for a long term future

The National Electrification Strategy and Plan

- Develop the solutions to separate commercial from social energy
- Ensure off-grid component can be developed without compromising limits of affordability and quality of supplies
- Off-grid model is a transitional solution to future on-grid electrification
- Mobilize Government support to social energy component

EDM in partnership with AfDB on the New Deal on Energy for Africa (Mozambique)

		From current energy situation in Mozambique		To Universal Access by 2030
Power	Population, *M*	27	X 1.3	36
	GDP, *$ bn*	15	X 3.4	50
	Electrification rate, *%*	27%	X3.7	97%
	Households[2] connected, *M*	1.4	X 5.0	6.9
	Grid	1.4	X 3.7	5.1
	Off-grid	0	x	1.7
	Grid capacity, *GW*	2,957	X 3.0	8,931
	Consumption *kWh/capita*	154	X 3.5	544
Clean cooking	Penetration rate, *%*		x	
	Households using clean cooking, *M*		X	

+3.7 M new on-grid connections

+1 M new off-grid connections

+6,000 MW of new capacity

Renewable Share

447 MW small hydro and solar PV

2,745 MW large hydro

Strategic Investiments: up to 8+ bill USD

Critical $227 M 1-2 Years

Emergency: Avoid fatal colapse of the electric system and secure supply of electricity

- Infrastructure damage by acidentes
- Infrastruture in risk of colapse
- Infrastructure due to risk of colapse there is a consequence of colapse of supply of electricity

(emergency/urgent need to repair transformers and networks to unlock power evacuation)

Short term $386 M 2-3 Years

Stabilization: Security of supply and safety operation

- Infrastruturas which are being operated bellow technical and safety operating standards
- Infrastructure which ensures the supplly to all major Capital of the Country

(New transformers & new lines to enable evacuation and new path/corridors of power)

Médium term $2,398 M 3-5 Years

Expansion: Priority and structural projects (Redundancy and Industrialization)

- Infrastructure which enables redundance, reliability of supply, inclunding Industries
- Infrastructure for Development corridors (Nacala, Beira, Mocuba, Pemba) and Industrial Hubs

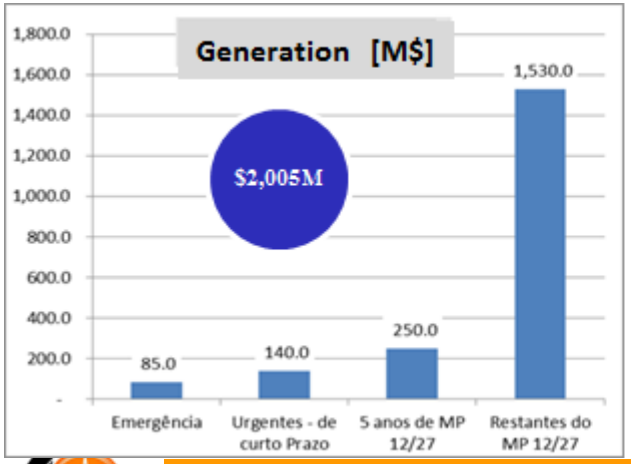
(New generation, new transmission lines, including redundancies)

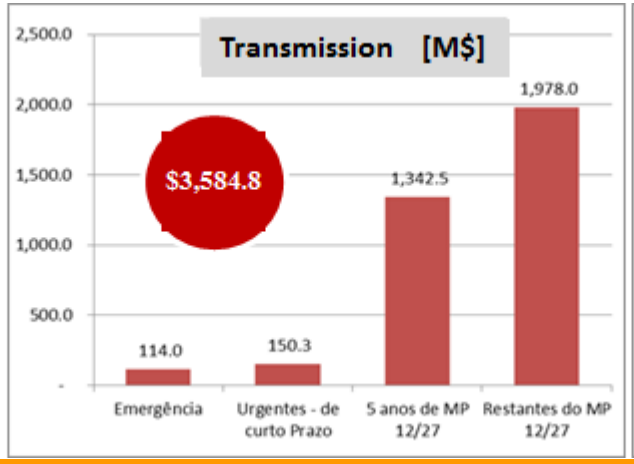
Long term $5,097 M 5-10 Years

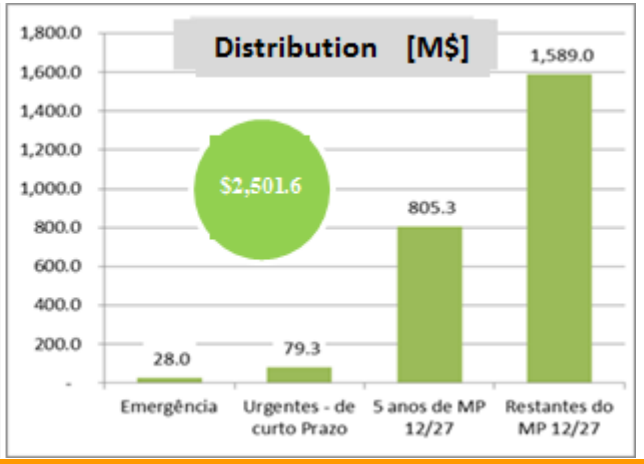
Leadership: Infrastruture GX, TX e DX (Markets, including exports)

- Infrastructure to sustain rapid demand and energy consumption growth
- Evacuate power from new generation to load centres, including exports

(Expansion of generation and transmission to conect loadas and markets)







Mozambique a Regional Hub

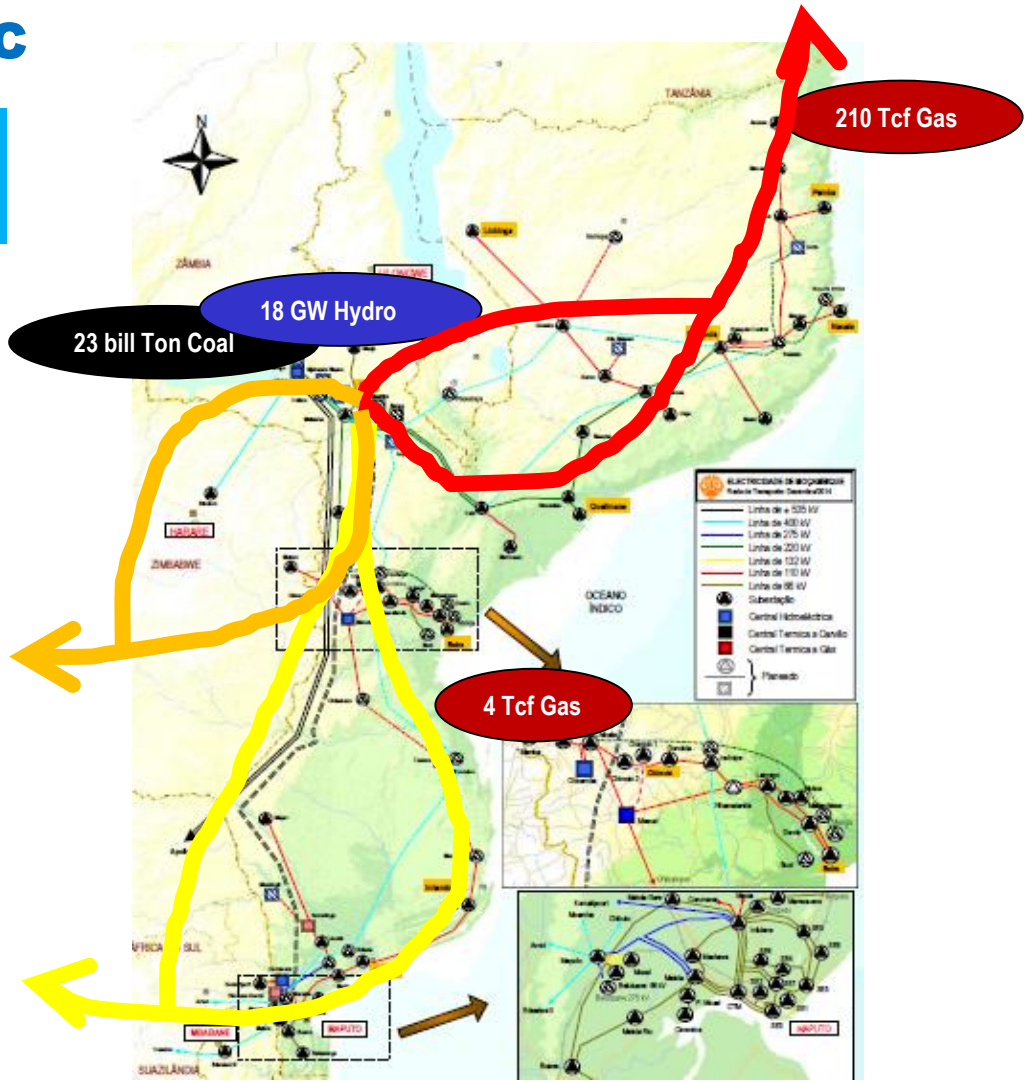
400 kV HVAC and 500 kV HVDC

Two major generation Centers in the North (Palma/Nacala) and West (Tete)

The West to North Power Corridor, in a loop, which will flow power into Tanzania and the Eastern Africa Power Pool (EAPP)

The Western Power Corridor, in a loop, which will flow power into Zimbabwe and Zambia, and the West African Power Pool (WAPP)

The North to South Power Corridor, in a loop, which will flow power into Maputo Metro, South Africa and the Southern African Power Pool (SAPP)



Monitoring and measuring results

Results from surveys 2011 - 2014

	2011	2014
Surveyed	**446**	**484**
% Female (head of HH)	24%	28%
Age (20-60)	88%	84%
None or Primary Education only (head of HH)	89%	85%
Activity: fishermen/agricult. tourism commerce	30%+18% 10% 5%	39%+19% 13% 6%
Monthly Cash Earnings 100 - 5 kMT > 5 kMT	42% 47% 3%	28.6% 60.8% 11%
Monthly Expenses 0 - 5 kMT > 10 kMT	87.5% 3.06%	60.7% 0.6%
Monthly Electricity no expense 100 – 5 kMT	79% 3%	< 100 or blank 48%
Use Kerosene	95%	42%
Use Grid Electricity	5.5%	55%
Use Charcoal	58.2%	58%
Use LPG	6.2%	3%

Monitoring and measuring results

Male x Female in 2014

	Male 2014	Female 2014
Surveyed	**339**	**134**
Age (20-39) (20 – 60)	37.5% 85%	47% 84%
None or Primary Education only (head of HH)	84%	87%
Activity: fishermen/agricult. tourism commerce	37%+17% 14.5% 3.5%	44%+27% 9.7% 13%
Monthly Cash Earnings 100 - 5 kMT > 5 kMT	25% 61% 14%	34% 60% 6%
Monthly Expenses 0 - 5 kMT > 10 kMT	90.5% 3.06%	98% 0.7%
Monthly Electricity expense 100 – 5 kMT	55%	40%
Use Kerosene	37.5%	51.5%
Use Grid Electricity	54.6%	42%
Use Charcoal	60.5%	51%
Use LPG	3%	0.8%