SWITCH Energy Case Competition 2024

Senegal & Namibia

Team: 112 Entensification

Home Country: United States

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Energy Poverty in Namibia and Senegal

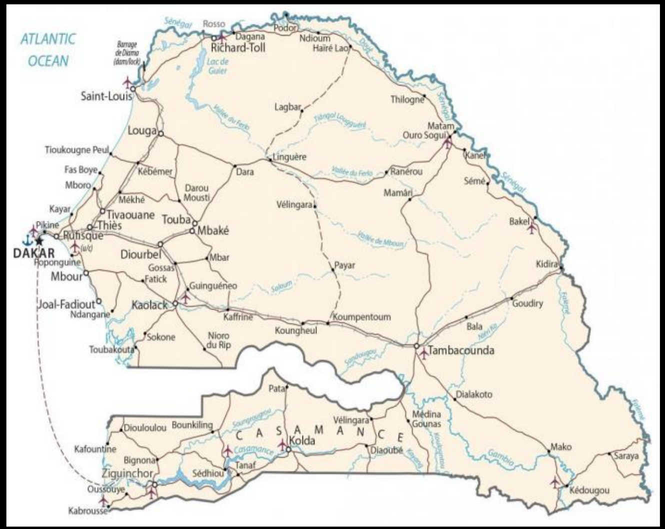
Unreliable and Expensive Energy Supply

Insufficient Funding and Infrastructure

Limited Education Opportunities

Lack of Access to Clean, Reliable, and Affordable Energy

Senegal Overview:



Population:
18,632,418 People

CO2 Emissions:
0.70 Tons Per Person

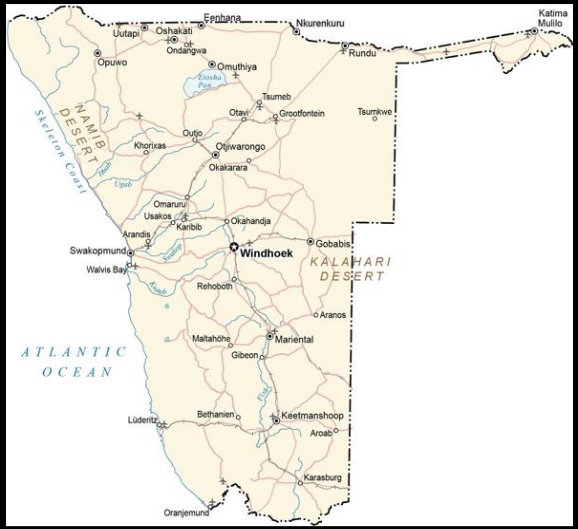
Urban Population:
8,499,952 People

Electricity Access:
Urban: 75%
Rural: 17%

Rural Population:
8,956,364 People

Clean Cooking Fuel
Access: 31%

Namibia Overview:



Population:
2,688,000 People

CO2 Emissions:
1.53 Tons Per Person

Urban Population:
1,385,057 People

Electricity Access:
Urban: 74.8%
Rural: 33.2%

Rural Population:
1,181,955 People

Clean Cooking Fuel
Access: 47.4%

Main Issues for Senegal

Rural Areas Lack Reliable Electricity Access

Insufficient Infrastructure

Overreliance on Imported Energy

Policy and Regulation

Economic Constraints

Dependent on Biomass Fuels

Main Issues for Namibia

Rural Areas Lack Reliable Electricity Access

Geographic Dispersion

Economic Constraints

Dependent on Biomass Fuels

Overreliance on Imported Energy

High Energy Costs

Policy and Regulation

Comparative Analysis:

Accessibility

Affordability

Environmental Impact

Safety

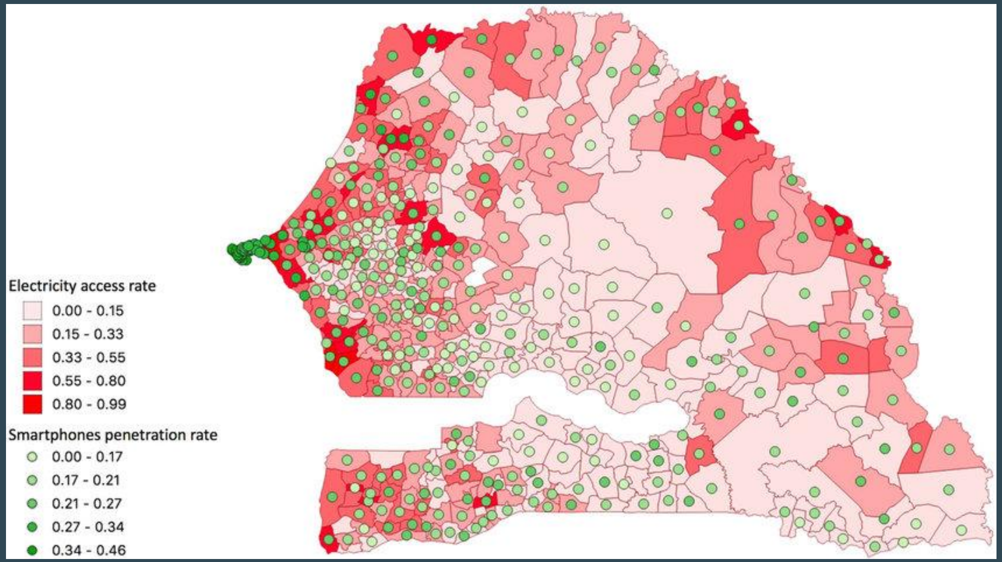
Quality of Energy Services

Security

Reliability

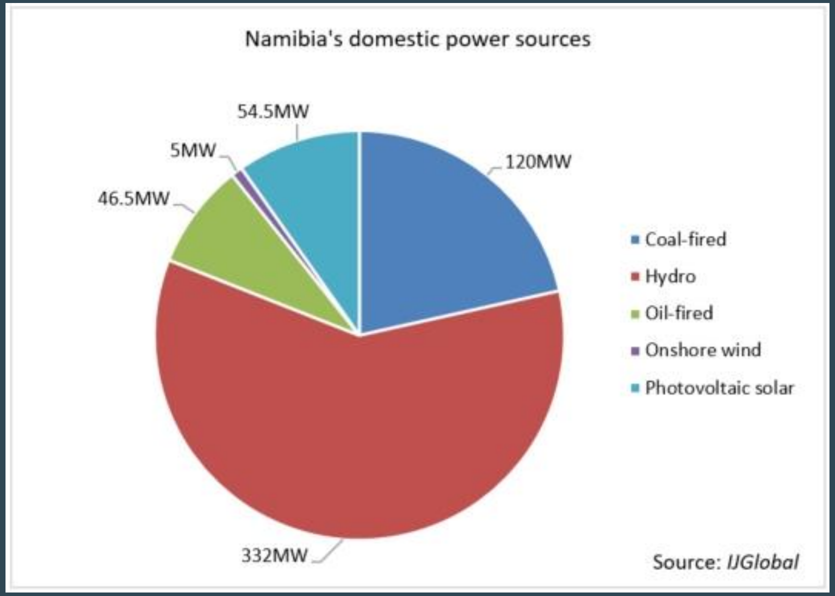
Potential for Roadblock

Senegal's Accessibility:



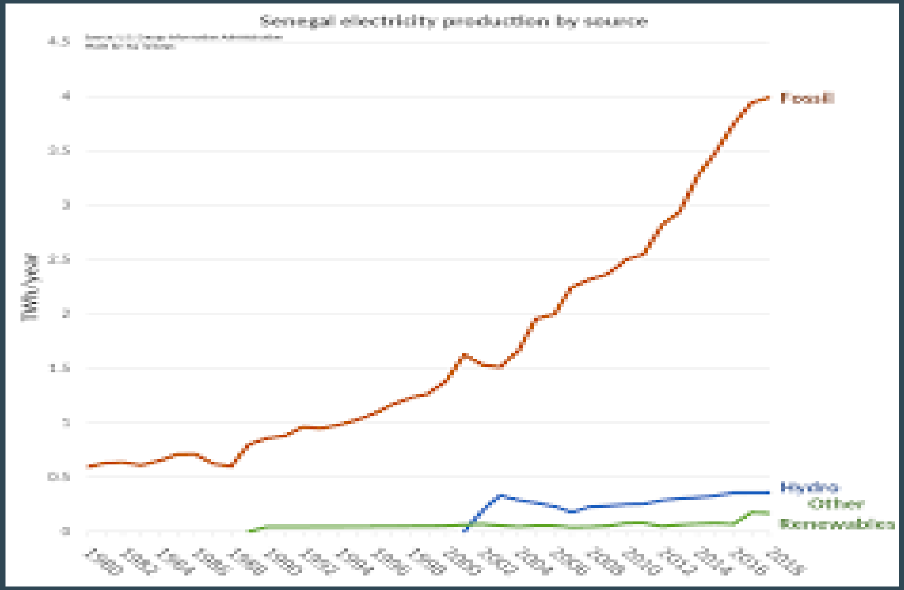
- Electrification Rates
  - Urban: 75%
  - Rural: 17%
- Animal Waste Used as Primary Cooking Fuel

Namibia's Accessibility:



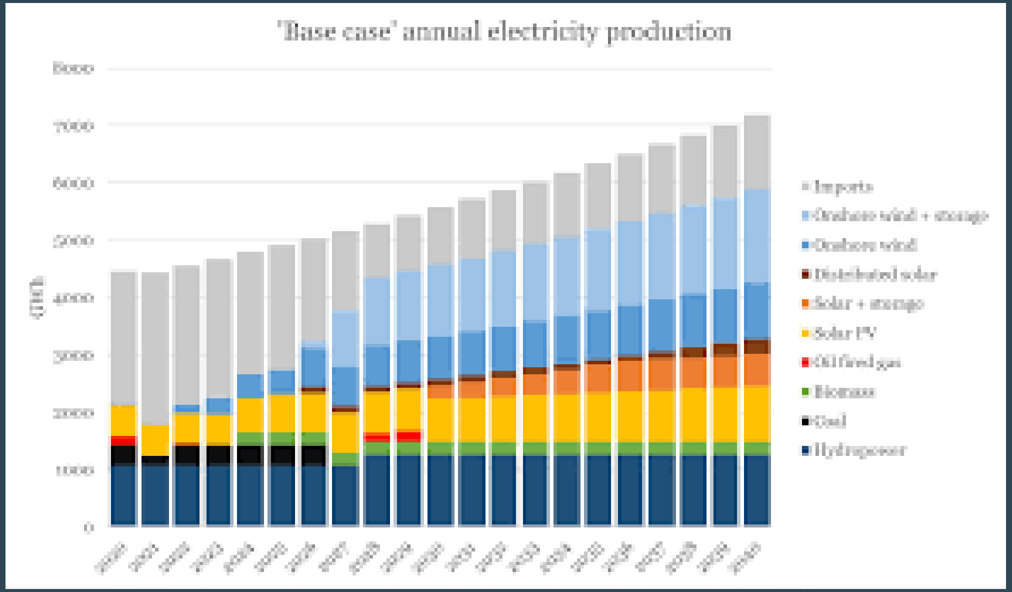
- Electrification Rates:
  - Urban: 75%
  - Rural: 36%
- Imported Electricity from South Africa

Senegal's Reliability:



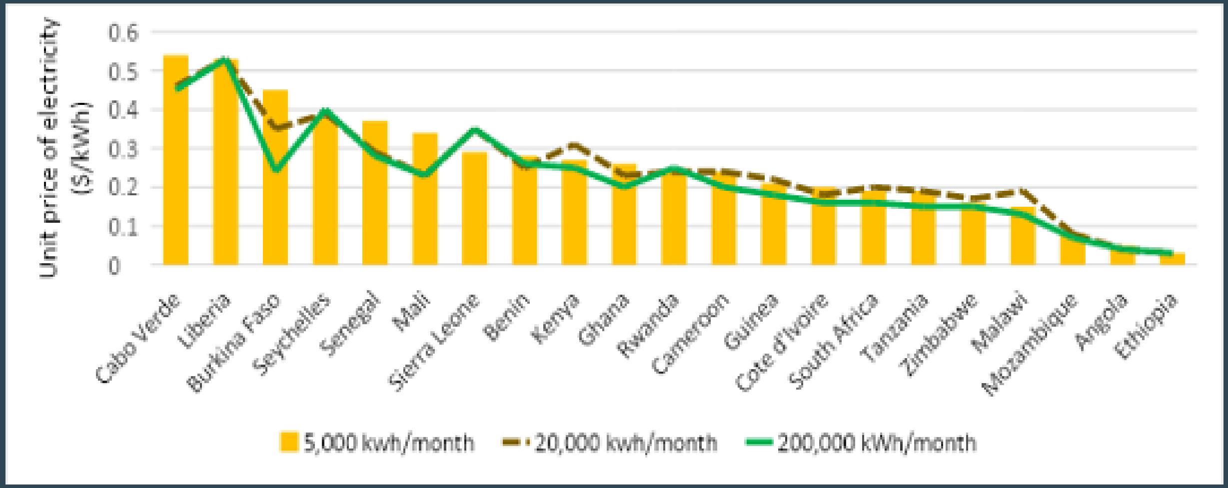
- Gap Between Demand and Growth
    - Blackouts & Inadequate Service

Namibia's Reliability:



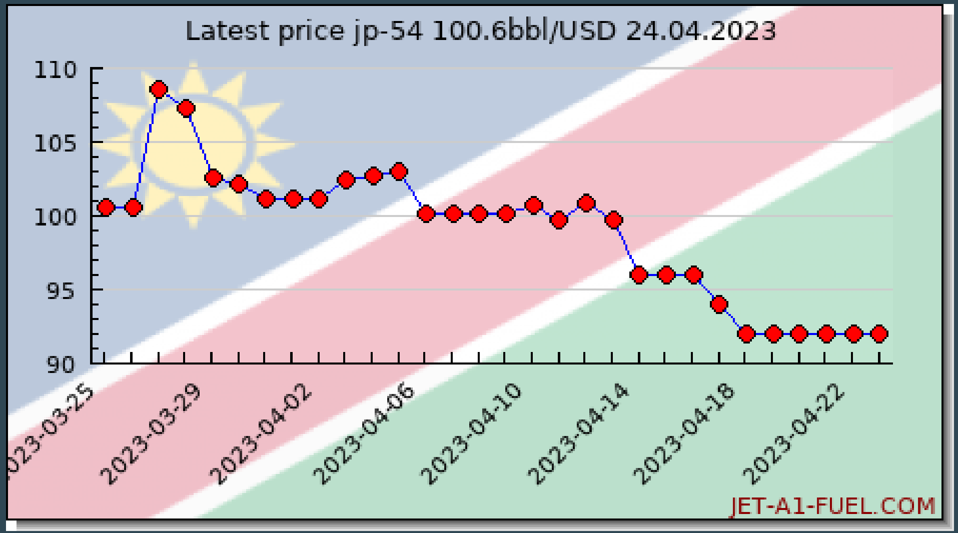
- Imported Energy from South Africa
    - Vulnerable to Disruptions
- Uses Hydroelectric Energy Sources

Senegal's Affordability:



- Energy Price High compared to Average Income
- Prepaid Metering
  - Once Funds are Depleted Households Face Blackouts

Namibia's Affordability:



- Energy Price High compared to Average Income
- Subsidies and Social Programs
  - Aimed at low-income areas
  - Effectiveness varies
- Rural Energy Access
  - Households rely on expensive and less effective energy sources

Other Considerations for Environmental Impact, Quality of Energy, Safety, Security , and Potential for Roadblock

Senegal:

- Heavily Reliant on Fossil Fuels
- Deforestation and Biomass Usage
- Water Scarcity
- SENELEC Failing to meet rising energy needs
- Current Biomass Fuels lead to:
  - Air Pollution
  - Poor Community Health
- Vulnerable to Disruption
  - Political Instability
  - Vandalism
  - Natural Disasters
- Aging Infrastructure
- Financial Constraints
  - Insufficient Investments for Power Expansion
- Infrastructure Deficiencies

Namibia:

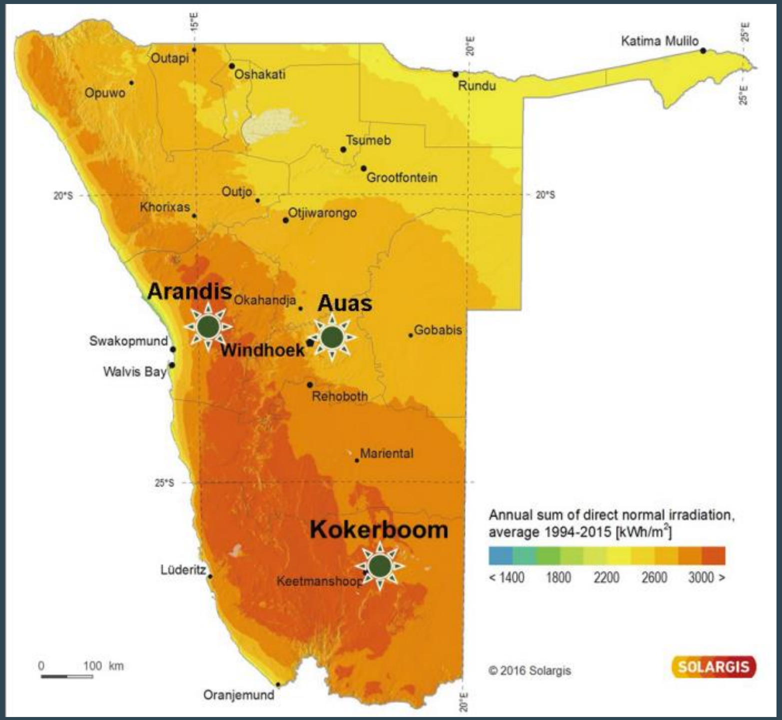
- Uranium and Copper Mining
- Oil and Gas Exploration
- Imported Energy
  - Reliability Issues
- 2.6 Billion Barrels of Oil Discovered
- Produces 8.2% of Global Uranium
- Current Biomass Fuels lead to:
  - Air Pollution
  - Poor Community Health
- Dependence on Imports
- Aging Infrastructure
- Natural Resource Management
- Limited Domestic Generation Capacity
- Political Uncertainties

Energy Poverty Comparative Analysis

Energy Poverty Factor	Namibia	Senegal
Accessibility	3	2.5
Environmental Impact	4	2
Quality of Energy Services	2	2
Reliability	3	3
Affordability	1	1
Safety	2	2
Security	3	2
Potential for Roadblock	3	2
Total	21	16.5

Main Focus: Namibia

Objectives and Targets:



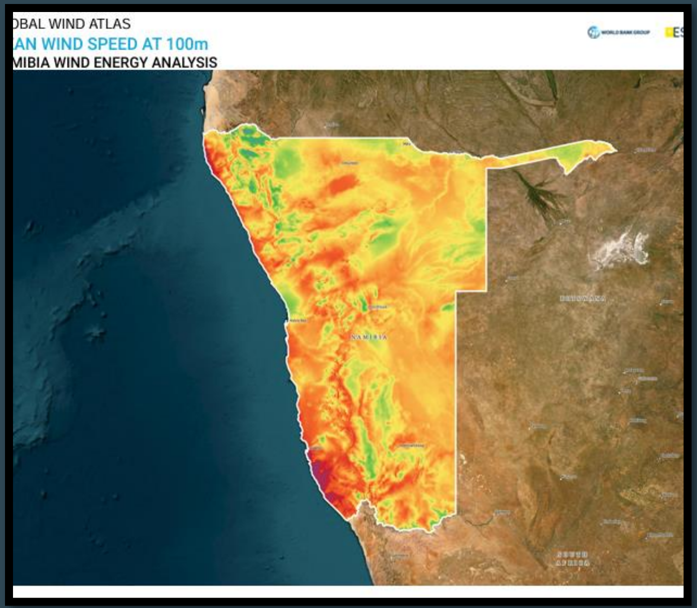
Decrease energy poverty by 8%, especially in rural areas

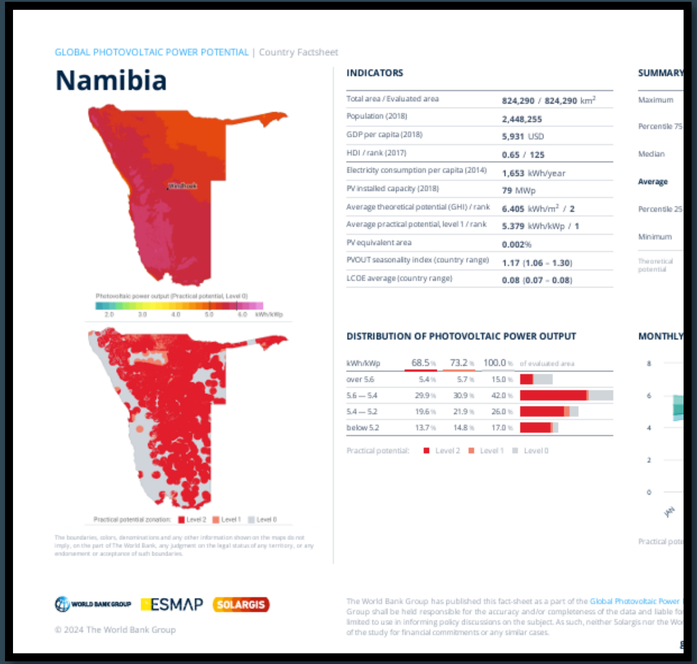
Provide framework for energy independence and full-grid integration

Stimulate economic growth by developing microgrids in proximity with natural resources (Uranium and Fossil Fuels)

Energy Sources Considered:

- Solar Power
- Hydro Power
- Wind Power
- Nuclear Power
- Fossil Fuels



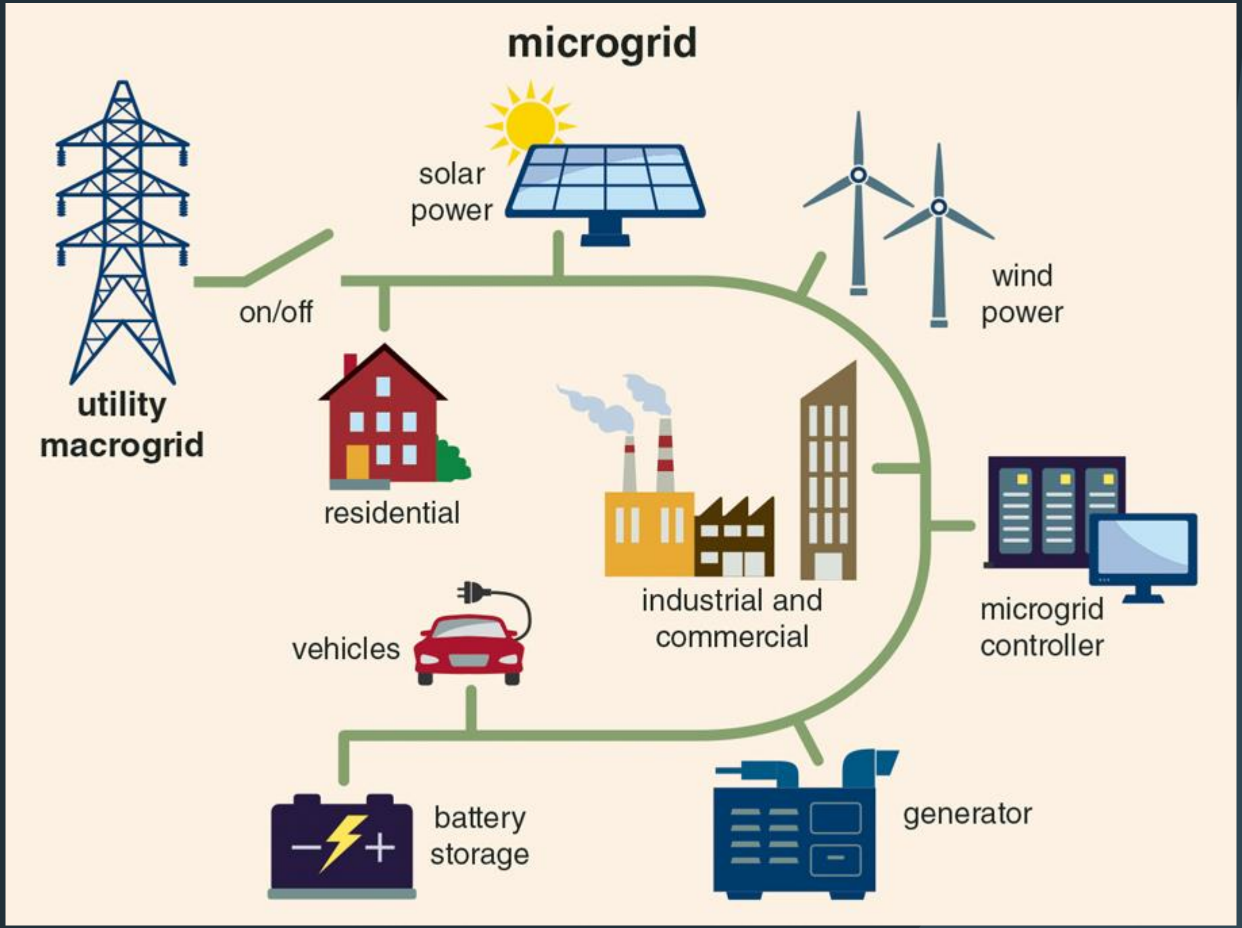


Energy Source Analysis:

Solar Power	1	Solar is a rank above the rest for its portability, power generation and ease of access.
Hydro Power	2	Hydro power has great potential due to Namibia's coastline, but it is very expensive on startup.
Nuclear Power	3	Namibia has immense uranium resources, but like hydro power, it is too expensive.
Fossil Fuels	4	The Orange Basin provides a high amount of fossil fuels. However, this is a less renewable and more expensive option compared to solar.
Wind Power	5	Wind power is least competitive in our analysis as it is high cost, non-portable, and not highly effective in all regions.

Proposed Solution: Solar Powered Microgrid

What is a Microgrid?



- Able to tie into the nations main grid if needed
- Functional independently of the nations grid
- Typically run on renewables such as wind or solar
- Require battery storage due to inconsistent power generation

Project Considerations:

01

Energy access is highly concentrated in urban areas

02

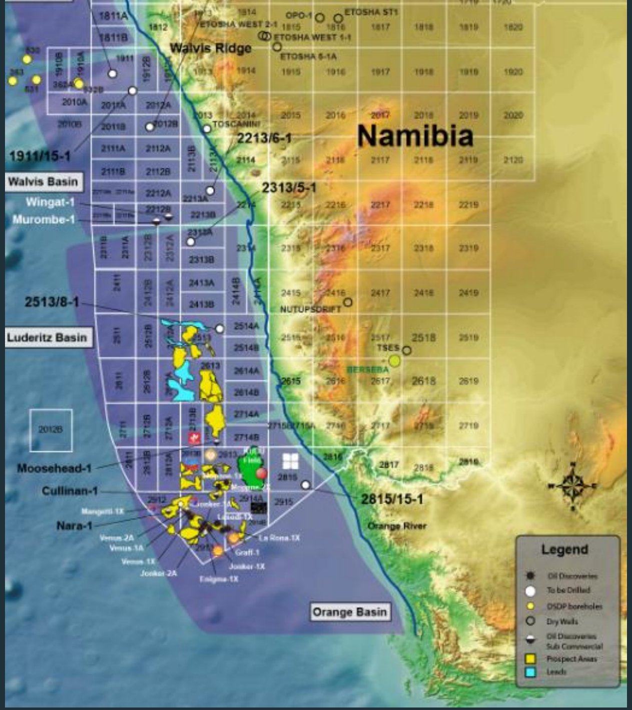
Dependent on South Africa and other neighboring countries for roughly 60% of all electricity

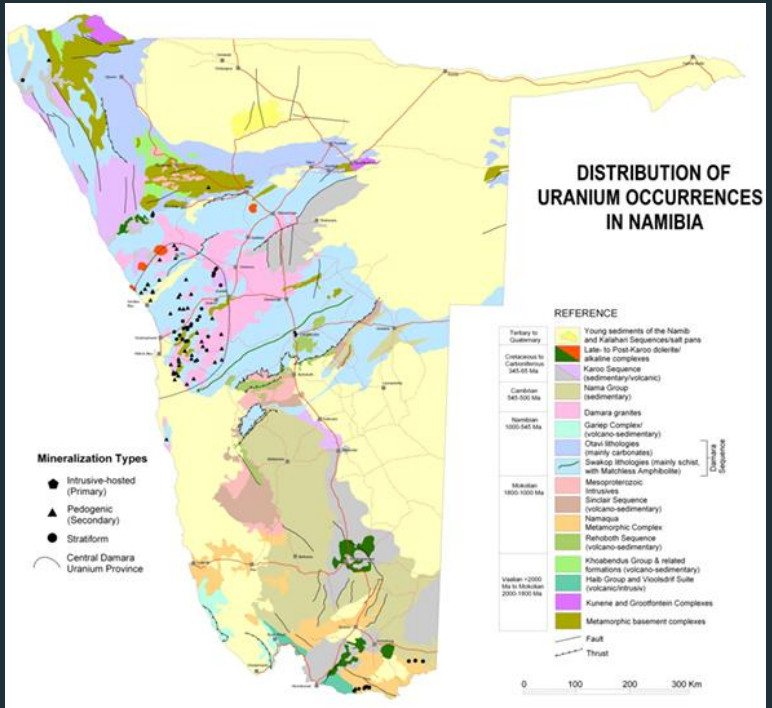
03

Exporter of energy resources such as Uranium and Fossil Fuels

04

Other energy initiatives are taking place such as IRENA's Green Hydrogen project and the UN’s AMP





Site Selection

- High rate of energy poverty
- Proximity to natural resources (Fossil Fuels and Uranium)
- High overlap of energy incentive areas (IRENA Green Hydrogen)

Solar Microgrid Overview:

DEVELOP A MODULAR MICROGRID STRUCTURE THAT CAN PROVIDE UP TO 26MW/DAY PER 1000 PEOPLE

SOLAR FARM IS APPROXIMATELY 22 ACRES

~$13 MM USD CAPITAL COST PER MODULE

Microgrid Design

- 4.6MW Solar Farm capable of 26 MWh peak production
- Centralized Tesla Megapack Powerwall storage for 27.4 MWh of energy
- Distributed microgrid suitable for residential and low-power commercial uses
- Built in capability for grid interconnection for future growth

Cost and Financing:

- Primary costs for microgrid installation is generation and storage equipment
- Solar Farm: $4.7 million USD
- Battery Storage: $6.4 million USD
- Infrastructure: $1.9 million USD
- Total Module Cost: $13 million USD
- Additional Funding: UNDP, IRENA

Energy Poverty Factors Addressed:

Microgrids with proper storage capabilities reduce dependence on countries primary energy grid

Communities become self sufficient

Access to energy brings more residents

Residents can live closer to their areas of work

10-year Plan Overview

01

Perform outreach to include Namibia in programs such as the IRENA Green Hydrogen Program and UN backed AMP.

02

Scout out ideal locations for microgrid implementation based on population density, energy poverty factors, and natural resource production.

03

Implement microgrids and perform a new energy analysis to determine the effectiveness of the program.

Leveraging AMP in Namibia

AFRICA MINIGRIDS PROGRAM

Figure 1: AMP Architecture

REGIONAL PROJECT – KNOWLEDGE & COORDINATION PLATFORM

Component 1	Component 2	Component 3	Component 4	Component 5
Knowledge Tools	Tailored Technical & Operational Assistance to National Project Implementation	Communities of Practice	Digital tools and solutions for minigrid cost-reduction	Monitoring and Evaluation (M&E)

Support to national project implementation

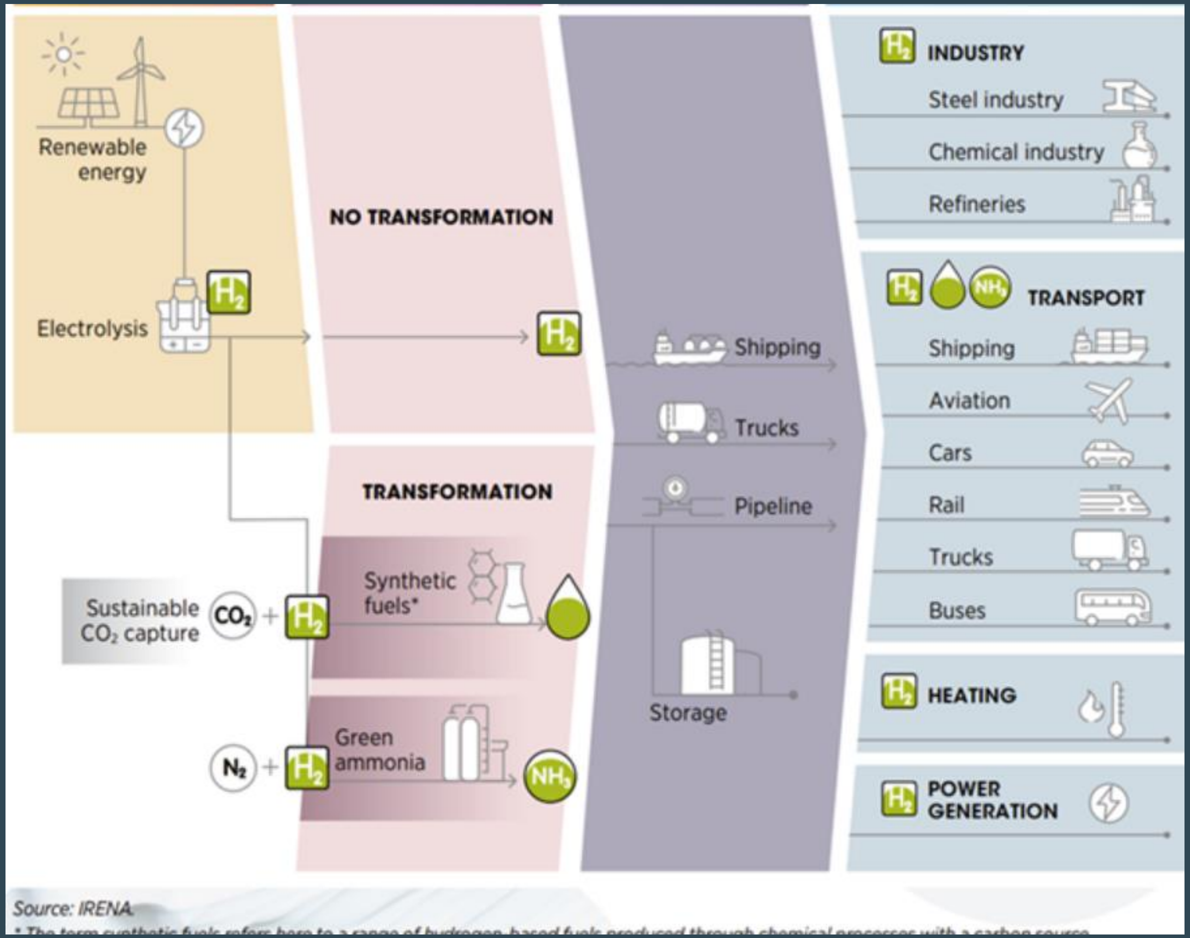
Harnessing data and insights from national project implementation to share with minigrids ecosystem

21 INITIAL NATIONAL PROJECTS

Component 1	Component 2	Component 3	Component 4	Component 5
Policy and Regulation	Business Model Innovation with Private Sector	Scaled-up Financing	Digital and Knowledge Management	Monitoring and Evaluation (M&E)

Leveraging IRENA in Namibia

- Implementation may include IRENA Green Hydrogen initiative locations
- Interconnection of microgrid systems to interact with IRENA



10 Year Plan by Year

January 2025: Project Development and Integration

June 2025: Site Selection

2026: Project Implementation

2027: Microgrid Commissioning

2028: AMP Technical Skills and Knowledge Development

2029: Project Scale-up

2030: Scale-Up Commisioning

2033: Developed Energy Infrastructure

2034: Integrate Energy Resources

Beyond: Expand Projects and Outreach

Beyond 10 years:

LEVERAGE NATURAL RESOURCES TO BEGIN GROWING NUCLEAR ENERGY PROGRAM

TRANSITION RURAL COMMUNITIES FROM MODULAR MICROGRIDS TO NATIONAL GRID

DEVELOP CHEMICAL INFRASTRUCTURE USING MODULAR MICROGRIDS

Application of Solutions in Senegal:

Use of micrograids will help with energy reliability, especially in rural areas

Challenge: Only 126 solar days per year

Similar inclusion of Senegal in the AMP and the IRENA will help funding and analysis

AMP structure and knowledge from Namibia can be used to better develop energy infrastructure

Solution Transfer Feasibility:

Guidelines and scoring determined by energy analysis comparison with Namibia

Capability	3	Less solar days per year than Namibia; however, Senegal is a smaller country and does not need as much of a capacity
Accessibility	4	Microgrids allow for more flexibility than large scale power grid implementation
Reliability	5	Microgrids would allow for higher energy reliability when compared to potential blackouts caused by national grid overload
Affordability	3	Solar would require greater capital investment for equal generation capacity. Lower GDP and available funds from Senegal government.
Safety	5	Solar farms require little maintenance and are generally much safer than natural gas or nuclear plants
Roadblocks	4	There are minimal roadblocks in implementing solar microgrids. Senegal's government and organizations such as AMP
Total Score	24	80% Overall Transfer Feasibility

Solution Summary:

- Modular Microgrids
- Leverage Green Energy
- Reliability, Safety, and Cost
- Sub-Saharan African Organizations
- Location!
- Natural Resources

Thank you!

Team Entensification would like to thank the SWITCH Energy Alliance, judges, and our audience. Big thank you to our mentor, Dr. Joseph Smith!

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