

Brazilian Isolated Systems

Overview about Energy Supply

August 2023

Brazilian Isolated Systems

Isolated systems (Off-grid systems): Power systems not electrically connected to the Brazilian National Interconnected System - SIN, for technical or economic reasons.



Sacambu (City of Manacapuru)
(Peak Demand: 0.3 MW)



Fernando de Noronha Island
(Peak Demand: 5.6 MW)



City of Afuá
(Peak Demand: 2.3 MW)

Characteristics of Isolated Systems



Approximately 3 millions consumers



More than 200 locations



0.6% of Brazilian total consumption and 40% of territory



Peak demand in 2023: 630 MW



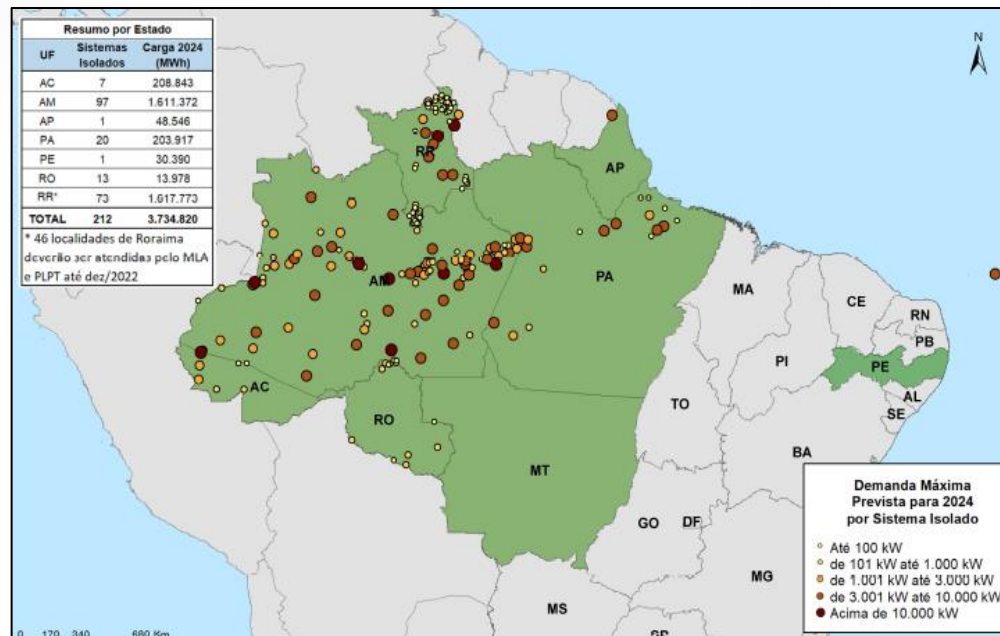
Diesel oil is the main source of energy supply



High rate of energy losses and poor energy quality

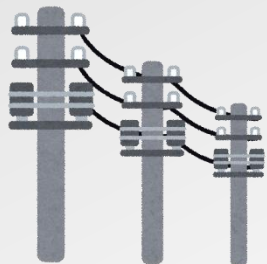


National Interconnected System



Isolated Systems

The Role of Agents in Isolated Systems



DISCOS are responsible for preparing the service planning proposal for their respective consumer markets located in Isolated Systems



EPE evaluates the proposals for supply energy planning to the Isolated Systems and publishes the Supply Planning Report

MINISTRY OF MINES AND ENERGY

MME approves the planning and publishes the auction guidelines to procure energy and power capacity, if necessary



EPE is responsible for technical prequalification process (evaluating the projects submitted to participate in the auction).

ANEEL carries out the auctions (bidding phase).

Supply Planning Report for Isolated Systems, Year 2022

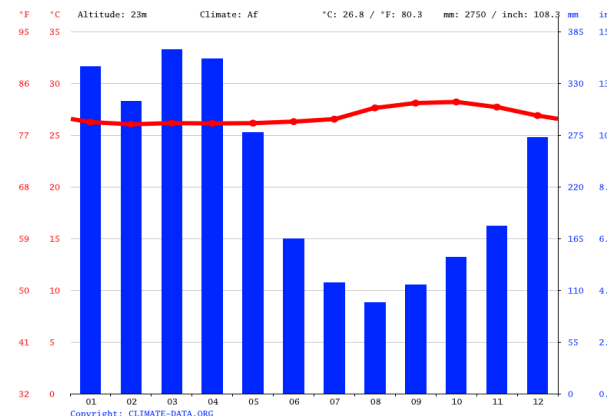
Available on the EPE website

<http://epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/relatorio-de-planejamento-para-atendimento-aos-sistemas-isolados-horizonte-2024-ciclo-2019>



Isolated Systems: Main challenges

- Logistical constraints:
 - ✓ Rivers are the “roads”, so there are several difficulties during the dry season in some areas;
 - ✓ Due to long distances it can take more than 7 days to reach some isolated systems by boat;
- Labor qualification:
 - ✓ There are no qualified workers in remote locations;
- Weather conditions
 - ✓ High temperature (average 28 °C; max 35°C)
 - ✓ Humidity around 90% in wet season
 - ✓ More than 22 rainy days per month (december-may)



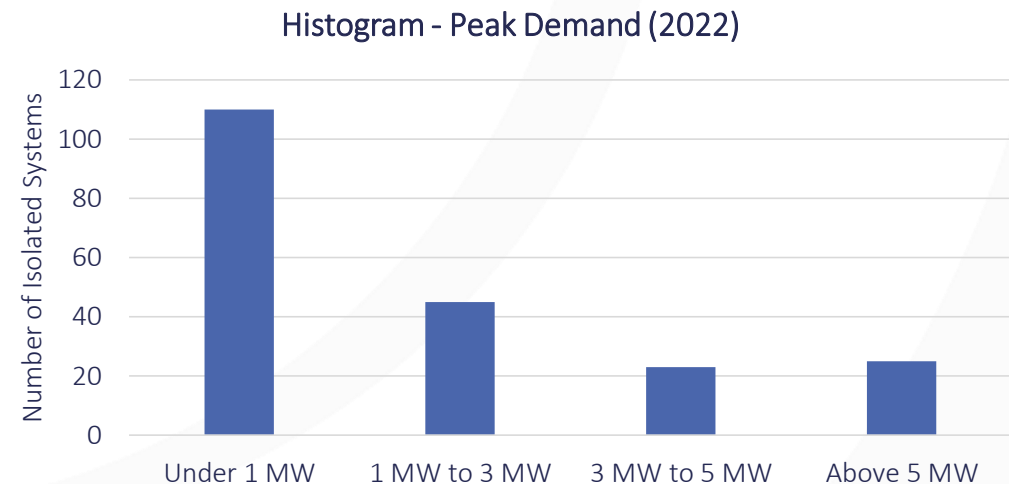
Characteristics of Isolated Systems

State	Isolated System	Interconnection Forecast	Peak Demand in 2022 (MW)
RORAIMA	BOA VISTA	2025	230.3
ACRE	CRUZEIRO DO SUL	2025	30.1
AMAZONAS	TEFÉ		18.4
AMAZONAS	COARI		18.2
AMAZONAS	HUMAITÁ	2026	15.3
AMAZONAS	CASTANHO		13.6
AMAZONAS	TABATINGA		12.4
AMAZONAS	RIO PRETO DA EVA	2023	11.4
AMAZONAS	MAUÉS		9.6
AMAZONAS	MATUPÍ		7.9
AMAZONAS	SÃO G. DA CACHOEIRA		7.9
AMAZONAS	BOCA DO ACRE		7.7
MATO GROSSO	ALCOA BENEFIC.	2025	7.5
AMAPÁ	OIAPOQUE		7.4
AMAZONAS	LÁBREA		7.2
AMAZONAS	MANICORÉ		6.9
AMAZONAS	AUTAZES		6.5
AMAZONAS	BENJAMIN CONSTANT		6.4
AMAZONAS	EIRUNEPÉ		6.4

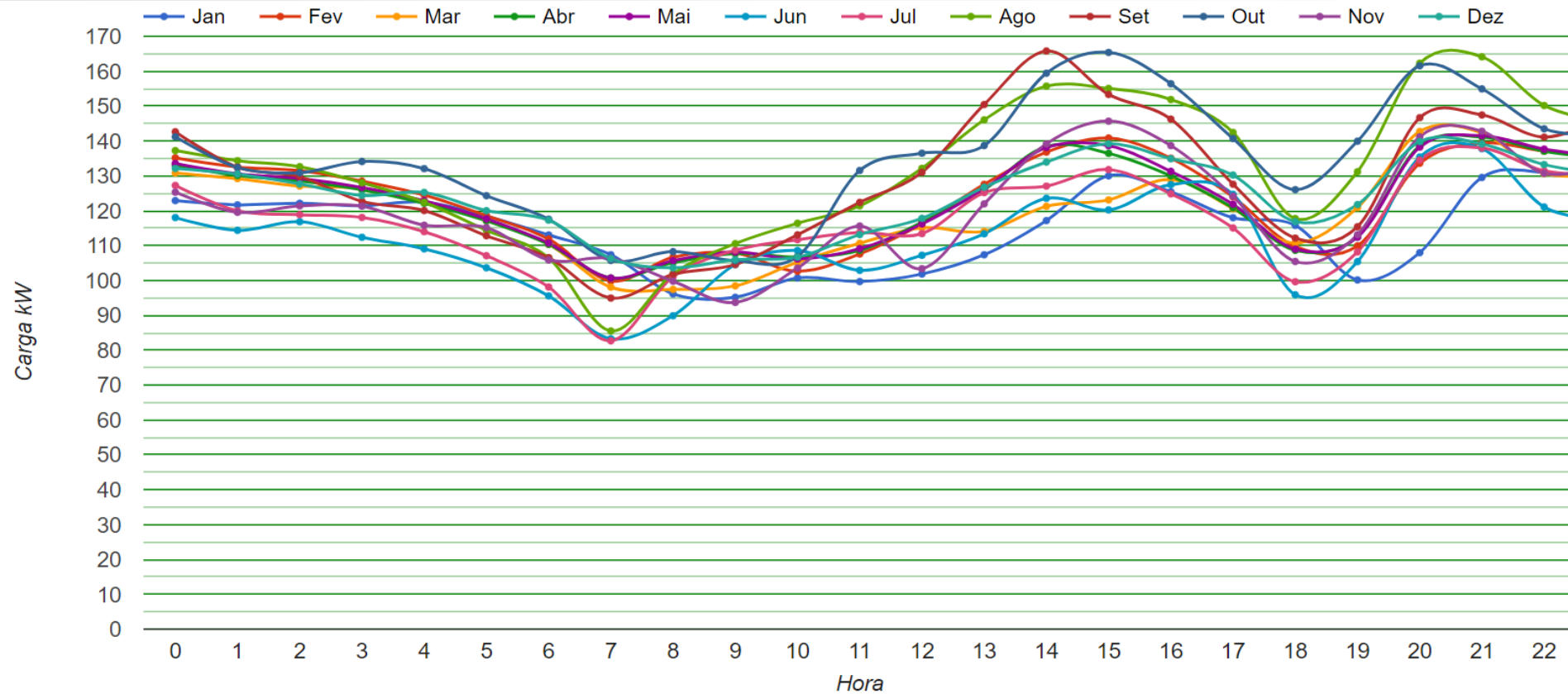
Largest Isolated Systems in 2022

There are around 200 Isolated Systems in Brazil:

- About 100 systems have a peak demand of less than 1 MW
- Only 30 systems have a peak demand above 5 MW - half of them will have been connected to the main grid by 2027.
- Several isolated systems will be connected to the national system in the next years, including the largest one (Boa Vista/RR)



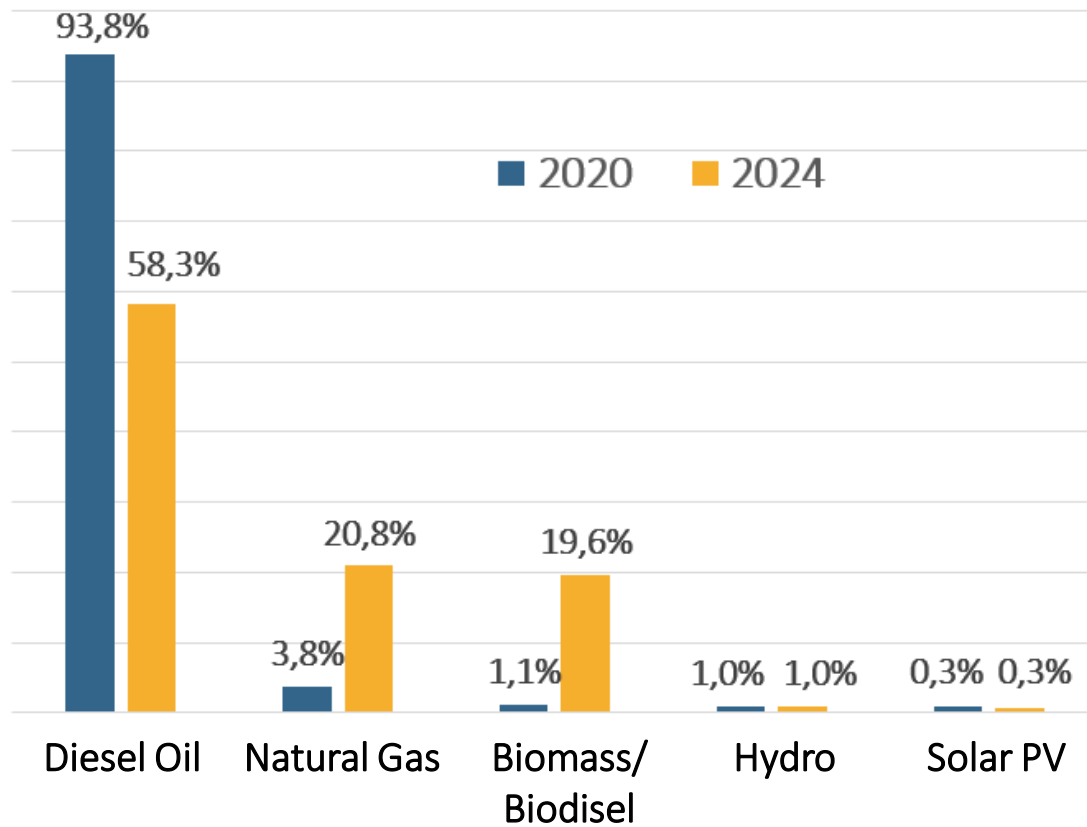
Characteristics of Isolated Systems



Load Curve (kW) – Hourly Average

Isolated System: Camaruã (Amazonas)

Electricity Mix



- New natural gas and biomass power plants procured in the last auctions tend to reduce the diesel share in isolated systems;
- Despite the high emissions and hard logistics, diesel oil is still a reliable technology for these locations, easy to maintain and operate.



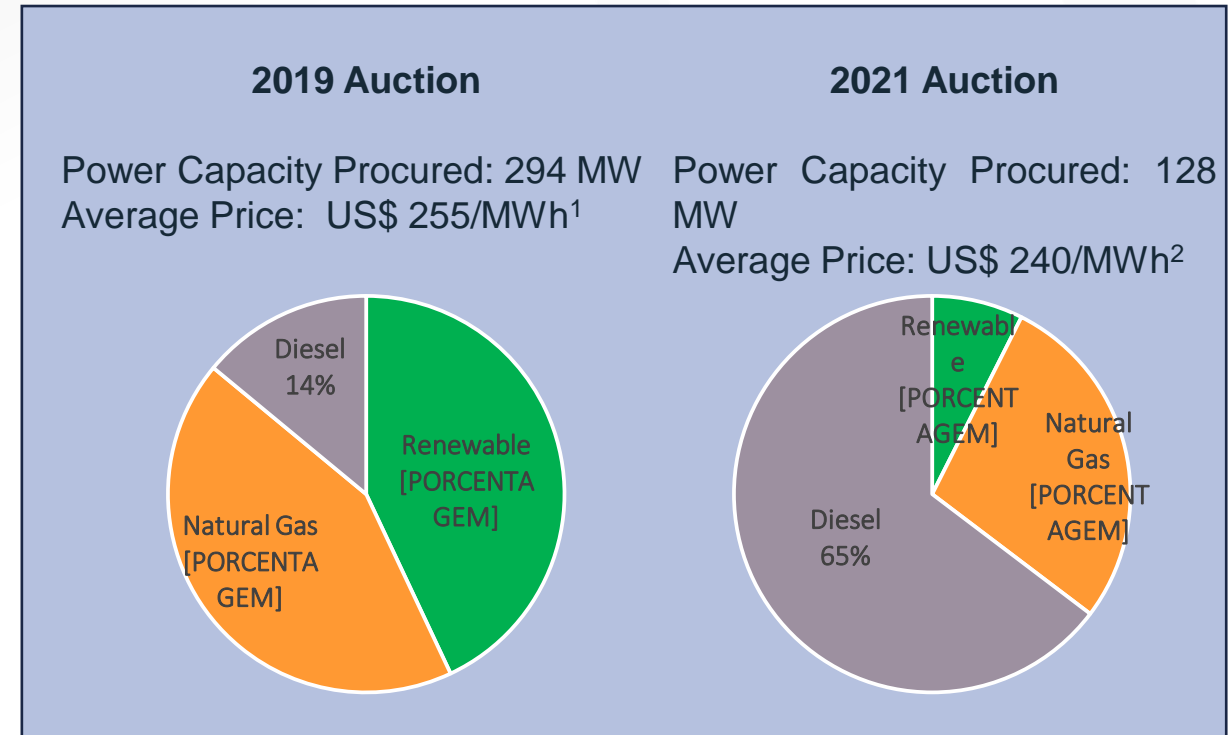
Diesel oil thermal power plant (Castanho II – 20 MW)

Isolated Systems Electricity Auctions

Auction Guidelines and Technical Requirements for the projects

- The power plants must have to load-following capacity for 24h/7 days a week;
- Reliable electricity supply (contingency reserve power units required);
- It is required on-site fuel reservation (tank or stock) to ensure the energy supply for 7 days in a role;
- Technological neutrality (some auction rules can make renewables more competitive);
- PPAs typically range from 5 years (fossil fuels) to 15 years (renewables);
- Guidelines can be adapted depending on the auction;

Auction Results



1 - May-2019 updated by CPI
2 - May-2021 updated by CPI

Isolated Systems

Interconnection Assessments

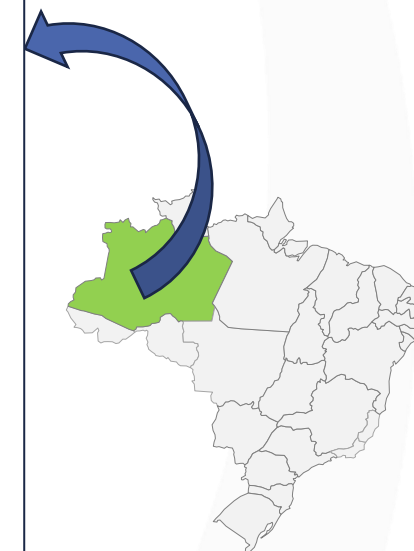
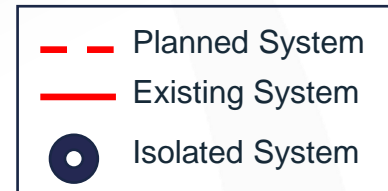
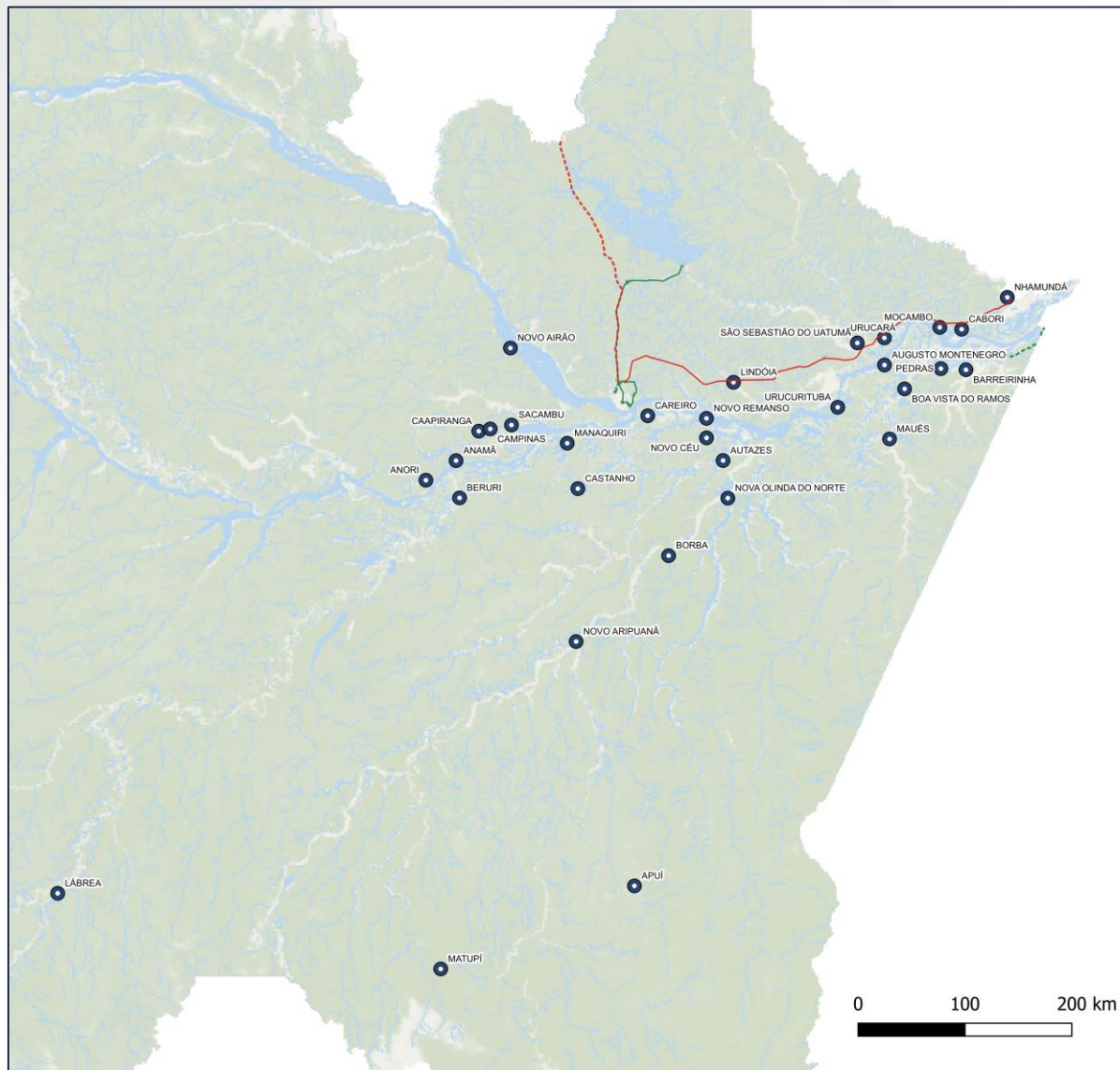
Isolated Systems Interconnection

→ The interconnection of isolated areas requires technical and cost-benefit assessments to identify:

→ The possibility of reduction of electricity costs related to substitution of local fuel-based energy supply;

→ The technical feasibility of implanting transmission and/or distribution lines in ecologically sensitive areas;

→ The reliability of energy supply in remote areas considering local Generation and/or Distribution/Transmission expansion.



Isolated Systems in the Amazonas State
Source: EPE

Isolated Systems Interconnection

→ Taking into consideration the characteristics of the isolated systems and the existing challenges associated to supply these locations, the following features are desirable for any kind of technology:

- Island mode capability
- Black-start capability
- Modular or small-sized units
- Reduced installation and operational costs when compared to commonly available options like fossil fuels.
- Load-following capacity
- Capacity of operating in a less established grid infrastructure
- Reliable electricity supply

Thank You!