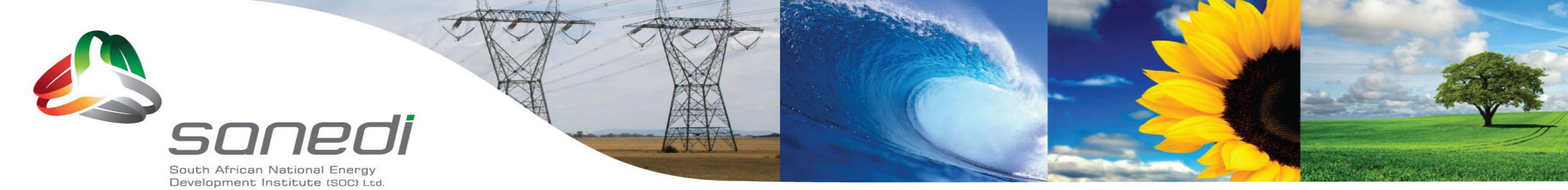

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Universal Access

Deploying microgrid capabilities into underserved urban, township and rural areas across South Africa.

Who is SANEDI?

Department of Electricity and Energy

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South African National Energy Development Institute

- Technology RD&I
- Policy Information
- Data Management
- Thought Leadership
- Capacity Building
- Project Management
- Demonstration & Pilot Projects

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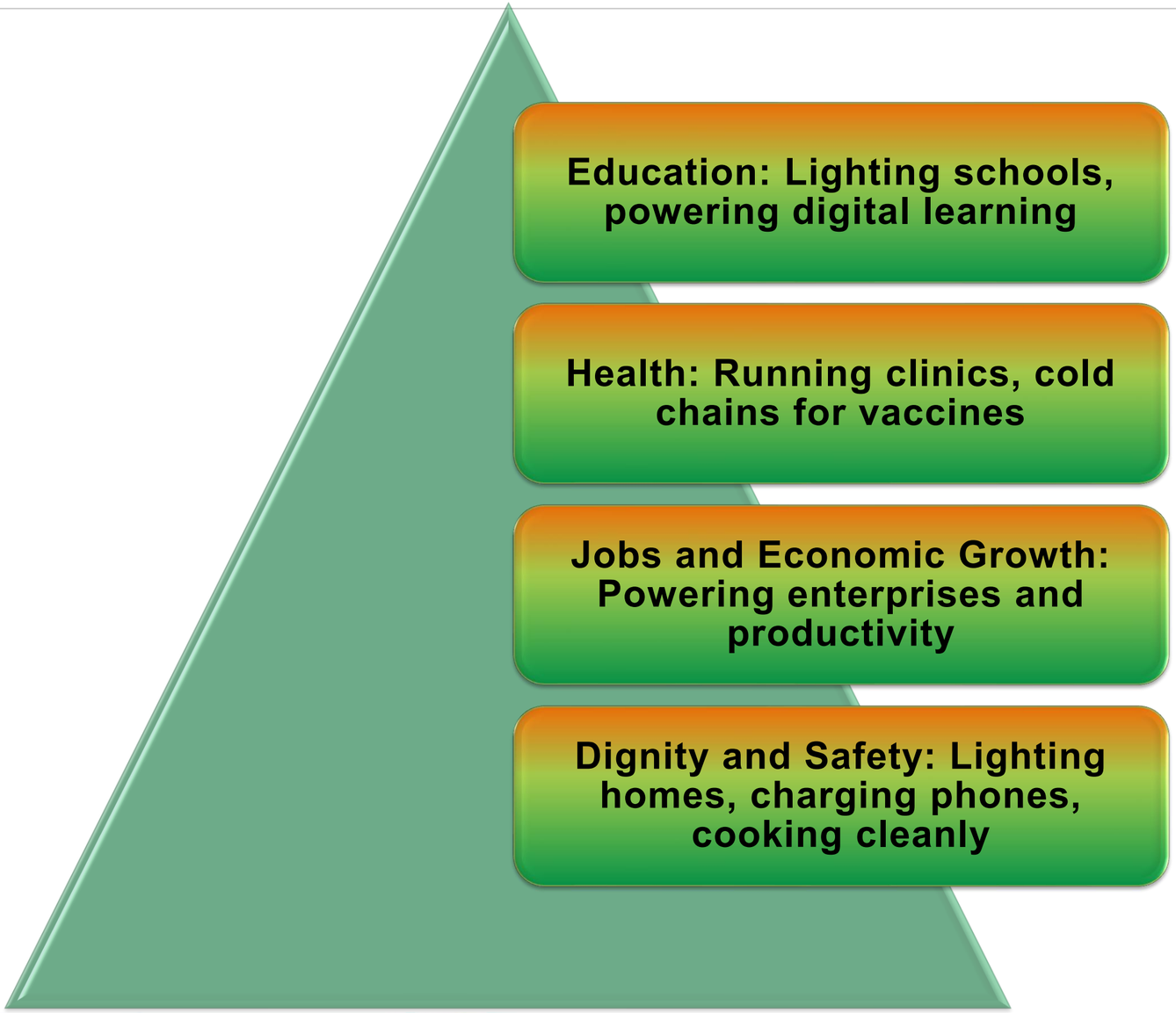
Electricity Access

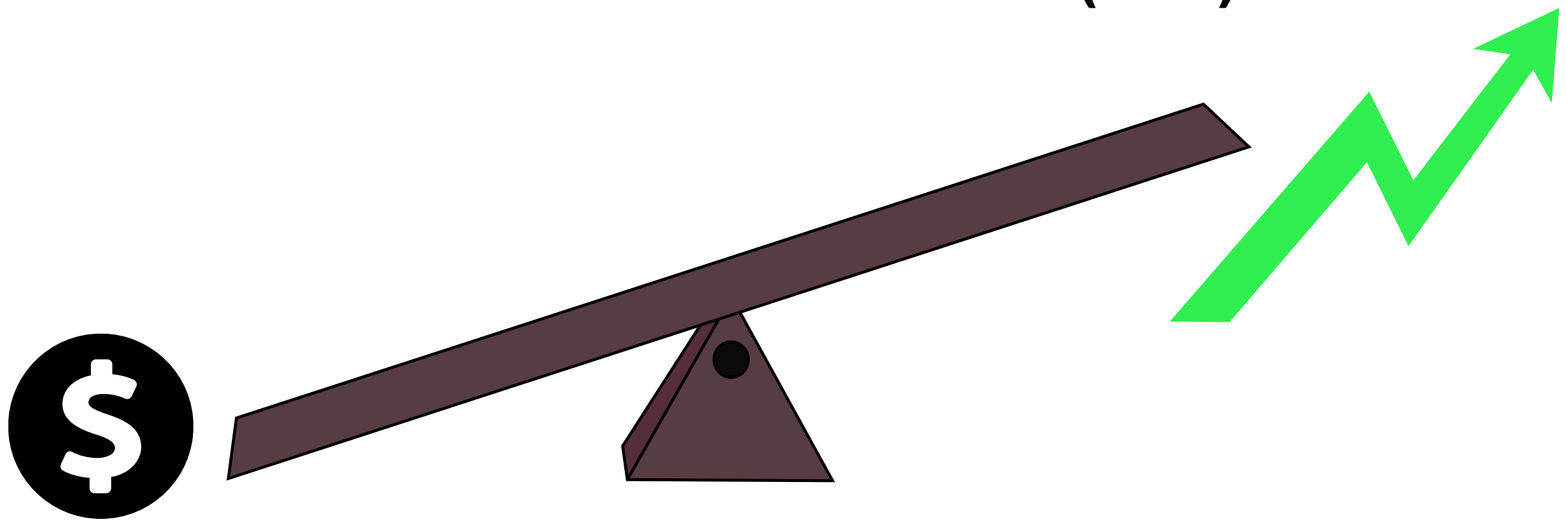
ENERGY INNOVATION FOR LIFE

Access to electricity is not just about lights, it is about:

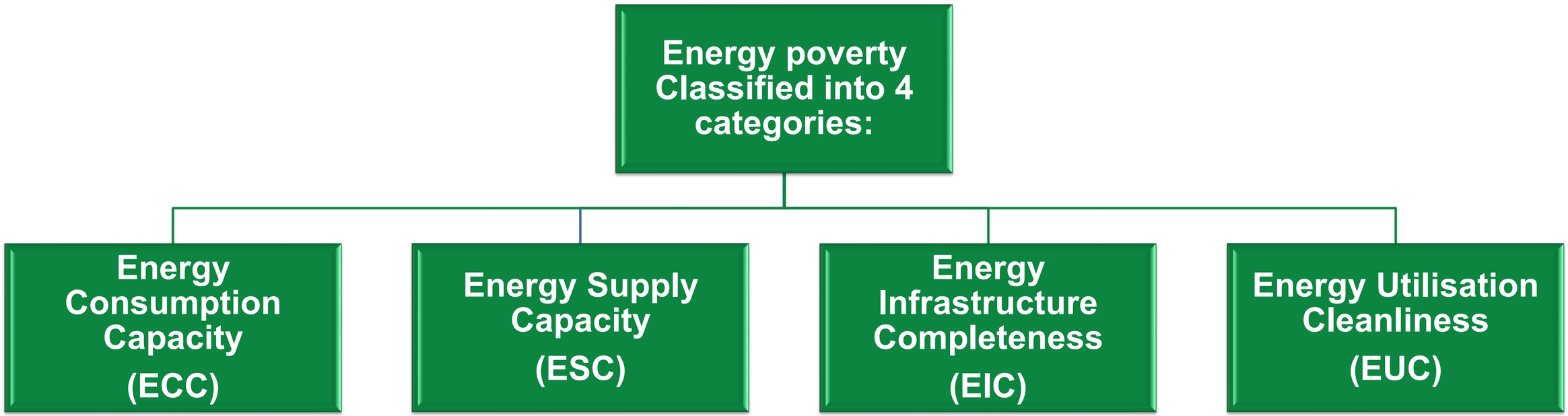


Why Electricity Access Matters?

Every Dollar invested in electrification yields ~4 Dollars in socio-economic returns (IEA)



Current State of Electricity Access



The State of Access

Global 

- ~89% of people have access to electricity (2021, IEA)
- 733 million still live in energy poverty
- Progress slowing in many low-income countries

Regional 

- ~89% of people have access to electricity (2021, IEA)
- 733 million still live in energy poverty
- Progress slowing in many low-income countries

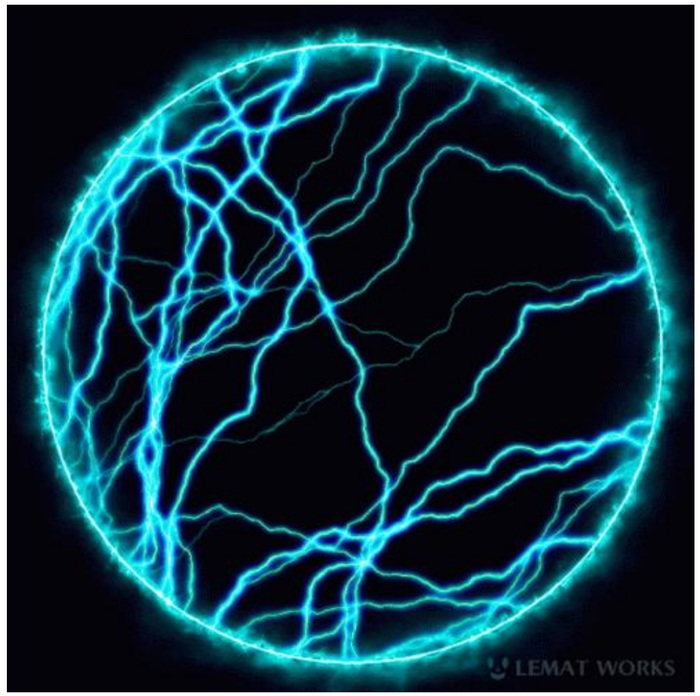
SA 

- ~94% electrified overall
- Remaining households (~6%) concentrated in:
  - Informal settlements
  - Remote rural areas
  - Municipalities with low technical or financial capacity

Sustainable Development Goal 7 (SDG7)

- Goal: Ensure access to affordable, reliable, sustainable and modern energy for all by 2030
- Key Targets:
  - Universal access to electricity and clean cooking
  - Increase renewable energy share
  - Improve energy efficiency
  - Enhance infrastructure, finance, and technology cooperation
- Current trajectory: We are NOT on track — accelerated action is urgently needed, especially in Africa

Universal Definition for Access to Electricity - SA



- Universal access to electricity in South Africa
  - Availability of reliable and affordable electricity services to at least 97% of households, businesses, and public institutions across the country
  - Regardless of geographic location, socioeconomic status, or remoteness
  - Should meet the basic energy needs of citizens, supporting both social and economic development
- Universal access ensures that all households can meet their basic electricity requirements includeing at minimum:
  - Lighting: The ability to power electric lights for household use, reducing dependency on kerosene or candles.
  - Appliances: The ability to use essential electrical appliances, such as refrigerators, televisions, and mobile phone chargers

South African context and challenges

National access: ~94%

- Urban: ~99% and Rural: ~75%
- Integrated National Electrification Programme (INEP)
  - South African government initiative aimed at providing access to electricity for all households
  - Grid and non-grid connections, particularly in underserved areas. It's managed by the Department of Electricity and Energy (DEE) and involves planning, funding, and implementing electrification projects
- Estimated 6% unelectrified households (over 2 million people)
- Last-mile connections are the hardest and most expensive

South African context and challenges

Load Shedding:

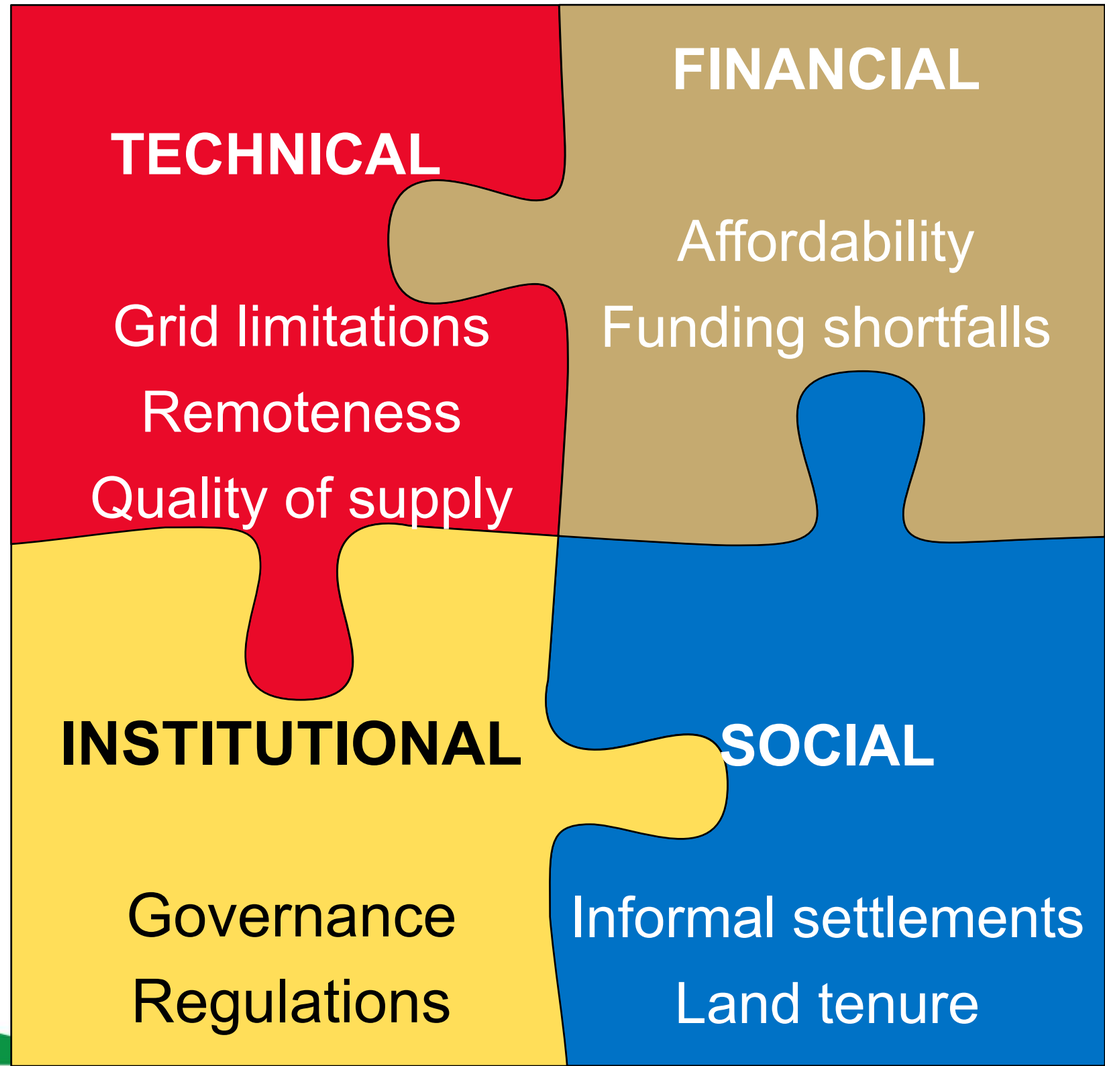
Supply instability impacts reliability and trust

Infrastructure Gaps:	Aging distrbution networks, grid congestion
Affordability:	High connection and usage costs in low-income areas
Informal Settlements:	Legal and technical barriers to formal connections
Institutional Capacity:	Weak municipal governance in many areas

Barriers to Access

Expanding electricity access is not only about generation — it's about removing barriers across four dimensions.

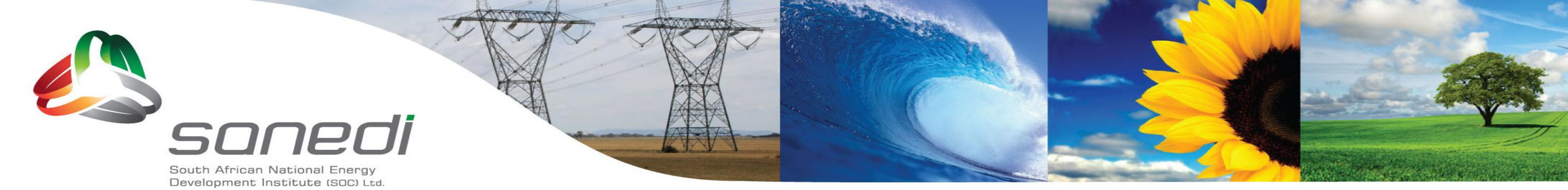
What's Blocking the Switch?



Financial: Affordability funding shortfalls

- High Upfront Costs: Connections, meters, and in-home wiring
- Affordability of Tariffs: For low-income households, even subsidised rates can be too high
- Funding Shortfalls: Insufficient public investment, high risk for private sector
- Currency & Credit Risk: Affects donor and investor confidence

LSM 1-3	LSM 4-6	LSM 7-8
Little to no disposable income. Most of these households rely on government grants and social support for their livelihoods.	This group is slightly better off but still has limited income.	These households generally have a stable income, often from formal employment.
Concentrated in rural areas and informal settlements.	They are more likely to be in urban informal settlements and peri-urban areas.	They are more likely to be in peri-urban areas.
Energy consumption is typically low, limited to basic lighting, cooking, and mobile phone charging.	Households in this segment may have access to basic appliances like refrigerators and televisions but still face significant constraints in terms of energy affordability.	Can afford higher energy consumption, including the use of larger appliances. While still price-sensitive, they are less vulnerable to tariff increases than the lower LSM categories.



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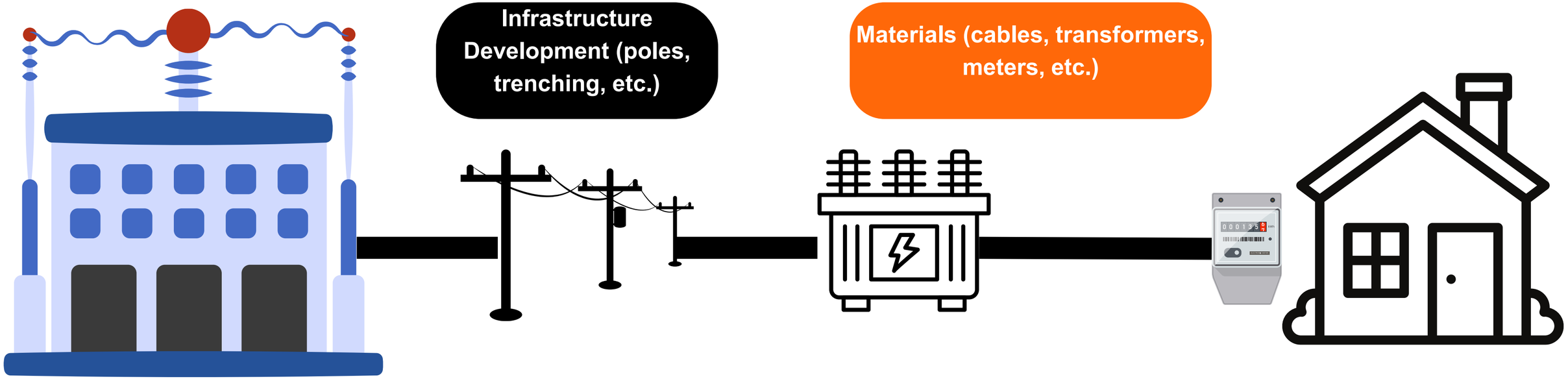
Technical: Grid limitations, remoteness, quality of supply

SUBSTATION

Infrastructure Development (poles, trenching, etc.)

Materials (cables, transformers, meters, etc.)



OTHER COSTS

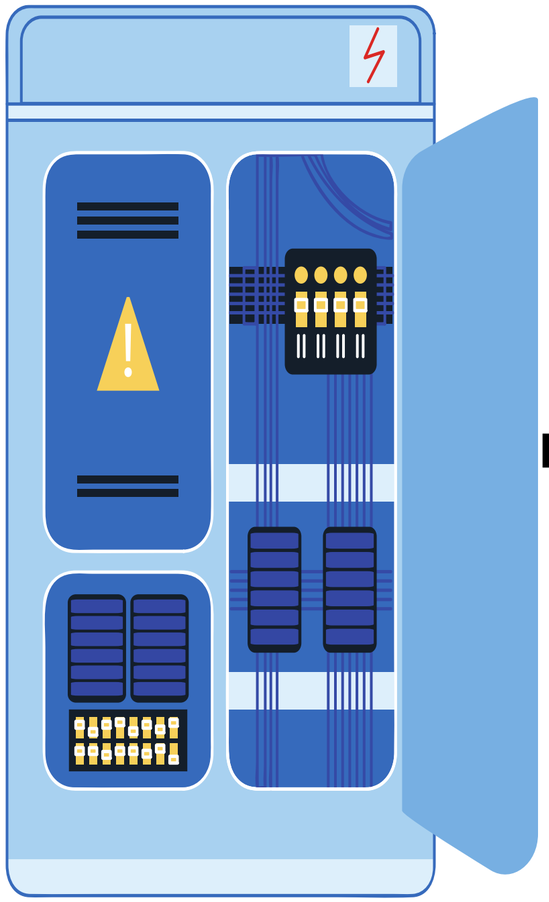
Logistics (transport, storage etc)

Administrative costs (permits, management)

Labour (engineers, contractors etc.)

Other costs (unforeseen circumstances)

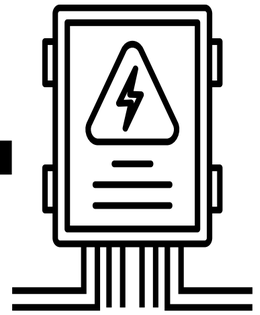
Shallow Electrification Costs

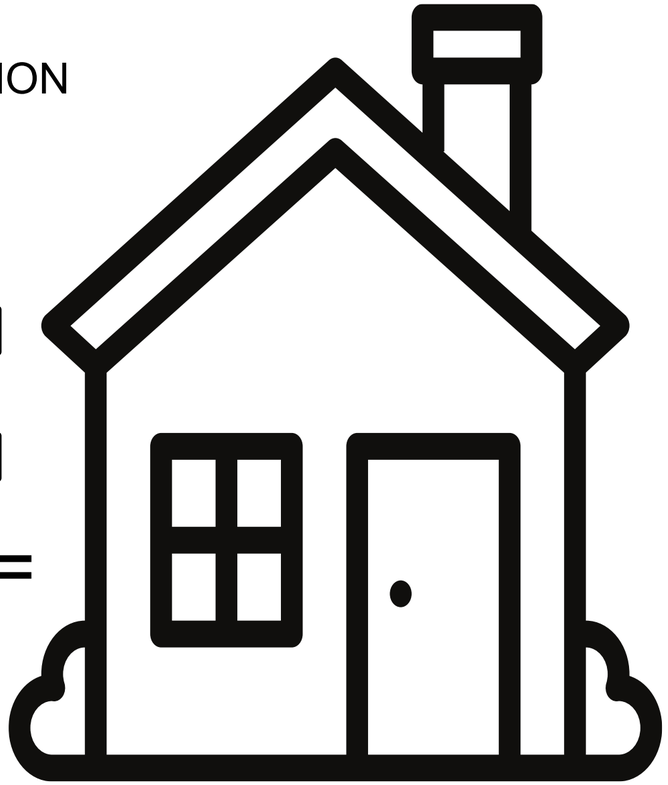


OUTDOOR KIOSK

16MM SQ. CABLE

DISTRIBUTION
BOARD



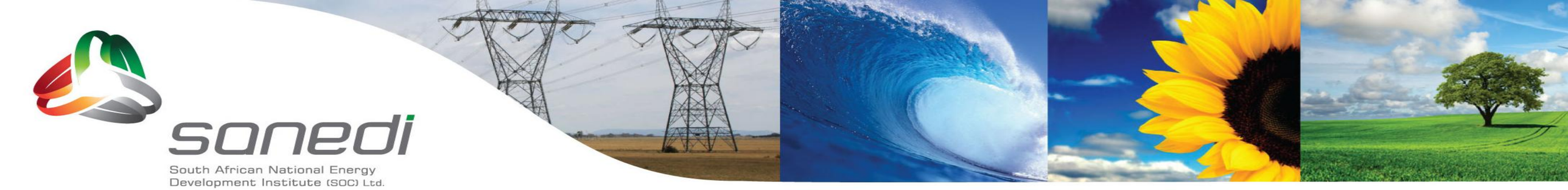


Institutional: Governance, regulatory bottlenecks

- Governance Issues
  - Inefficiencies, lack of coordination between stakeholders
- Regulatory Delays
  - Licensing for mini-grids, procurement of IPPs
- Weak Municipal Capacity
  - Poor planning and execution of electrification projects
- Policy Gaps
  - Disconnect between national goals and local implementation

Social: Informal settlements, land tenure

- Informal Settlements
  - Legal barriers to formal grid connections
- Lack of Community Engagement
  - Poor buy-in for energy solutions
- Low Energy Literacy
  - Limited understanding of costs and technologies



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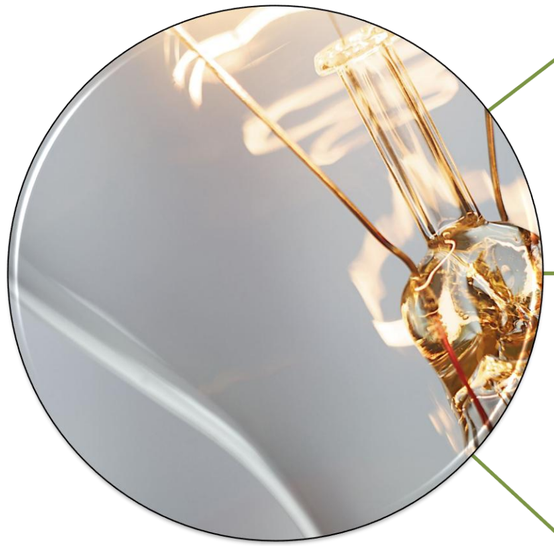
Technology Pathways for Access

Status Quo for Solar Technologies in South Africa



Policy

- Integrated Resource Plan
- South African Renewable Energy Masterplan
- Tax Incentives

Technology

- Currently no local manufacturing capacity
- BESS still expensive
- No competitive localisation potential

Society

- Energy security
- Decarbonisation
- Technology awareness & understanding
- Increased uptake recently

Unlocking Access through Technology

Electrification can be accelerated through a portfolio of technological approaches tailored to geography, demand, and affordability

Technology Options

Grid-Tied:

Suitable for urban and peri-urban areas with existing infrastructure

- Cost: Higher upfront cost but long-term sustainability and reliability
- Advantages: Supports high consumption and economic activity

Option 1:

Lowest Cost – FBE Services

- Provides basic electricity (lighting, refrigeration, phone charging, TV)
- Suitable for the most remote, low-income households
- Cost-efficient but limited in capacity

Option 2:

Medium Cost Solution

- Supports additional appliances (TV, small refrigerator)
- Targeted at semi-rural areas with moderate energy demand
- Higher cost but more comprehensive service

Option 3:

Full Solution

- Comparable to grid-tied access
- Full support for household appliances and greater energy demands
- Best for areas with potential for economic development

Decentralised Energy Solutions

Mini-Grids	10kW to 1MW systems supplying communities
Microgrids	Often smaller, serving clusters of homes or institutions
Hybrid Configurations	Solar + diesel + battery
Renewable Mini-Grids	Lower O&M, cleaner energy
Rationale and Methodology for Grid/Microgrid Selection	Selection Criteria Methodology: Decision-making based on life cycle cost analysis and community needs

Possible Rationale and Methodology for Grid/Microgrid Selection

Distance to Existing Grid Infrastructure

Prioritise grid extension areas within 10-15 km of existing infrastructure, cost per connection viable

Areas beyond 15 km, microgrid deployment more cost-effective.

1

2

Population Density

High population density (urban/peri-urban) focus on grid connections, extending grid more economic connecting large numbers

Low-density rural areas better suited to microgrid solutions

Geography and Terrain

Challenging geographic regions where grid extension prohibitively expensive prioritises microgrid solutions

Flat accessible regions more suitable for grid extension

3

4

Energy Demand

Higher energy demand (e.g. small business, schools, clinics) in rural areas justifies use of MG3 microgrids or grid extension

Low energy demand households, particularly indigent communities, MG1 microgrids

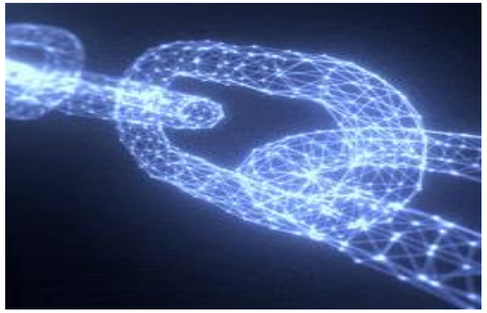
Cost per Connection

If cost per connection for grid extension exceeds a specific threshold (e.g. R70,000) microgrids should be deployed, offer more affordable alternative

5

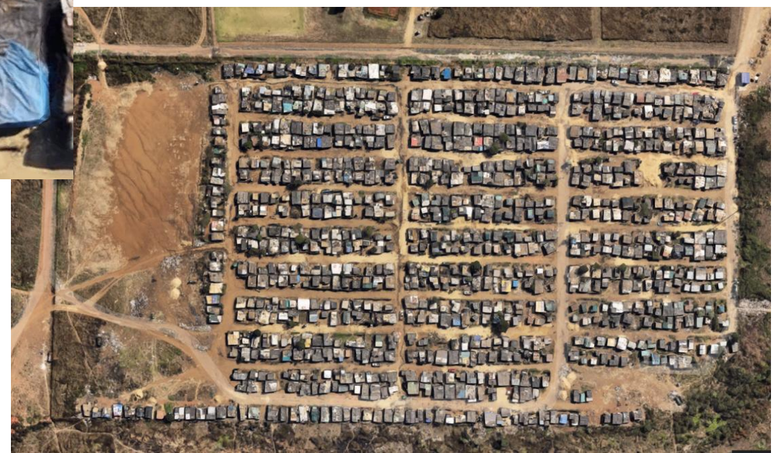
Digital Innovation Driving Access

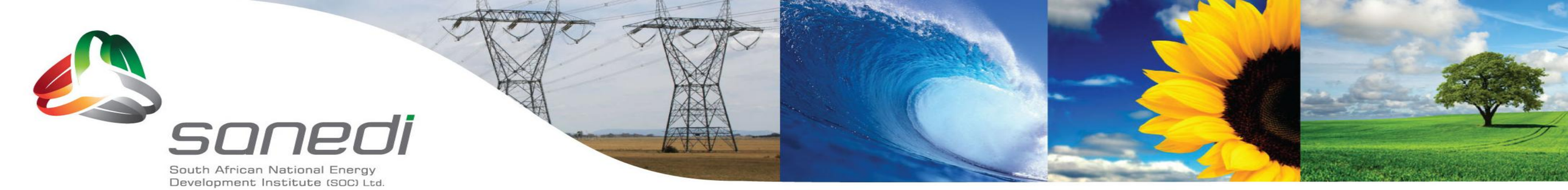
- AI: Forecasting demand, optimising dispatch in mini-grids
- IoT: Real-time monitoring of distributed assets
- Mobile PAYG Platforms: Enable scalable business models for SHS and mini-grids
- Remote Diagnostics & Predictive Maintenance



Policy and Financing Mechanisms

- Achieving universal access requires not only technology — but also robust policy frameworks and sustainable financing mechanisms.
- Community-driven and municipal-led initiatives
- Create new business models
- Create win-win tariffs





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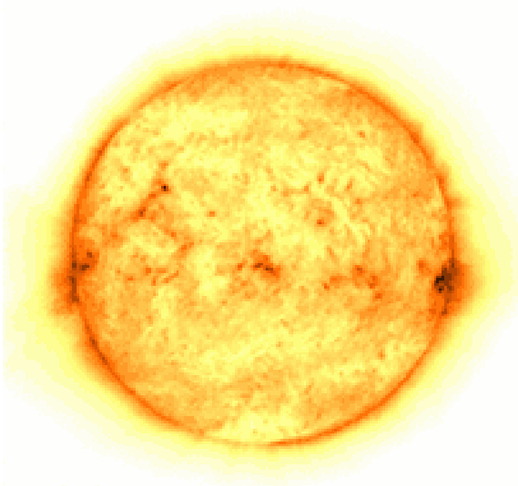
Strategic Framework for South Africa

97% access to affordable, reliable, sustainable electricity in line with SDG7 and the Just Energy Transition (JET)

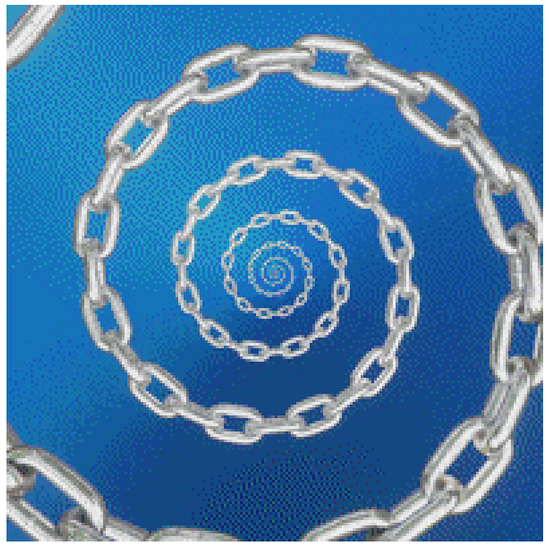
Integration with Just Energy Transition

- JET prioritises
  - Social equity
  - Job creation
  - Clean energy access
- Electrification must serve marginalised communities, especially in coal regions
- Distributed energy solutions (mini-grids, SHS) can support rural transformation
- Integration with green economy for inclusive development



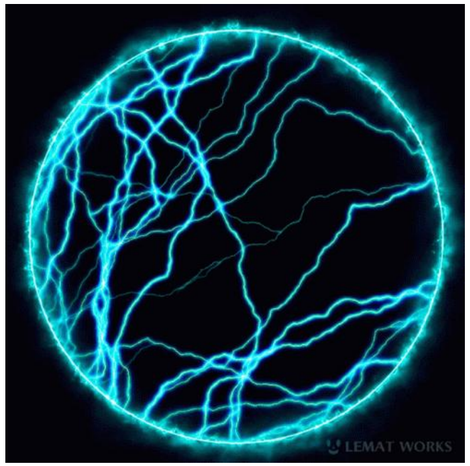
Collaborative Governance for Scale

- Municipalities
  - Last-mile delivery, informal settlement planning, community engagement
- Eskom
  - Bulk infrastructure, grid expansion, technical standards
- Independent Power Producers (IPPs)
- Key Need
  - Clear roles, coordination, and funding pathways across all levels



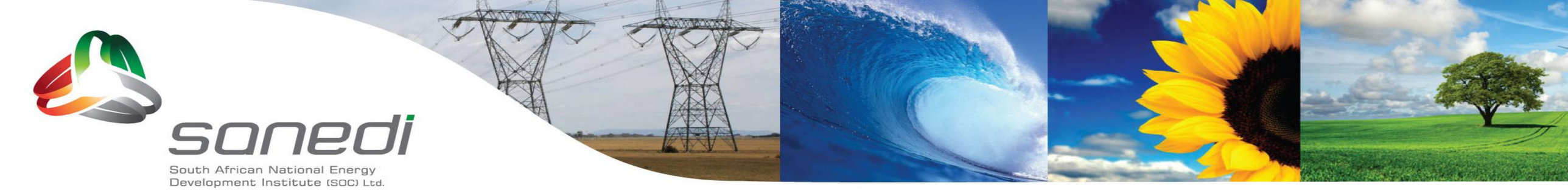
Empowering the Workforce of Electrification

- Shortage of skilled technicians, planners, and utility managers
- TVET Integration
  - Renewable energy, wiring, metering, microgrid O&M
- Higher Education
  - Planning tools, energy analytics, AI for energy
- Local job creation through community-based rollout and energy entrepreneurship
- Skills = Sustainability, quality delivery, and economic inclusion



Conclusion: What we've learned?

- Electricity access is foundational to economic development, health, education, and dignity
- Rural, informal, and marginalised communities still face major gaps
- Need to match technology with local context
- Policy, finance, and governance are as important as infrastructure
- Community involvement and innovation are critical for sustainability



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THANK YOU

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