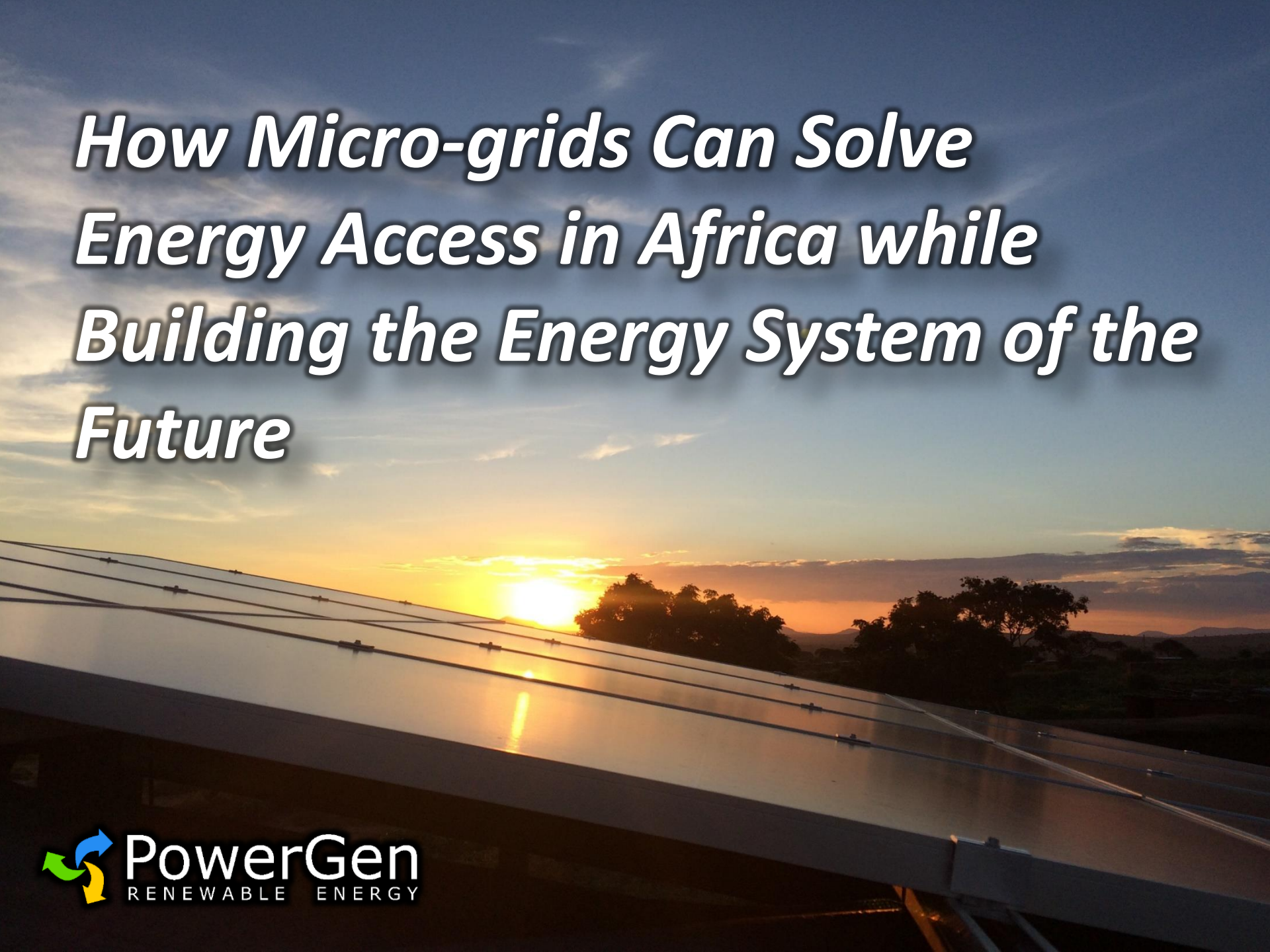

How Micro-grids Can Solve Energy Access in Africa while Building the Energy System of the Future
PowerGen
RENEWABLE ENERGY

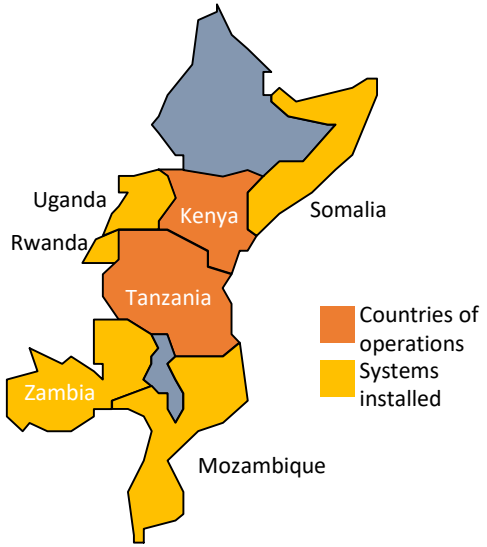
Excellence in green energy in East Africa for 5+ Years

PowerGen RENEWABLE ENERGY

Proven Track Record

- Founded in **2011**
- **100+** full-time employees with offices Nairobi, Kenya and Arusha, Tanzania
- Leading micro-grid installer in Africa, by grids installed (**>60**)
  - Connected **5,000+** homes and business
- **200+** renewable energy systems installed across **7 countries**

Country Experience

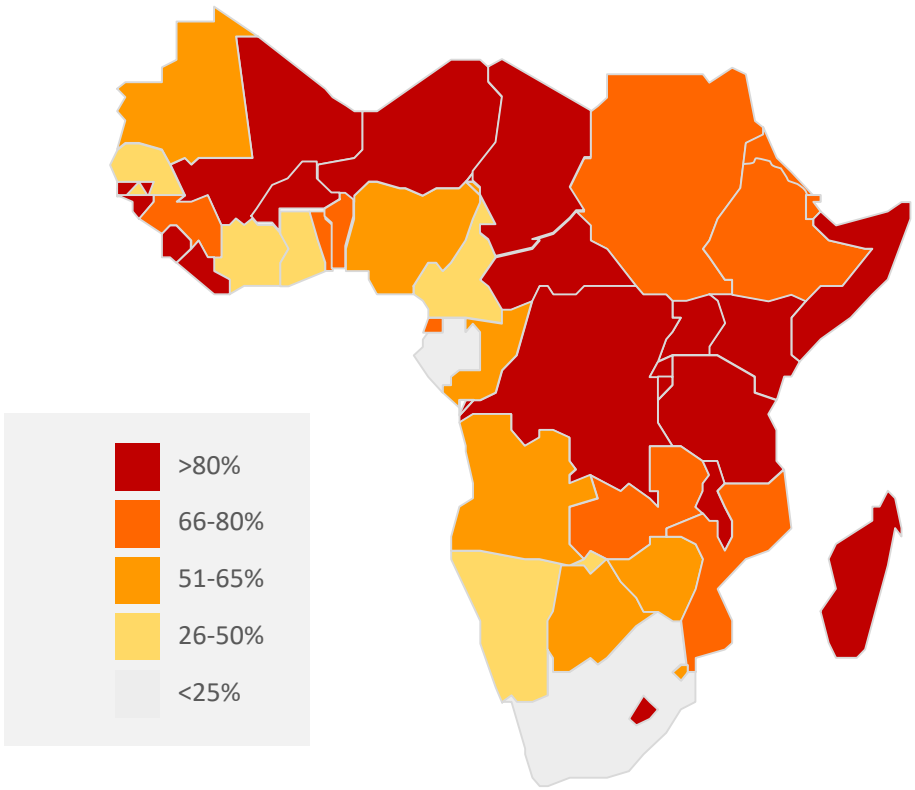


Awards and Recognition

TED · The Economist · AECF Funding Innovation for Business in Africa · The Challenge Cup 1776 · EEP Energy and Environment Partnership / Southern and East Africa · 6th Global Entrepreneurship Summit Nairobi 2015 · Power Africa A U.S. Government-led Partnership · Kenya Climate Innovation Center · This is Africa · Sankalp Forum An Intellecap Initiative

There is enormous potential for growth in the Sub-Saharan Africa electricity sector

% of Population Without Electricity



600M people without power = 100M connections

40% addressable by private utilities = **40M connections**

$4B – $7B

annual market opportunity

Source: McKinsey & Company and World Bank.

Africa has two major problems in energy it needs to solve over the coming decades

1. Bring high-quality **energy access** to the **500m+** people in Africa who do not yet have electricity

2. Build the **future energy system** in Africa **now**, to avoid upgrading African power infrastructure in the coming decades as the global energy system evolves

How will these two challenges be solved?

1 Energy access to 500m+ people

2 Future energy system

- **Focus on convergence** – Africa must build the future energy system that converges on the system that is evolving in developed markets
- **Grids will be important** – fully autonomous solutions won't be able to deliver sufficient energy and low enough cost
- **Embrace new technologies** – Africa must be integrating future grid technologies (distributed storage, generation, smart metering) into its power infrastructure now, to avoid expensive retrofits later
- **Increased emphasis on the customer experience** – just as developed country utilities are becoming more customer-centric, so must African energy providers
- **Access to concessional financing** – rural energy access has always required public support, and Africa should be no different or we risk punishing the most vulnerable populations
- **Organizations which can implement at scale** – with 500m people to connect, operational scale will be critical
- **Cost reductions** – utility companies must find ways to reduce capital and operating costs

Who is equipped to play this role in the African market?

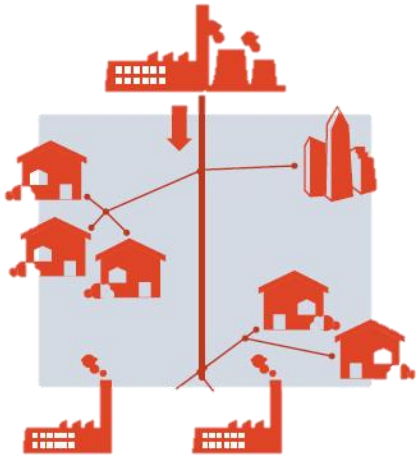
There are essentially three options:

Unlikely to be able to provide enough power cheap enough for development, or converge with the future global energy system

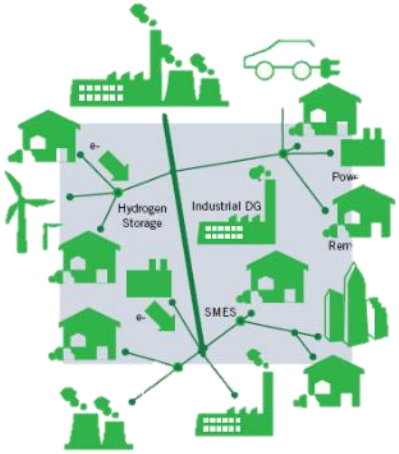
	Public Utilities	Private Utilities	SHS Companies
Focus on convergence	✓	✓✓	
Grids will be important	✓✓	✓✓	
Embrace new technologies		✓✓	✓✓
Increased emphasis on the customer		✓✓	✓✓
Concessional financing	✓✓	Key challenge to resolve	
Implementation at scale	✓✓	Not yet	✓
Cost reductions		✓✓	N/A (non-grid)

Unlikely to be sufficiently innovative or capital efficient

What does the future power system look like?



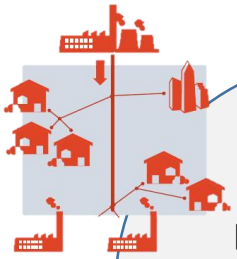
Mono-directional	→	**Multi-directional**
Centralized	→	**Decentralized**
Analog	→	**Digital**
Carbon-based	→	**Decarbonized**
Infrastructure-centric	→	**Consumer-centric**



Technologies Driving this Transition

- Smart Metering & Controls
- Rooftop Solar
- Low-cost Energy Storage
- Electric Vehicles
- Micro-Inverters
- Blockchain

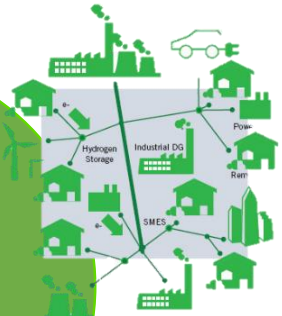
Critical for Africa's power systems to converge on the **future** of the global grid, not the old/current model



Existing Grid Architecture in the West

- Smart Metering
- Distributed Generation
- Distributed Storage
- More Renewables
- Deregulation

Future State of Global Power System



Bad!
(gov't, donor, DFI risk)

Good!

Africa's Power System

Bad!
(SHS sector risk)

Parallel African System, Unique from the Rest of the World

Micro-grids are becoming the “building block” of this future architecture

FINANCIAL TIMES

‘Mini-grid’ household energy sharing begins to take off

Network of 20,000 German homes selling to each other shows new distribution model

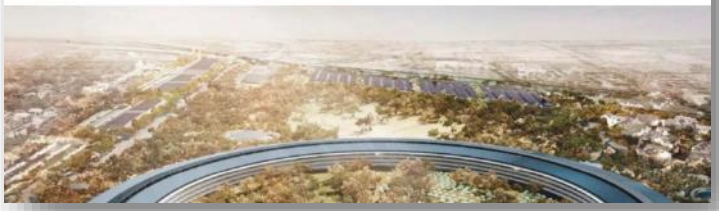
Harvard Business Review

TECHNOLOGY

How Utilities Are Using Blockchain to Modernize the Grid

Apple has just become an energy company, looks to sell excess electricity into the grid and maybe more

Seth Weintraub - Jun. 9th 2016 8:18 am PT @illsethj



SIEMENS

Smart energy supply for the University Campus of Savona

University of Genoa, Italy

Illinois Project Opens the Door for Non-Utility-Owned Microgrids

Statement from EDF’s Christie Hicks and CUB’s David Kolata

February 28, 2018

The Illinois Commerce Commission (ICC) today approved Commonwealth Edison’s (ComEd) $25-million microgrid project and agreement to create a first-of-its-kind tariff, which will give non-utilities the opportunity to use ComEd’s existing wires to develop microgrids.

Media contact

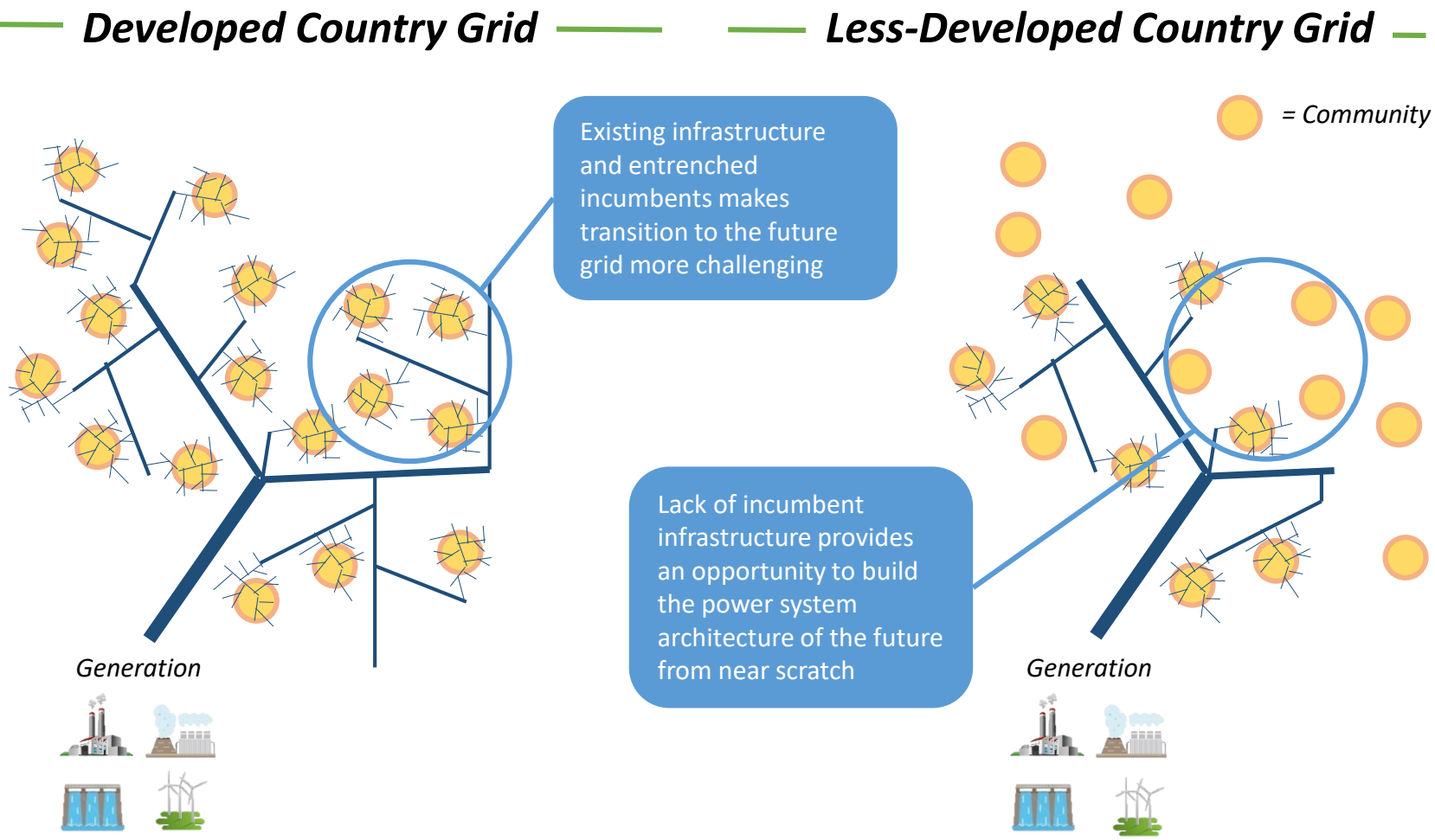
Catherine Ittner
(512) 691-3458
Contact

MIT Technology Review

Blockchain Is Helping to Build a New Kind of Energy Grid

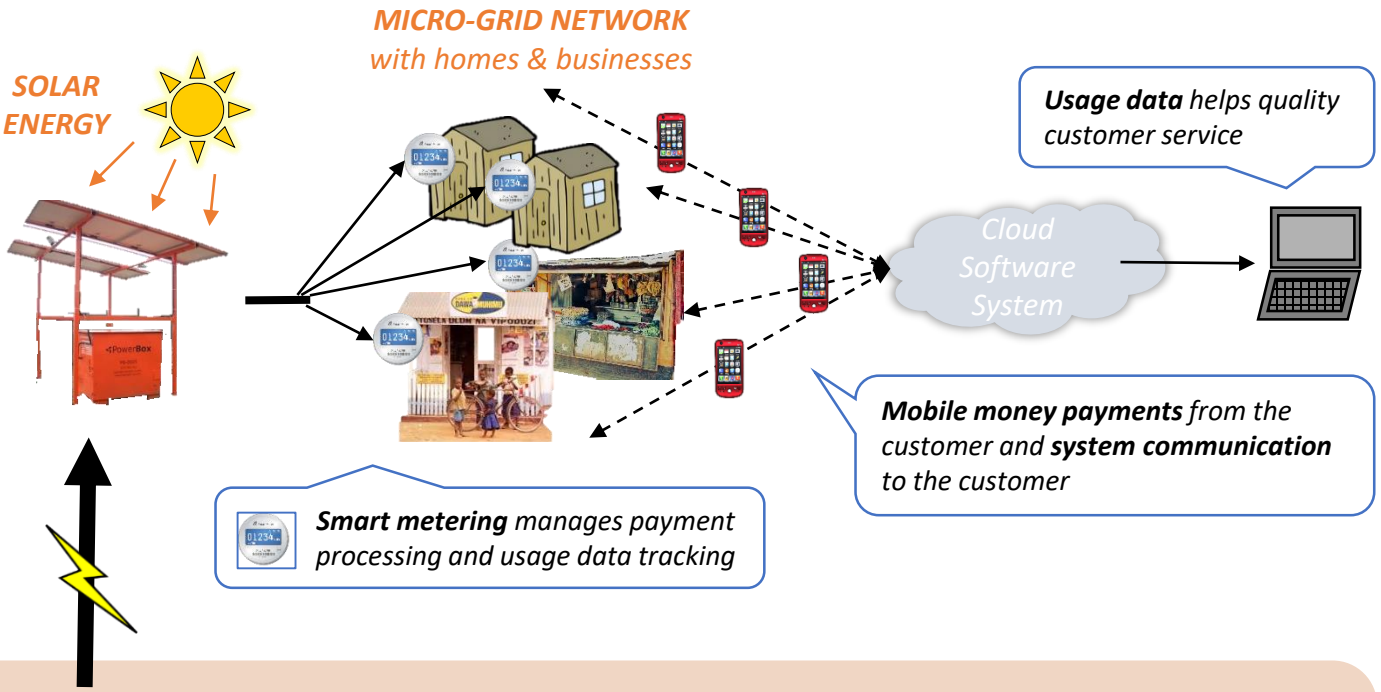
Using the technology behind Bitcoin, participants in the Brooklyn Microgrid are buying and selling locally generated renewable energy over a peer-to-peer network.

Micro-grids build the energy system of the future from the grid edge in

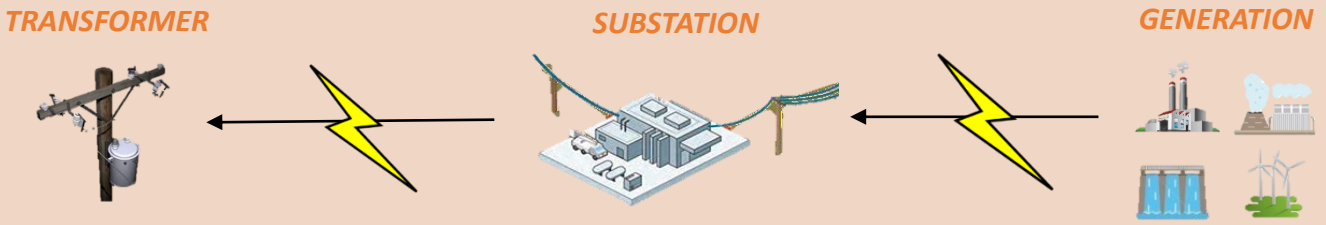


Micro-grids address energy access with modern clean energy - faster and more reliably than grid extensions

Step 1:
Autonomous Solar Micro-Grid



Step 2:
Grid-Connected Solar Micro-Grid



But Public Utilities still have some key advantages over Private Utilities which must be addressed if Private Utilities are to achieve scale

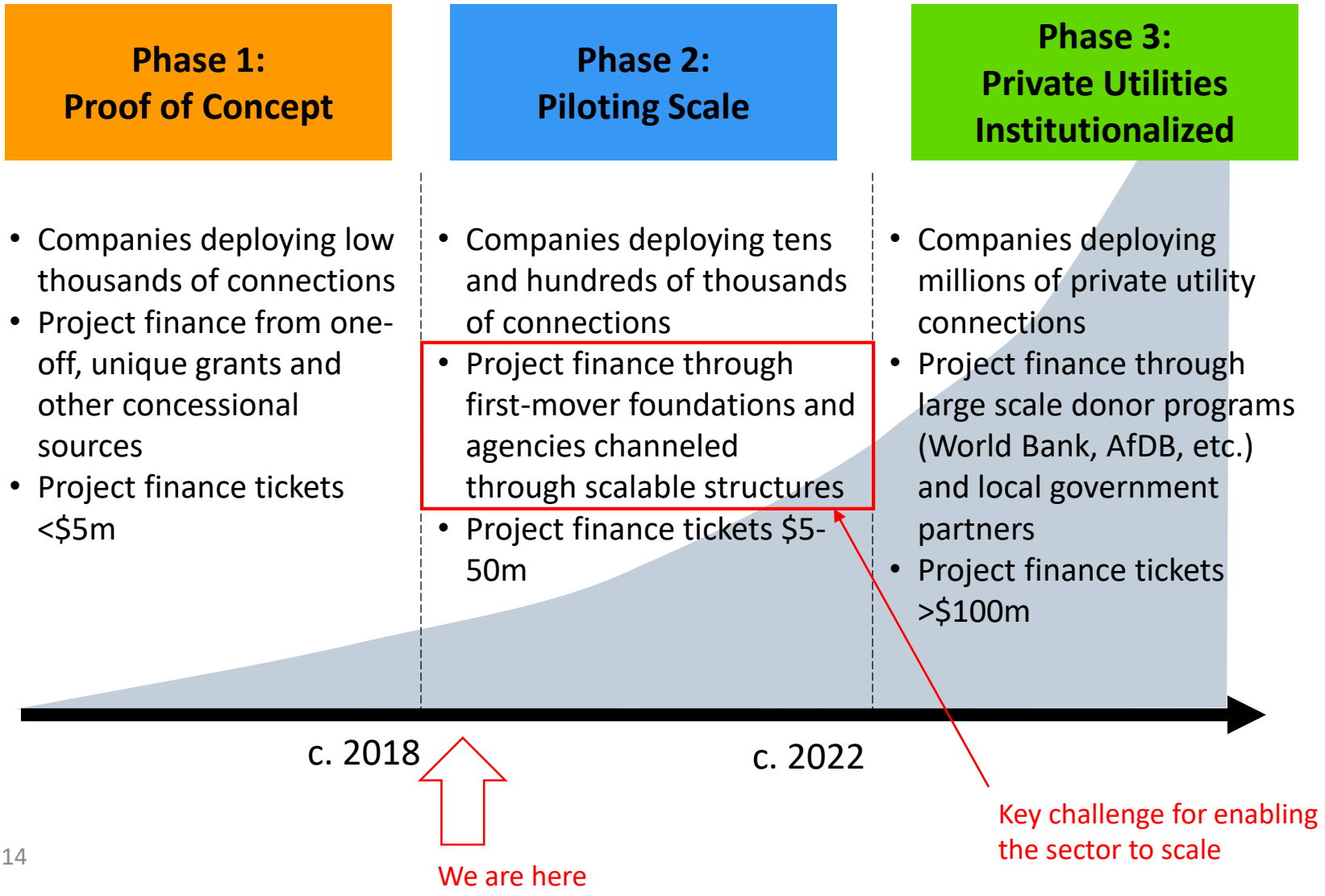
Public Utilities	Private Utilities
1. Able to obtain **subsidized capital** through relationship with local governments and the sovereign grants and debt they receive from donors-lenders like the World Bank 2. In most countries, already have meaningful **scale**	1. More **capital efficient** than public utilities, can deliver the same level of energy access for less cost 2. Focus on **customer** experience, reliability, and service 3. Serve as a conduit for channeling **future grid technologies** into the market

The optimal path forward: a vibrant private utility sector which can advance energy access and the future grid, while provoking improvement from public utilities

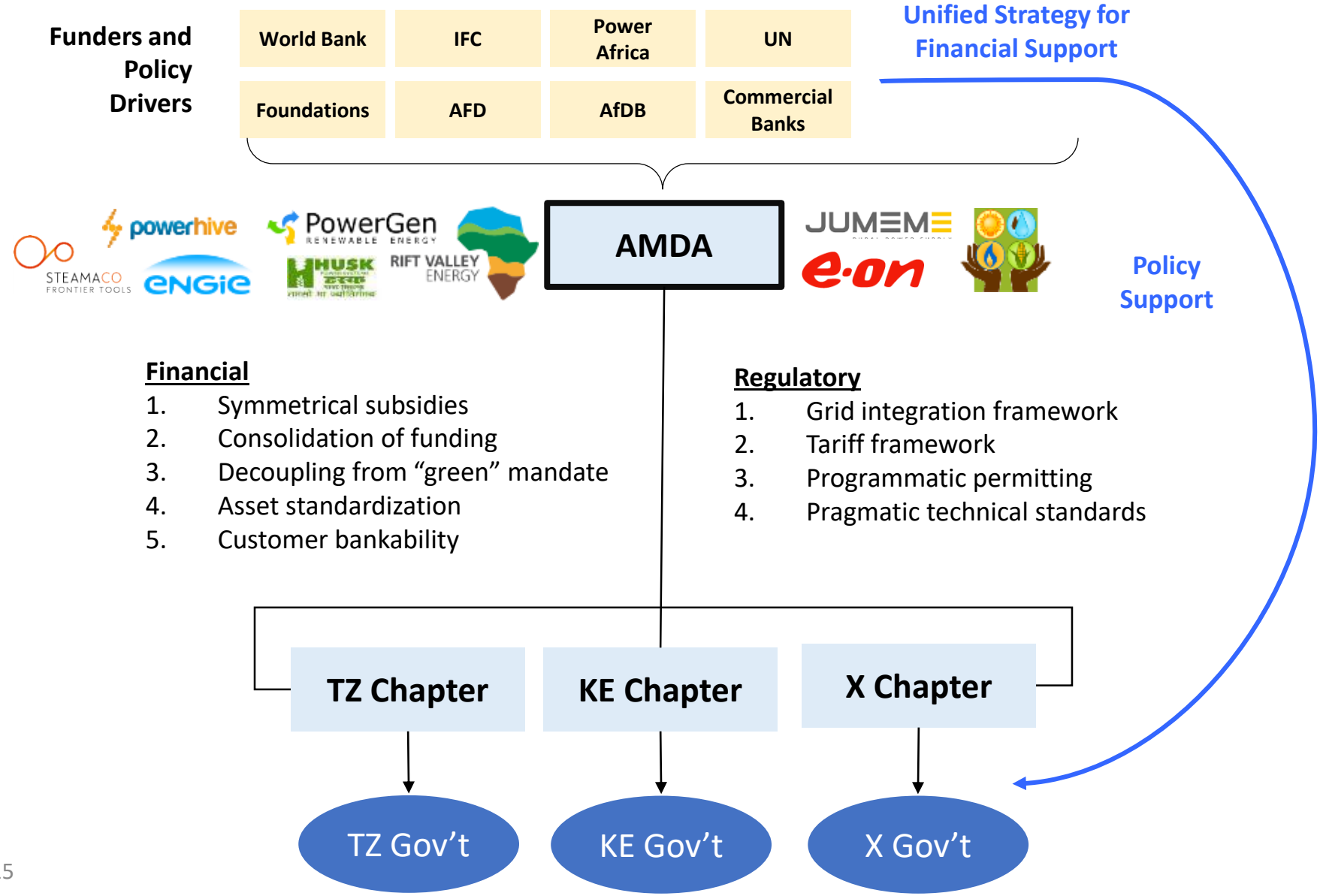
This will be achieved by Private Utilities absorbing the advantages which the Public Utilities current have:

Public Utilities	Private Utilities
1. Able to obtain **subsidized capital** through relationship with local governments and the sovereign grants and debt they receive from donors-lenders like the World Bank	1. More **capital efficient** than public utilities, can deliver the same level of energy access for less cost
2. In most countries, already have meaningful **scale**	2. Focus on **customer** experience, reliability, and service
	3. Serve as a conduit for channeling **future grid technologies** into the market
	4. Access to **subsidized capital**
	5. Growing to **scale**

Access to concessional capital and achieving scale in the private utility sector will occur through 3 phases



PowerGen leads Africa Mini-grid Developers Association (AMDA)



Building the future grid in Africa with micro-grids is in everyone's interest

All stakeholders win

Good for:

Governments	Achieve electrification targets and prepare their countries for future power investment
National Utilities & Regulators	Sell more power (because more people are connected) and better manage overall grid performance
Consumers	Obtain access to electricity faster, and enjoy better reliability and service from that power supply
Environment	Improves due to ability to utilize more renewable energy sources on the "mesh" grid of the future
Donors & Lenders	Leverage their investments further by bringing private capital into the utility sector in Africa


THANK YOU!
PowerGen
RENEWABLE ENERGY