Application of smart grid technologies and digitization in active distribution networks

ATSEDE GUALU ENDEGNANEW

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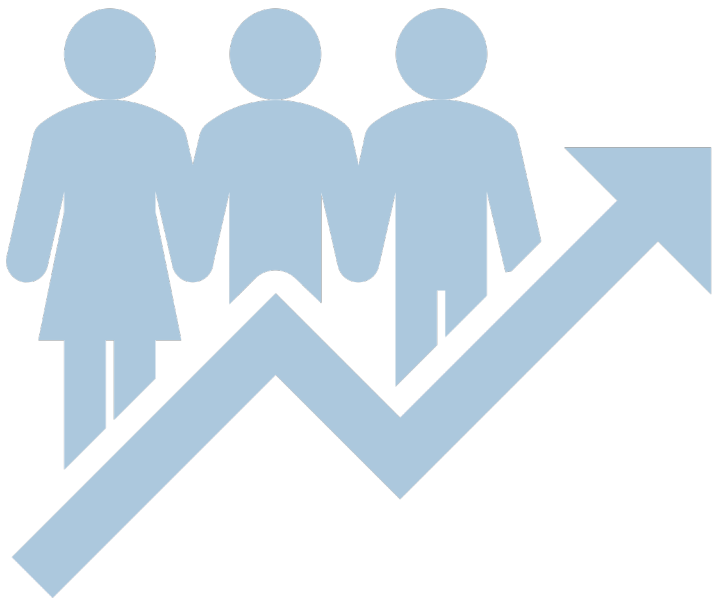
ADDIS ABABA, ETHIOPIA

Increase in electricity demand



1. Increase in number of consumers
   - Increase in access to electricity
   - Increase in population
2. Electrification of energy use
   - Increase in consumption per customer
3. Growth in industries, manufacturing, etc.

Current status

44% access rate

High losses

Aging infrastructure

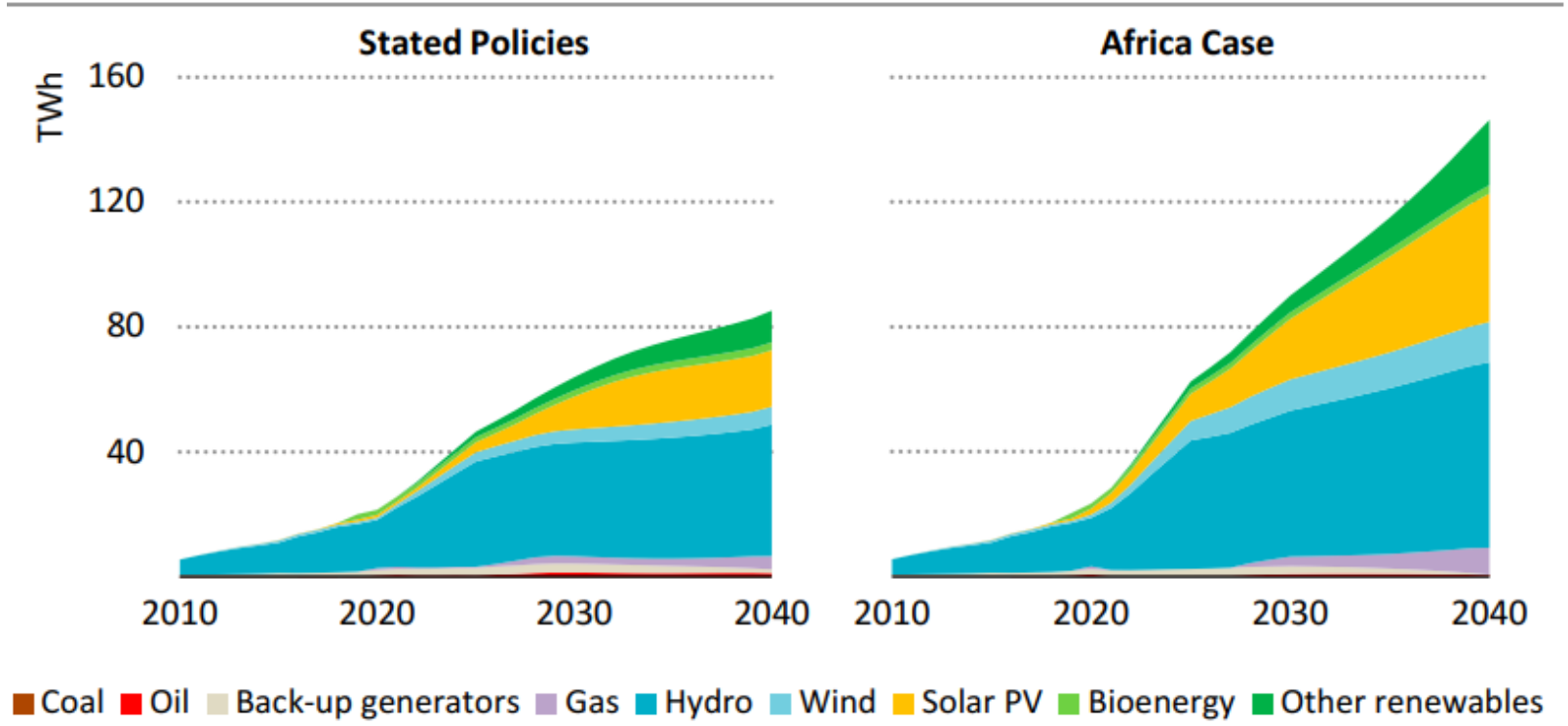
Low reliability

Electricity generation by technology

Multiple folds increase in capacity

≈100% renewable

- Hydro power dominates
- Significant share of solar and geothermal followed by wind



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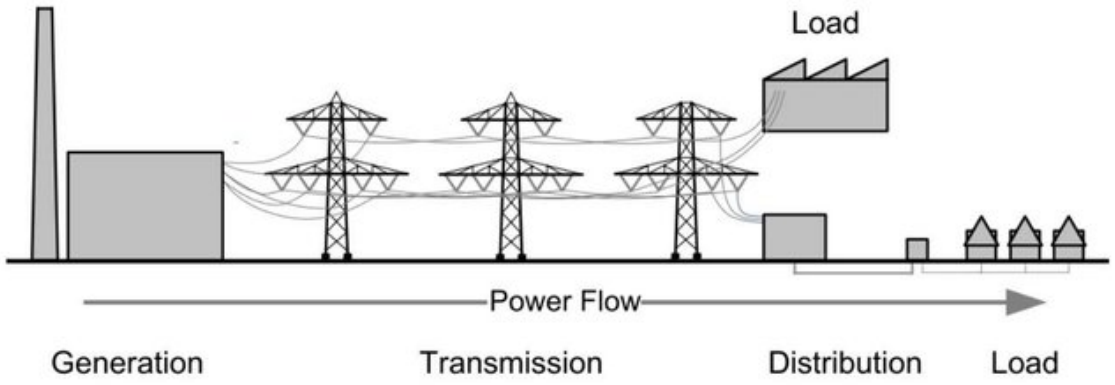
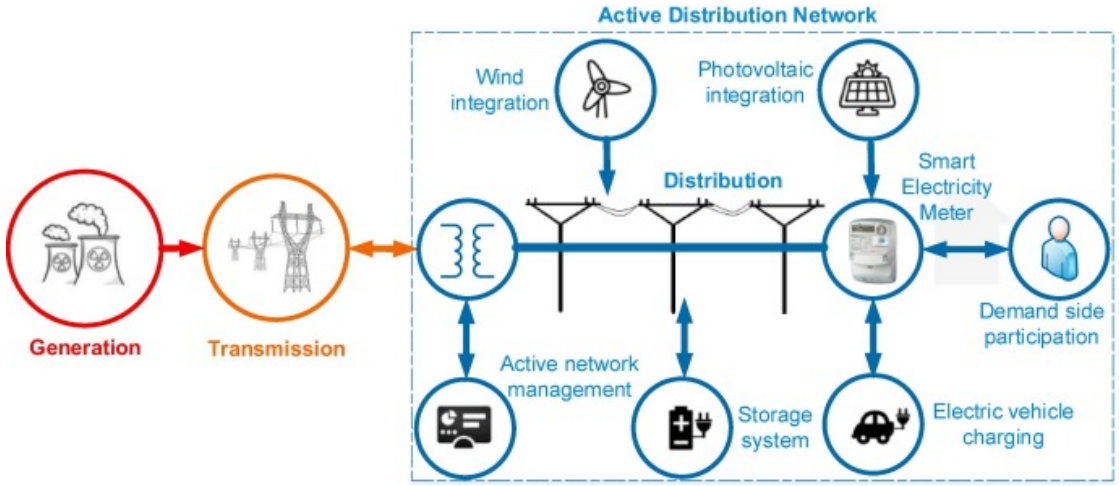
Passive vs Active distribution networks





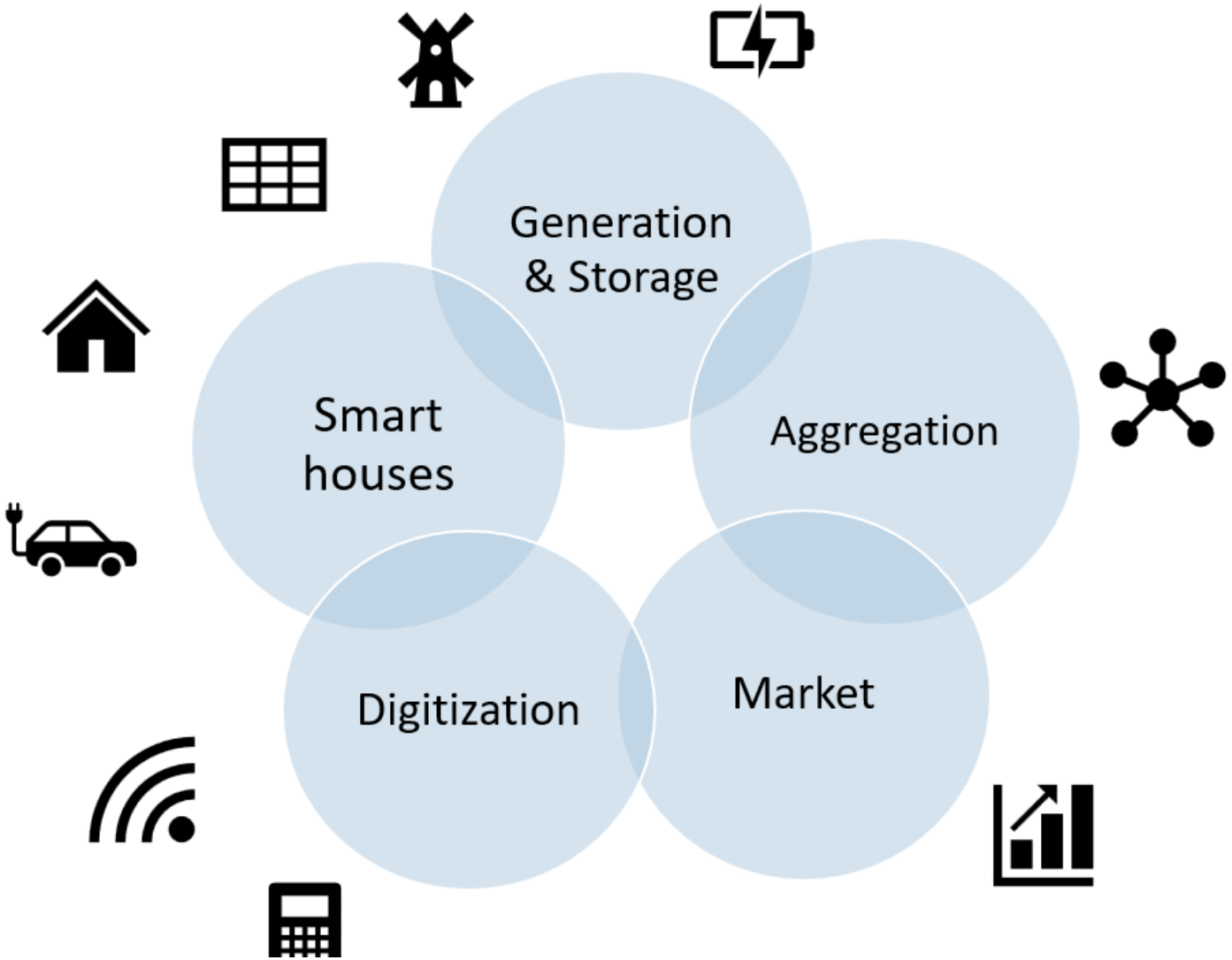
- Centralized bulk power generation
- Unidirectional power flow
- Limited to no control
- Passive consumers

- Distributed generation
- Reverse power flow
- Intelligent monitoring and control
- Active consumers and energy storage

Towards Active Distribution Networks

Diversification of the energy mix

Mini-grids will be absorbed by the interconnected grid



Increased complexity

Efficient operation

Multiple stakeholders

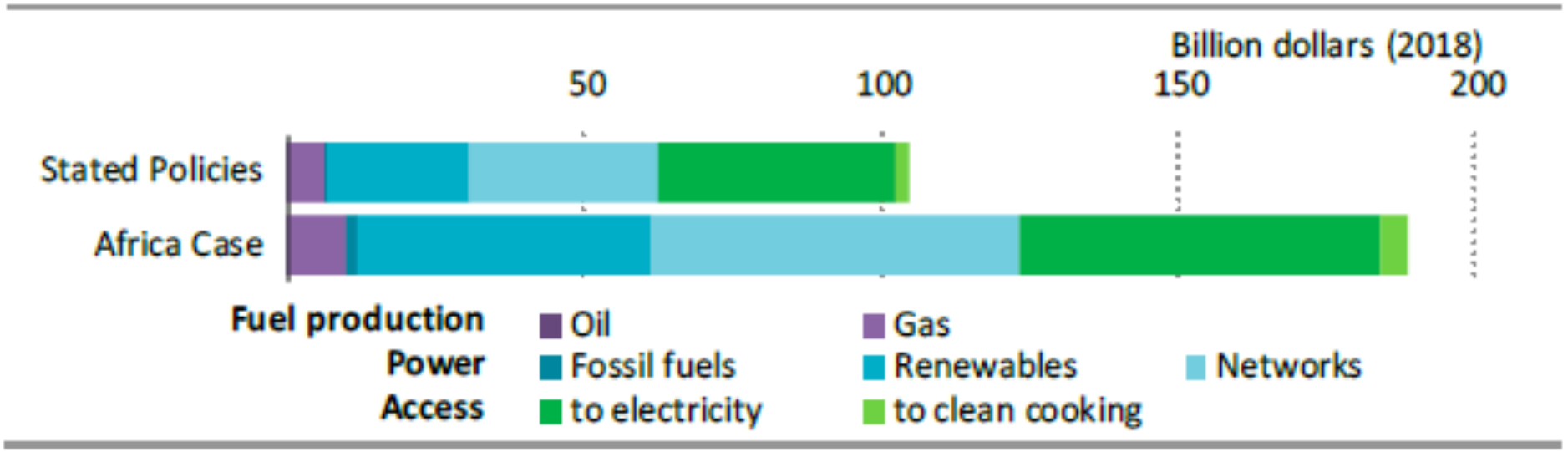
New market design

Flexibility

Cyber security

Huge investment needs

90 – 150 billion USD depending on the scenario



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Other measures

Policy/Regulatory

- Set up local energy market
- Open (non-sensitive) data policy for research and innovation
- Knowledge and capacity development

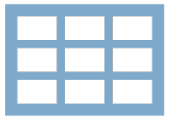
Planning

- Integration of variable generation
- Smart grid and digitization plan in parallel to universal access

Operation

- Active network management e.g. shifting from involuntary to incentivized load shading
- Coordinated voltage/reactive power control
- Network reconfiguration plan to minimize outage duration

Conclusion: Future distribution grid



Generation

Weather dependent & variable

Power electronic interface

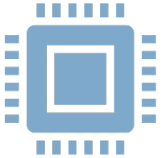
Digital control

Consumption

New load patterns

Prosumer

Power quality issues



Digitization

High bandwidth and high-speed communication

Real-time measurements

Digitized components

Cloud and artificial intelligence