

# Innovative Microgrid Business Models

Electrifying Underserved Nigerian Communities  
Using Distributed Energy Resources

*HOMER International Microgrid Conference*

14 October 2020





# Overview

- Microgrid or minigrid? For now, let's use those words interchangeably.
- **Minigrids in Nigeria have a lot of momentum**, particularly in rural off-grid locations, with dozens of operational projects and a large funding pipeline.
- There is an untapped opportunity to use minigrids and other distributed energy resources (DERs) to improve service to an **enormous market of underserved customers** currently connected to the bulk grid (nominally).
- **Innovative business models are the key** to unlocking this market, integrating utility, developer, and community interests to create an economic 'win-win-win'.
- In Nigeria alone, the '**undergrid' minigrid model could create a \$1 billion/year market**, reduce capital costs 12–30% through shared distribution infrastructure, save customers \$0.15/kWh, and reduce distribution utility losses 60–100%.
- Stakeholders across sub-Saharan Africa are exploring alternative approaches, and a **new pilot project in Mokoloki** demonstrates the undergrid model.

# AGENDA

1. Background on Nigeria
2. Existing Initiatives: Mokoloki Pilot & Others
3. Business Case for Undergrid Minigrid Approach
4. Implementable Business Model Options
5. Next Steps



# Rocky Mountain Institute (RMI) transforms energy systems to create a clean, prosperous, and secure low-carbon future

- **Impartial NGO** grounded in technical and economic analysis with a whole-systems approach and focus on market-based solutions
- **Staff of 200+** scientists, engineers, and business, and policy leaders
- **Global operations** collaborating with governments, development partners, utilities, and the private sector – including the US, China, India, sub-Saharan Africa, and the Caribbean
- **38-year history** of transforming energy systems to increase efficiency, sustainability, and resilience (electricity, buildings, transportation, industry)
- **Africa Energy Program** drives **affordable, efficient, and resilient** energy systems that incorporate emerging distributed energy resources to **rapidly provide energy access and increase economic development**



RMI's Africa Energy Program receives generous programmatic support from:



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# Nigeria's rural electricity customers, who compose nearly half of all consumers, are significantly un- and under-served

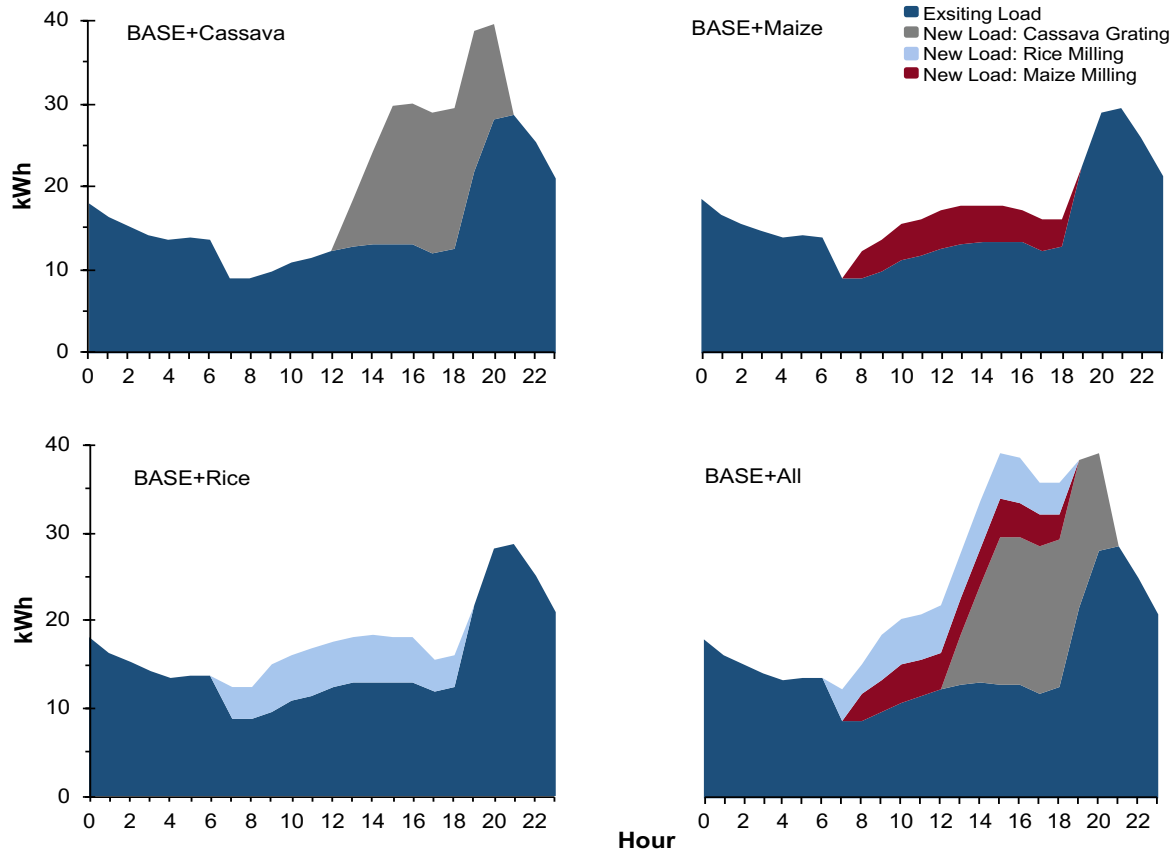
- **41% of rural customers are connected** to the main grid, but they often lack access to reliable service
- Nearly all rural customers rely on non-grid alternatives to meet basic energy needs, often **spending \$0.60/kWh or more**
- **Options to improve electricity service** include:
  - Grid extension/improvement
  - Minigrids
  - Solar home systems
  - Diesel/petrol gensets
- Rural connections **may not be best served by the traditional grid** due to remoteness and low consumption levels
- Utilities typically losing money for every kWh they provide in rural underserved communities due to high ATC&C losses



*Customers today rely on expensive generators to power their businesses and homes*

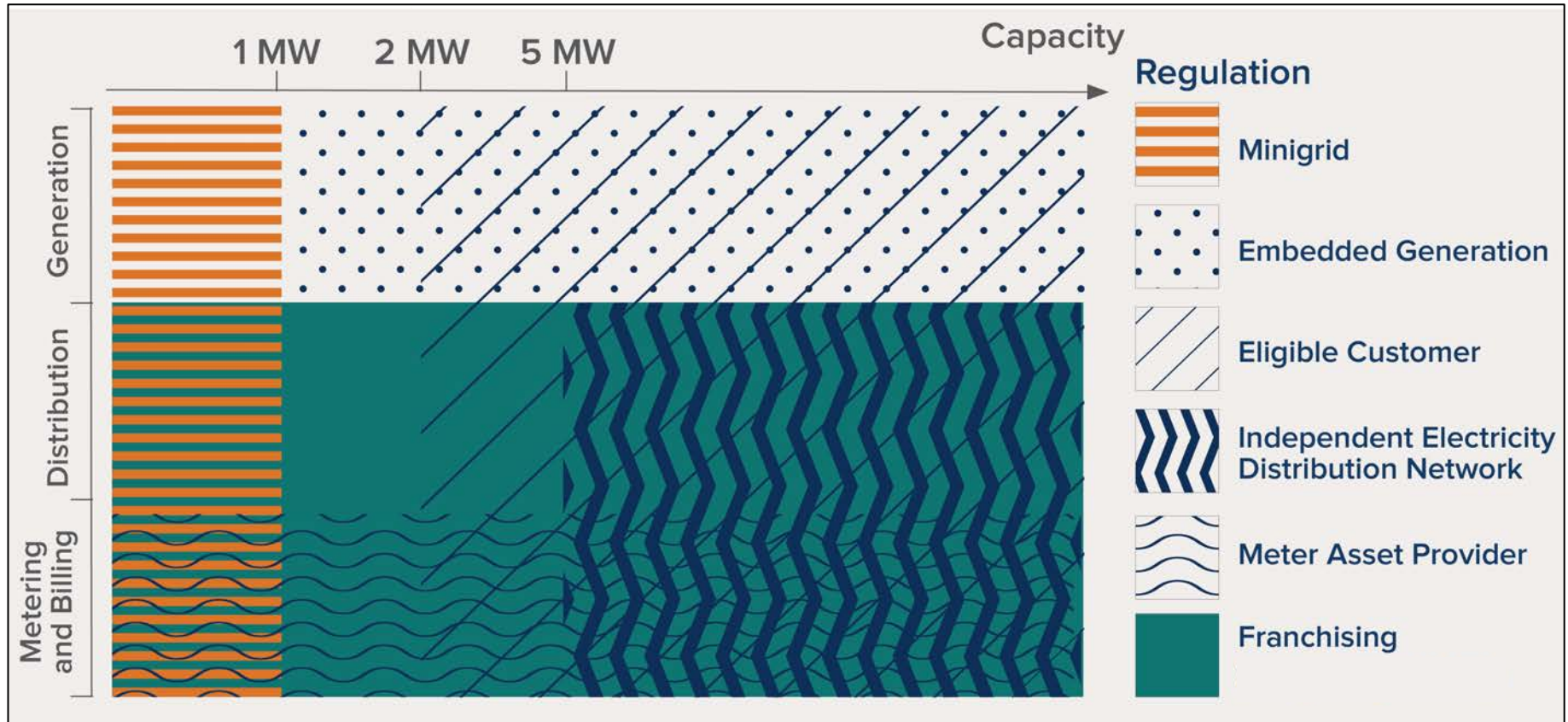
# Unreliable power is a primary barrier to electrifying productive uses, like agroprocessing, limiting economic growth

## Potential Increase in Community Load by Electrifying Priority Agroprocessing Activities



*In grid-served communities, fee-for-service processors prefer electric mills but must often pause milling for days when power is out.*

# Nigeria has an enabling environment that allows for alternative DER-driven solutions, including several regulations





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# Recognizing this need and business opportunity, a number of initiatives are underway to test new solutions

*\* Examples—not comprehensive!*

## Distributed Energy Solutions for AEDC (DESSA) - Nigeria



## Interconnected Minigrid Acceleration Scheme - Nigeria



## Mokoloki Undergrid Minigrid - Nigeria



## Utility 2.0 Initiative - Uganda



## Utility of the Future Franchising - Nigeria



## Wuse Market Interconnected Minigrid - Nigeria



# The solar hybrid project in Mokoloki, Ogun State, is Nigeria's first rural commercial undergrid minigrid



- Project **online in February 2020**, 99.9% reliability since commissioning.
- **Innovative partnership** between Ibadan Electricity Distribution Company, Nayo Tech, and the Mokoloki community—with advisory support from RMI.
- Demonstrates successful collaboration on a **new DER business model**, facilitated by the incumbent utility.
- **Modular design approach** installed 100 kW solar PV, 192 kWh battery, and 88 kW diesel backup to start, with **planned expansion** as load grows.

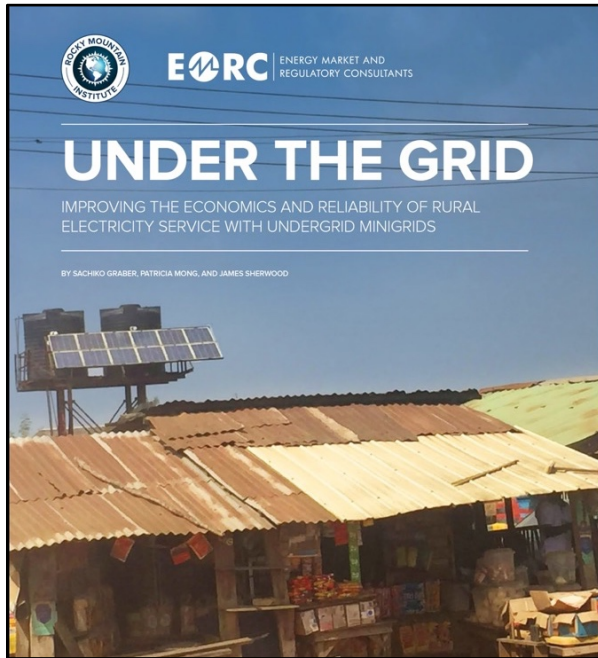


The video linked below provides perspective into the community and individual customer experiences

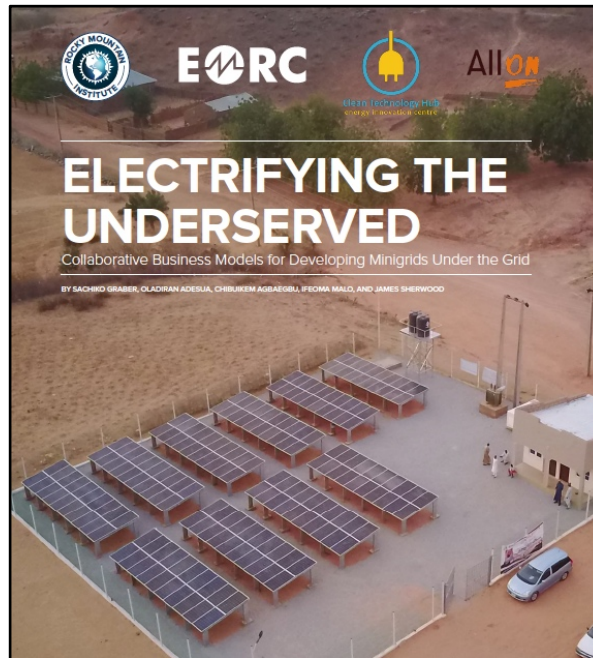


[rmi.org/mokoloki](https://rmi.org/mokoloki)

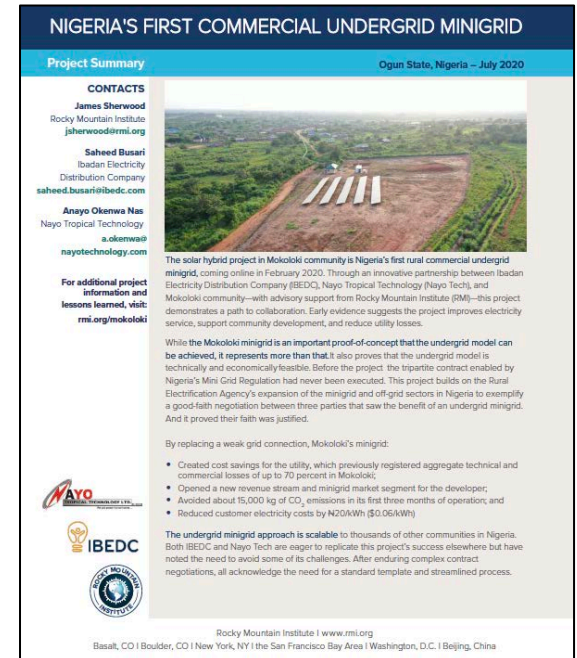
# Several resources are available for more details on undergrid minigrids in Nigeria



**Under the Grid**  
Economics of  
undergrid minigrids



**Electrifying the Underserved**  
Undergrid business models



**Mokoloki Summary**  
Details of the Mokoloki  
undergrid minigrid

Downloadable at: [rmi.org/mokoloki](http://rmi.org/mokoloki)



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# Minigrids are an option to provide better electricity service to underserved communities

## Create a 'win-win-win'

1. Reduce utility losses and demonstrate a model for sub-franchising of utility responsibilities
2. Provide reliable, affordable electricity to undergrid communities
3. Open a new market for minigrid developers to scale and reduce cost

## Definitions

- ***Isolated minigrids*** serve off-grid communities without existing distribution infrastructure
- ***Undergrid and interconnected minigrids*** will serve underserved areas in utility territory, with existing grid infrastructure but unreliable or no service
- The minigrid can serve the community as an **island**, or connect to the grid for **one- or two-way power flow**

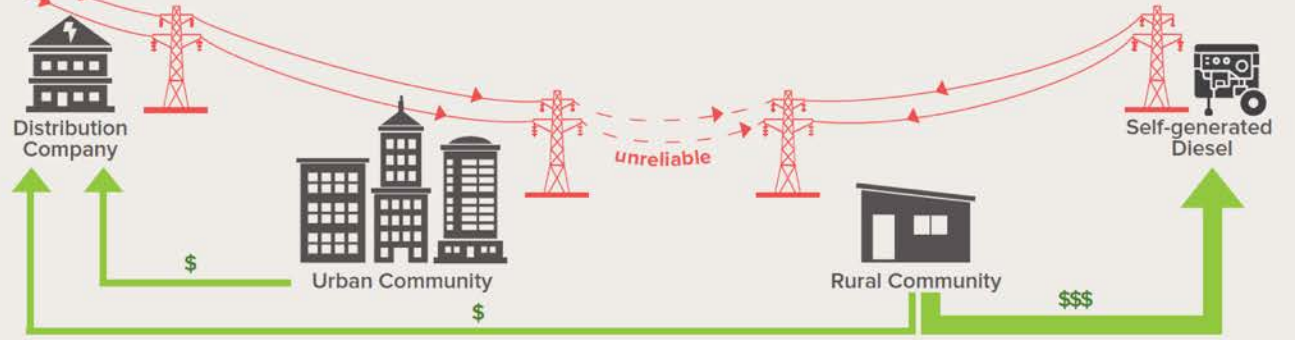
# Undergrid minigrids can help improve a utility's financial situation in rural and peri-urban communities

- Undergrid minigrids can help distribution utilities reduce financial losses by **transferring the collections responsibility** (and risk) to a third party
- Enable independent minigrid operator to charge a **cost-reflective tariff** and **install metering** solutions to minimize collections losses
- Nigeria's minigrid regulations allow utilities to **collect a usage fee** for sharing distribution infrastructure with the minigrid
- Provide a **finite-duration bridge** (e.g., 10 years) to transfer service, allowing the utility to **focus on improving service to other areas** of their network while resuming service at the end of the contract



# TODAY

👎 Rural users pay up to 10x grid costs for power



# PROPOSED

👍 Rural community saves money  
👍 Consistent, reliable, power




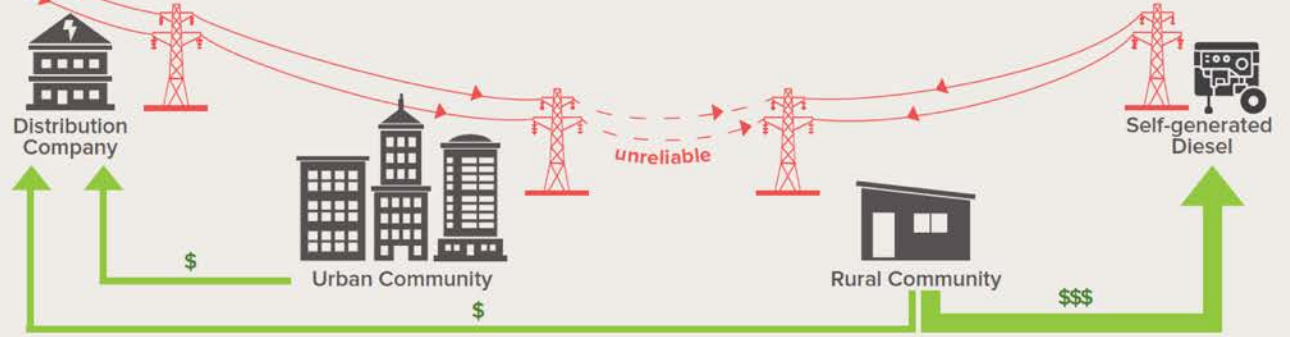
# LONG TERM

👍 Additional cost savings  
👍 Minigrd becomes distributed resource supporting grid



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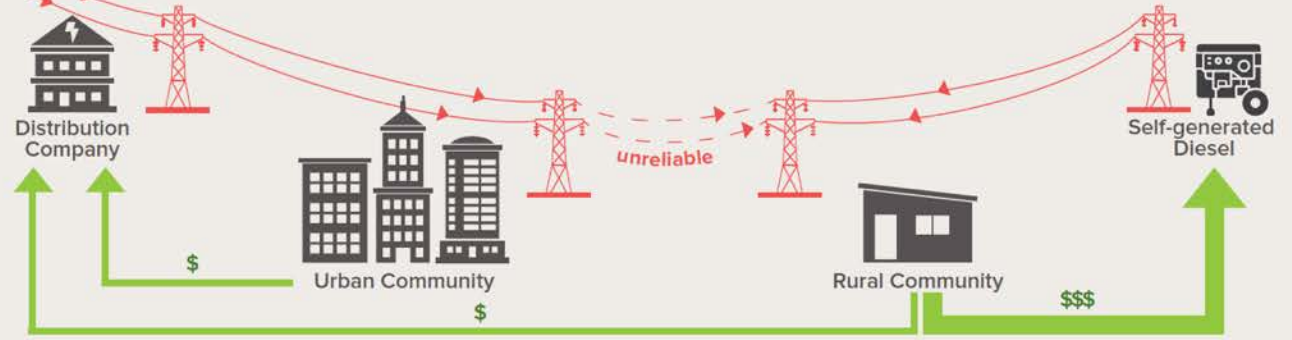
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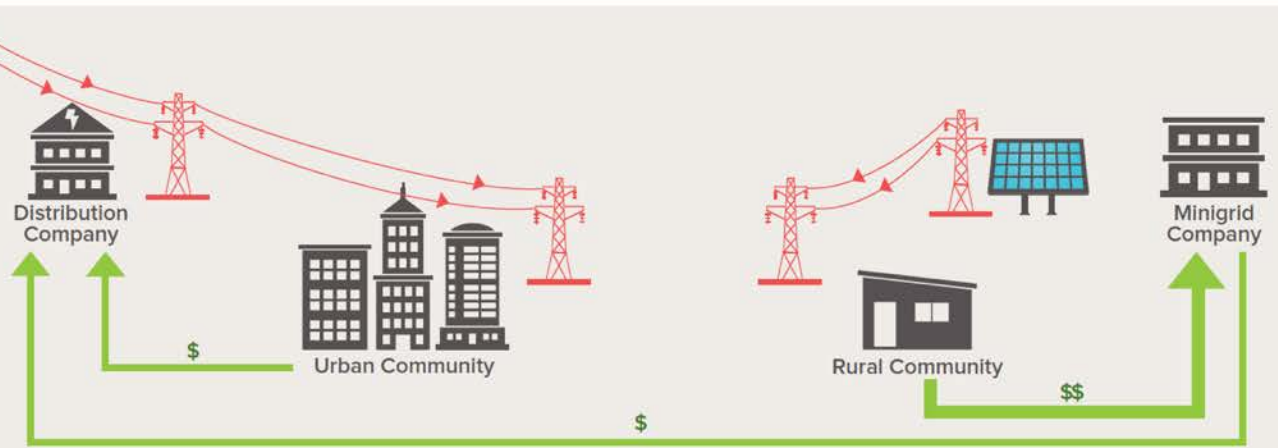
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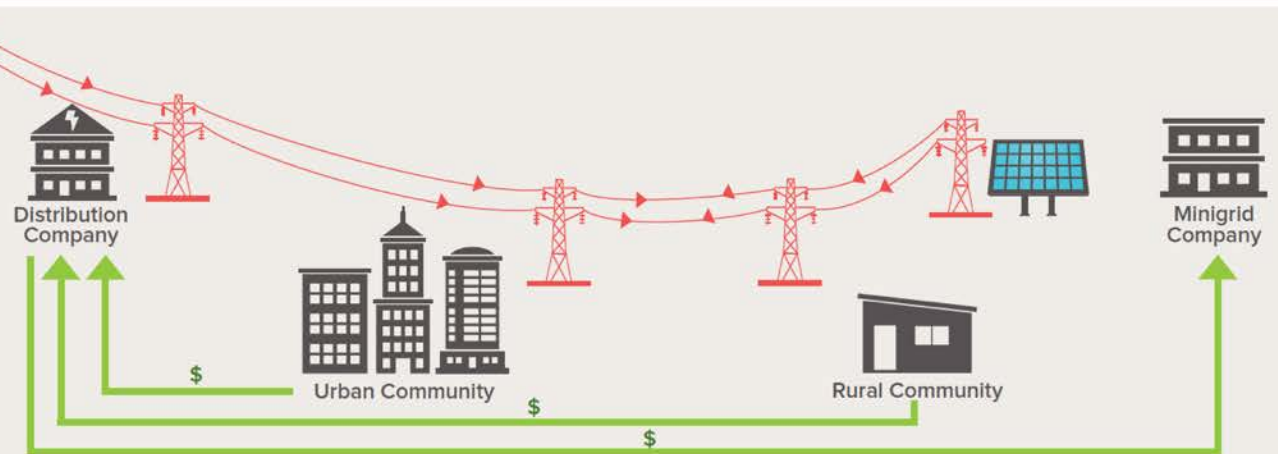
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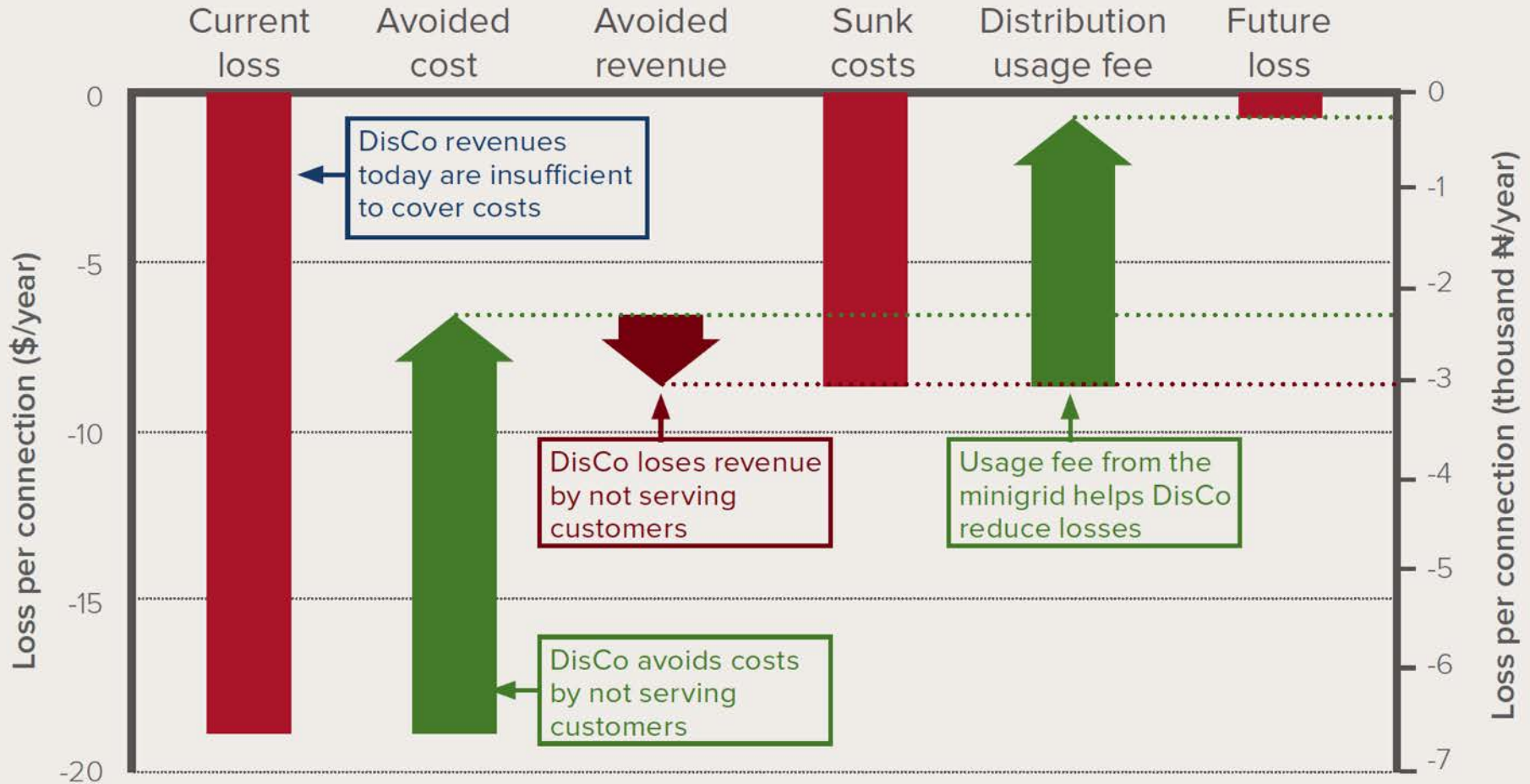


# LONG TERM

 Additional cost savings  
 Minigrd becomes distributed resource supporting grid



# Transitioning service to an undergrid minigrid can reduce utility financial losses by 60–100% in a rural community



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# Several undergrid minigrid business models are viable today



- **Minigrid Operator-led** – Private minigrid operator leads development of minigrid with consultation across the utility and community



- **SPV-led** – Development is led by an SPV and certain specialized functions are subcontracted to a minigrid operator























- **Cooperative-led** – A cooperative formed by the community leads minigrid development



- **Collaborative SPV-led** – Ownership and operation functions are spread across the utility, minigrid operator, and undergrid community (via a co-op)

# Each of these four models has strengths, but the minigrid operator-led model will be the fastest to begin with

	 Minigrid Operator-Led	 SPV-Led	 Cooperative-Led	 Collaborative SPV-Led
DisCo Investor Loss Reduction Potential				
Speed to Implement				
Less Regulatory Complexity				
Customer Tariff Affordability				

○ = less desirable outcome      ● = more desirable outcome

# Business model options are defined by key decisions about roles and the commercial terms of operation



## Minigrad Operator-led Roles

Role	Minigrad Operator	DisCo	Undergrid Community
Invest or Attract Capital	Leading role	Minimal role	Minimal role
Identify Project Site	Leading role	Supporting role	Minimal role
Engage Customers	Leading role	Supporting role	Minimal role
Obtain Regulatory Approval	Leading role	Supporting role	Minimal role
Own Generation	Leading role	Minimal role	Minimal role
Own Distribution	Minimal role	Leading role	Minimal role
Manage Customer Relationships	Leading role	Minimal role	Minimal role
Meter, Bill, and Collect	Leading role	Minimal role	Minimal role
Operate and Maintain Generation	Leading role	Minimal role	Minimal role
Operate and Maintain Distribution	Leading role	Supporting role	Minimal role
Monitor, Evaluate, and Assess Impact	Supporting role	Supporting role	Supporting role

■ Leading role 
 ■ Supporting role 
 ■ Minimal role

## Major Commercial Terms of Operation

- Grid interconnection.** Does the minigrad exchange power with the main grid? What are the Cost and design tradeoffs (e.g., reliability and hours of supply)
- Distribution usage fee.** How is the utility compensated?
- Decommissioning.** What happens when the contract ends but DERs have useful life remaining?

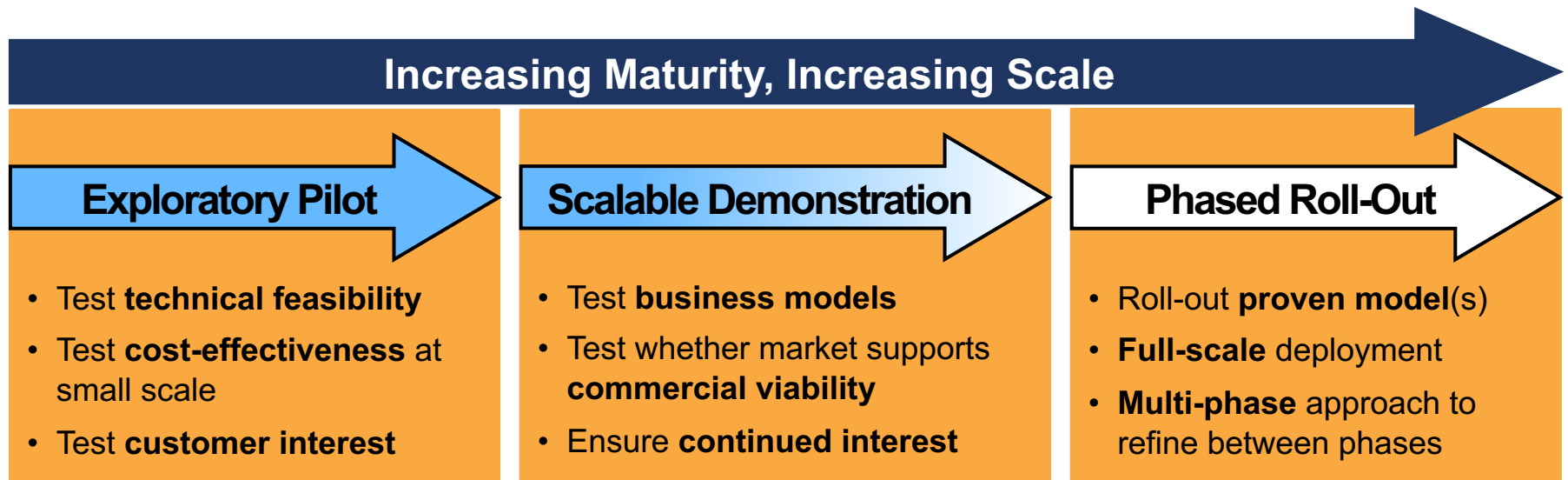


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# To bring this market to scale, several things need to happen

- **Testing.** Continued expansion of demonstration projects to prove and refine business models.
- **Data.** Sharing results—both successes and failures—from pilots so the industry can learn together.
- **Finance.** Commitment from funders to develop and invest in these projects.
- **Standardization.** Shift from bespoke pilot projects to standardized utility programs, as demonstration learnings allow.



Source: RMI, “Pathways for Innovation”, 2017.

[rmi.org/insight/pathways-for-innovation/](http://rmi.org/insight/pathways-for-innovation/)



# Thank You

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