Microgrids & minigrids

Comparing Kenya and the United States' markets and drivers

Isaac Maze-Rothstein and Benjamin Attia | 12 October 2020

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- Acquisition of Genscape, MAKE and Greentech Media (GTM)
- Leaders in the energy transition and cross-commodities
- Over 600 sector-dedicated analysts and consultants globally
- Located close to customers and industry contacts

About the analysts

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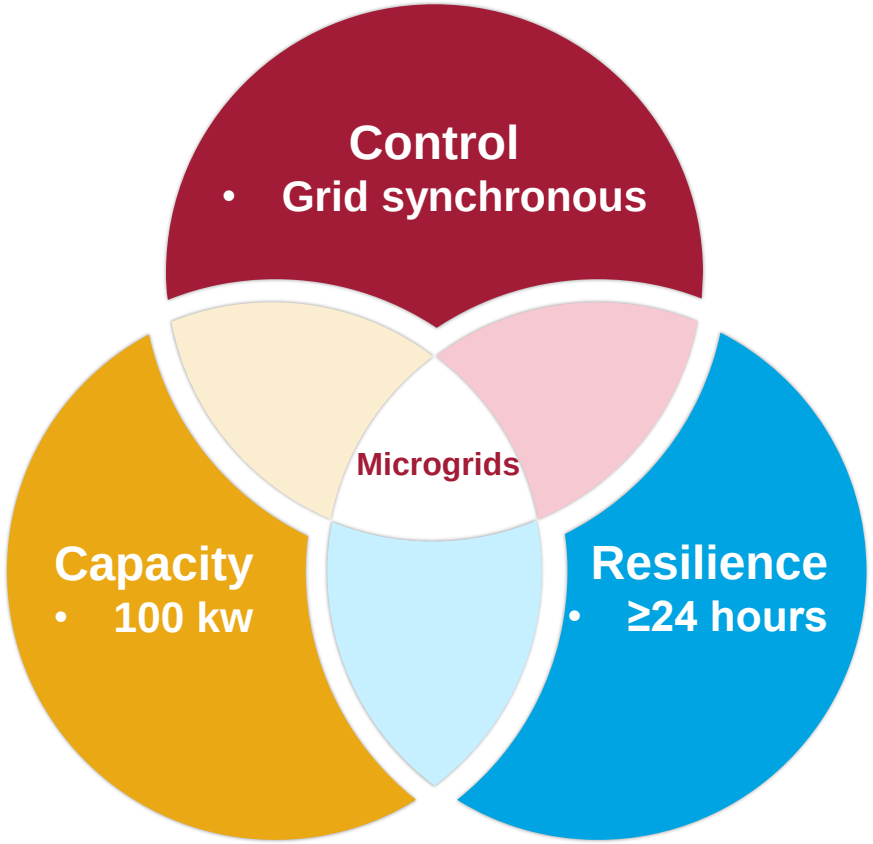
Source: Wood Mackenzie

1. Definitions

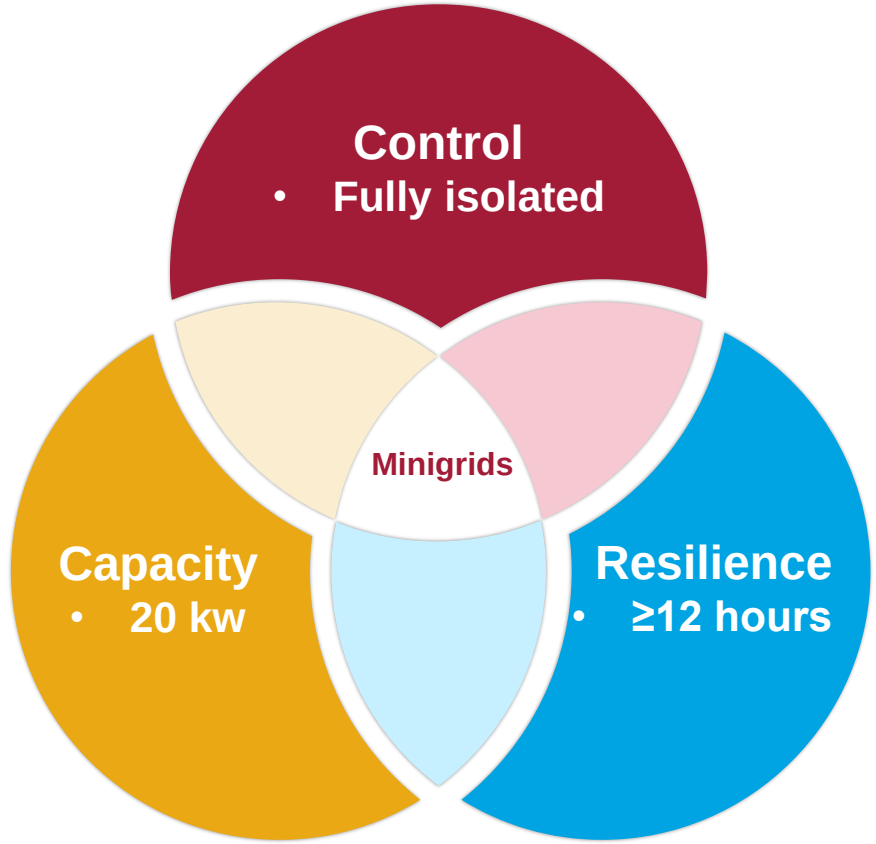
Defining microgrids and minigrids

At least one distributed energy resource (DER) providing power services to loads within a geographic perimeter with the ability to be controlled as a single entity

Distributed Energy Resources (DER)



Distributed Energy Resources (DER)

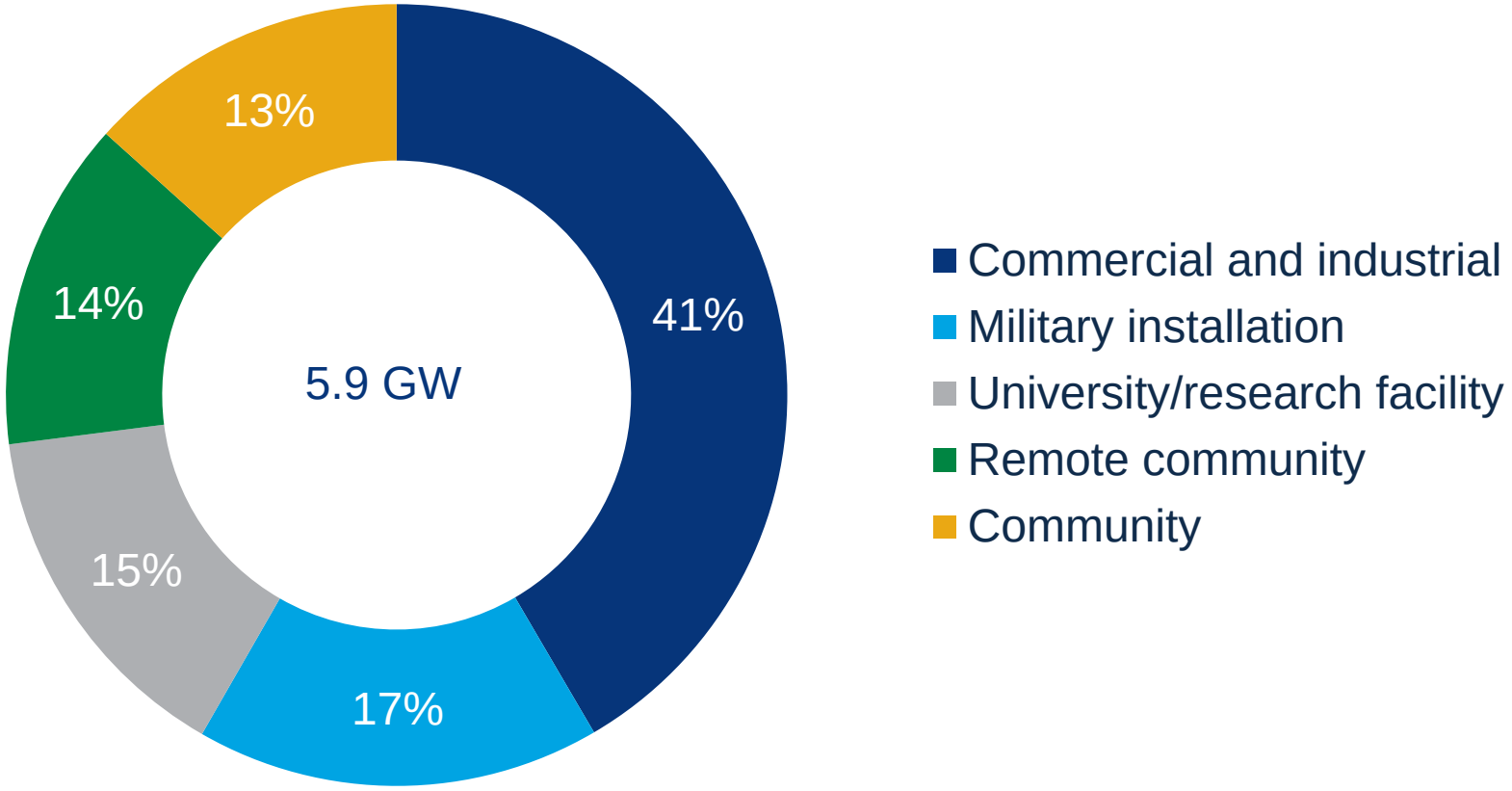


Source: Wood Mackenzie Power & Renewables

3. US microgrid landscape

Customers, size, and drivers

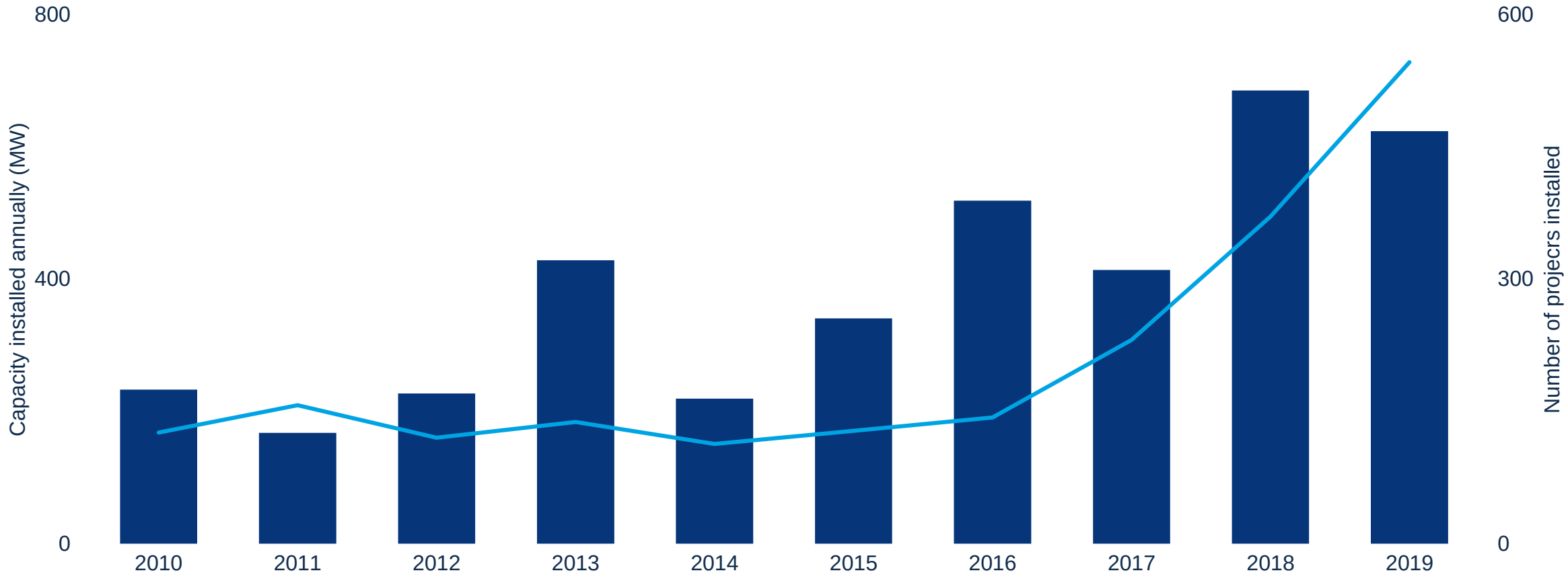
Who are the customers?



Source: Wood Mackenzie Grid Edge Service

How big is the market?

The last three years has seen the growth of the number of projects



Source: Wood Mackenzie Grid Edge Service

What is driving this market?

Three motivations for microgrids

Economics

26% & 36%

Cumulative cost declines of storage and solar since 2014

Resilience

61%

Increase in the average United States customer's outage duration from 2014 to 2018

Sustainability

63%

Percent of Fortune 100 have sustainability goals

Source: Wood Mackenzie Grid Edge Service, EIA, CERES

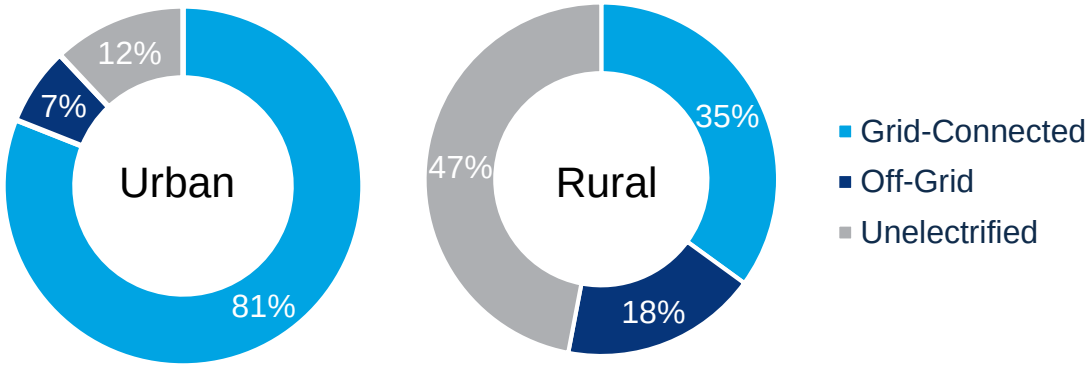
2. Kenya minigrid landscape

Customers, size and drivers

Kenya has made massive strides towards universal electricity access since 2015

National electrification rates boomed from 42% in 2015 to 75% percent in 2018, the third fastest globally

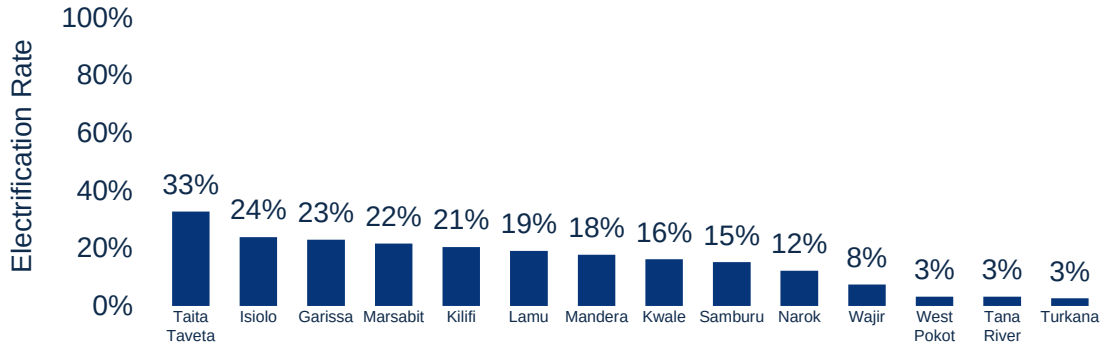
Electrification rates for rural and urban populations in Kenya



Source: World Bank Group "Tracking SDG7: Energy Access Project Report" (2019)

Electrification rates of 14 underserved, rural counties

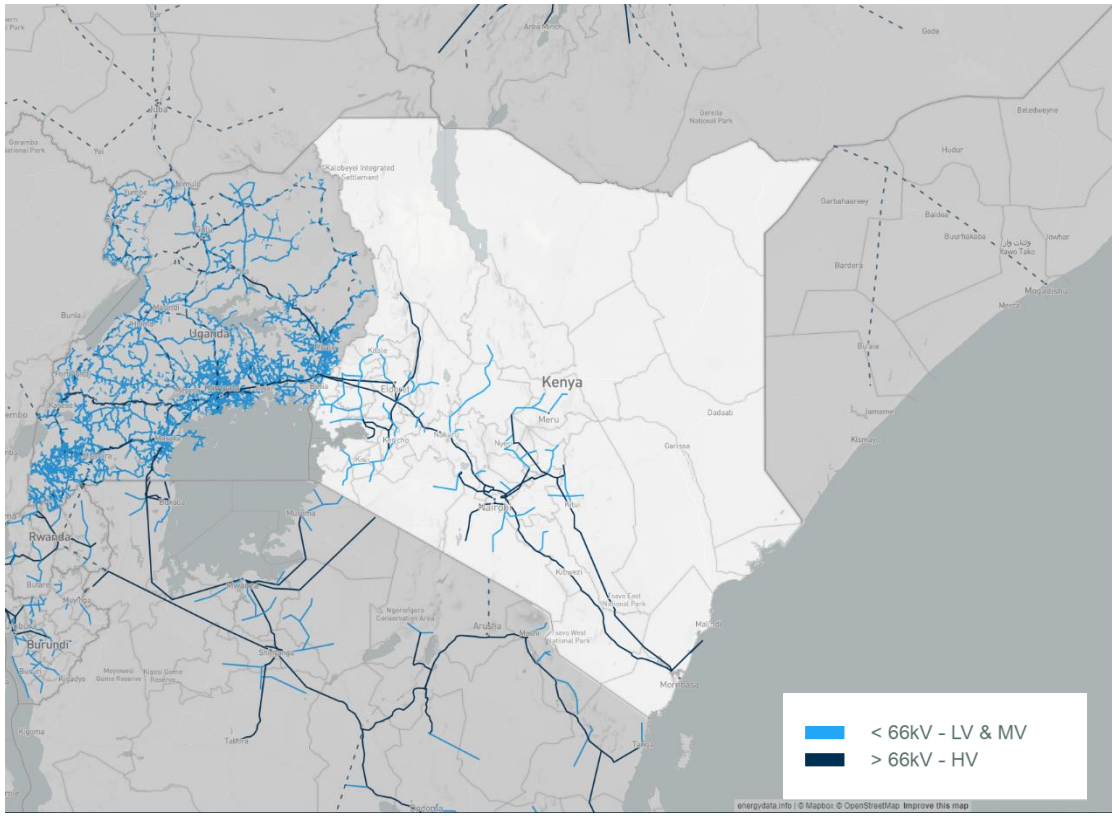
Gaps in electricity access persist between rural and urban populations



Source: World Bank Group KOSAP Project Appraisal (2018)

Grid network concentrated between Lake Victoria and Mombasa

The World Bank has identified 14 underserved counties, mainly in the country's north and east, representing 72% of Kenya's land and 20% of the population.

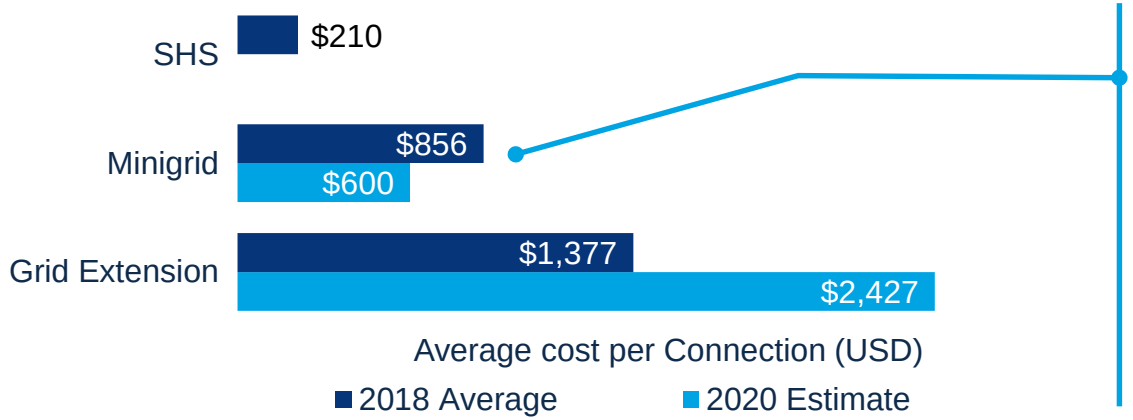


Data source: World Bank Group KOSAP Project Appraisal (2018); Map source: World Bank Group Africa Electricity Grids Explorer

Minigrids are less cost-intensive than grid extension, offer more flexibility than SHS

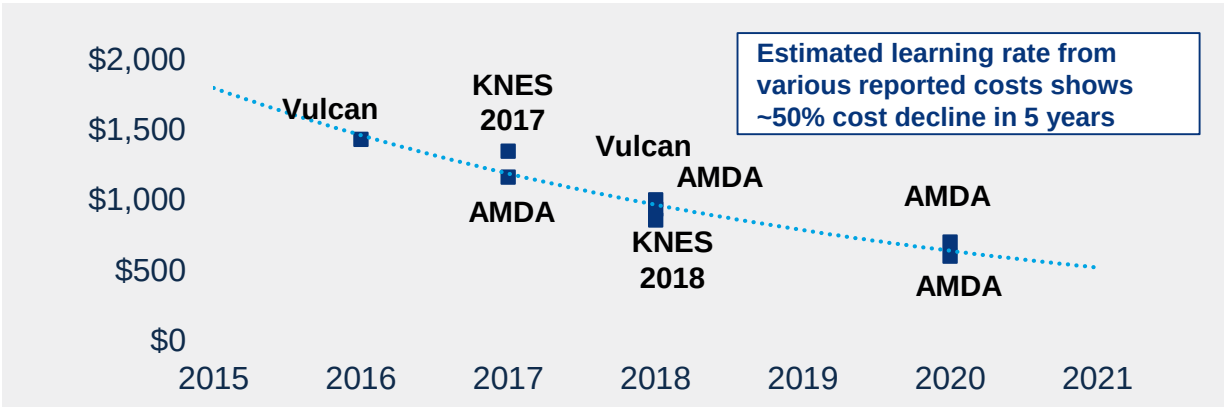
Minigrids have moved steeply down the learning curve, but cost profile still a “missing middle” for investors

Average cost per connection for electrification solutions



Source: New Climate Institute, “The role of renewable energy minigrids in Kenya’s electricity sector”

Estimated minigrid cost per connection (USD) through 2021



Source: New Climate Institute, “The role of renewable energy minigrids in Kenya’s electricity sector”

Cost evolution highlights

Wood Mackenzie estimates that minigrid costs per connection will reach as low as $600 USD in Kenya by 2021 as the sector continues down the learning curve.

Grid extension costs are estimated to rise by over 75% from 2018-2020, as remaining customers are in increasingly rural areas with low demand.

Given the low cost of SHSs, minigrid potential is often overlooked in least-cost estimates.

Source: Wood Mackenzie Power & Renewables, [1]New Climate Institute, “The role of renewable energy in Kenya’s electricity sector”; World Bank, “Minigrids for half a billion people”

Four ownership models make up Kenya's energy access minigrid market landscape

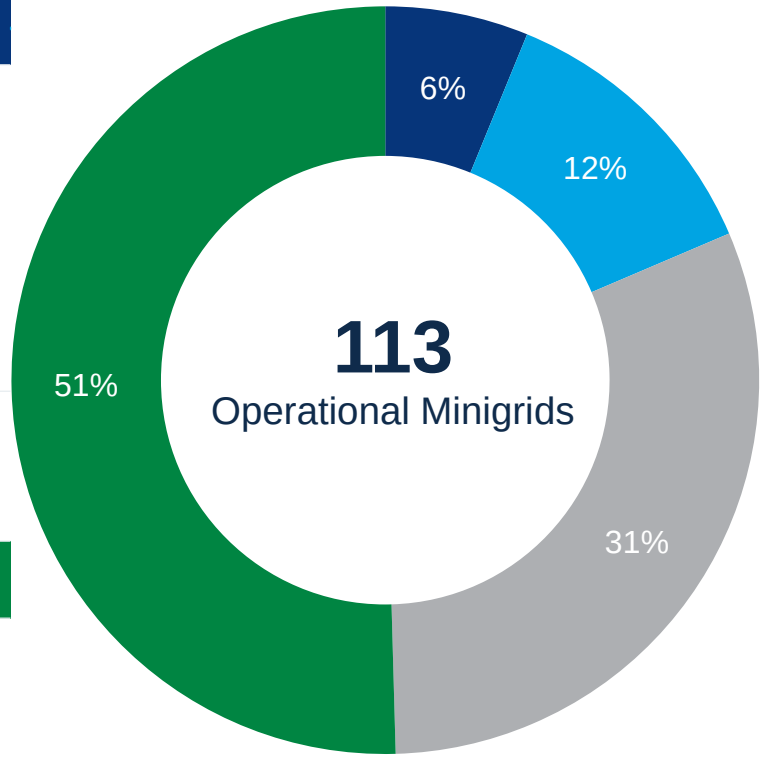
Over half of installed projects are publicly-owned, and nearly a third are owned by private licensees

Community ownership

Under a typical community model, local communities with a specific electricity demand partner with private companies for EPC work and grid operation. Upon completion of the minigrid, ownership and asset management responsibilities are passed to the local government or a governing committee.

Public ownership

Public minigrids are owned and operated under KPLC and REREC. Customers are charged a regulated tariff paid directly to KPLC. Public minigrids make up the majority of projects >20kW capacity with installations in operation as early as 1976.



Public-private partnership (PPP)

PPPs split ownership between the public utility (KPLC) and private developers. Private developers are responsible for EPC work and asset management and receive monthly payments as determined under the power purchasing agreement (PPA). Customers are charged a regulated tariff paid directly to KPLC. The 121 minigrids planned under the K-OSAP program will utilize this model and will drastically increase the total share of PPP projects when implemented.

Direct ownership

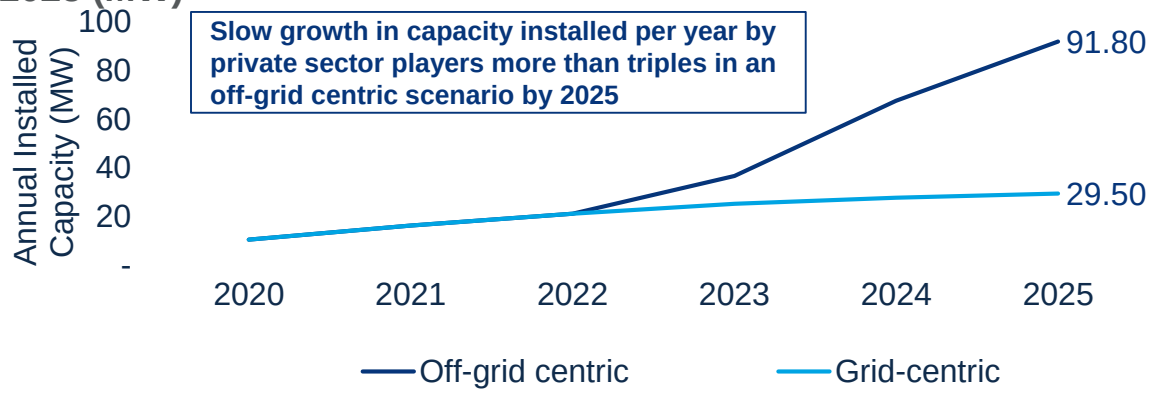
Private-sector players can apply to receive generation licenses approved by the EPRA. As part of the licensing process, EPRA approves cost-reflective tariffs and connection fees. In 2015, Powerhive became the first minigrid developer to receive an generation license in Kenya.

Source: Wood Mackenzie Power & Renewables

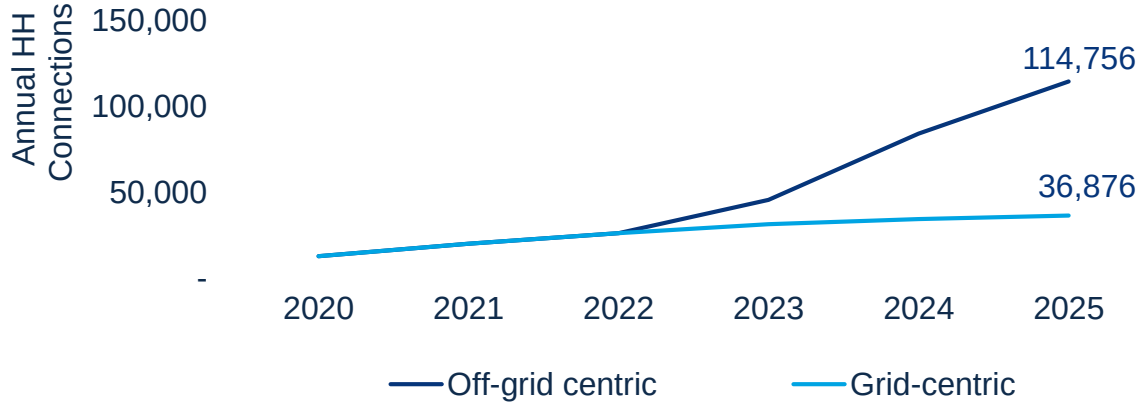
Private sector players will contribute between 164k-305k new connections by 2025

38-57% of Kenya's unelectrified population is slated to receive electricity access through off-grid solutions

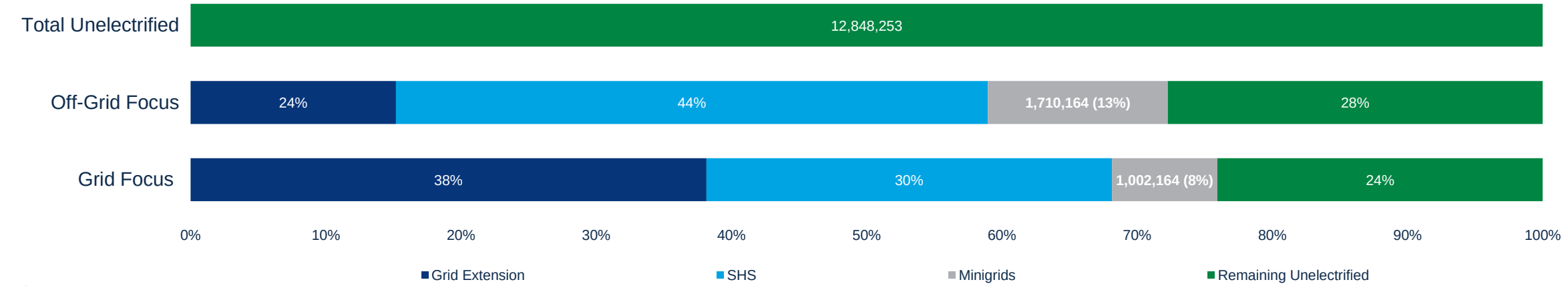
Annual minigrid generation capacity installed by scenario, 2020-2025 (MW)



Annual added household connections by scenario, 2020-2025



Distribution of solution types addressing unelectrified population given two scenarios of grid extension success (2025)*



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Source: Wood Mackenzie Power & Renewables

What is driving this market?

Minigrid market drivers differ by customer segment

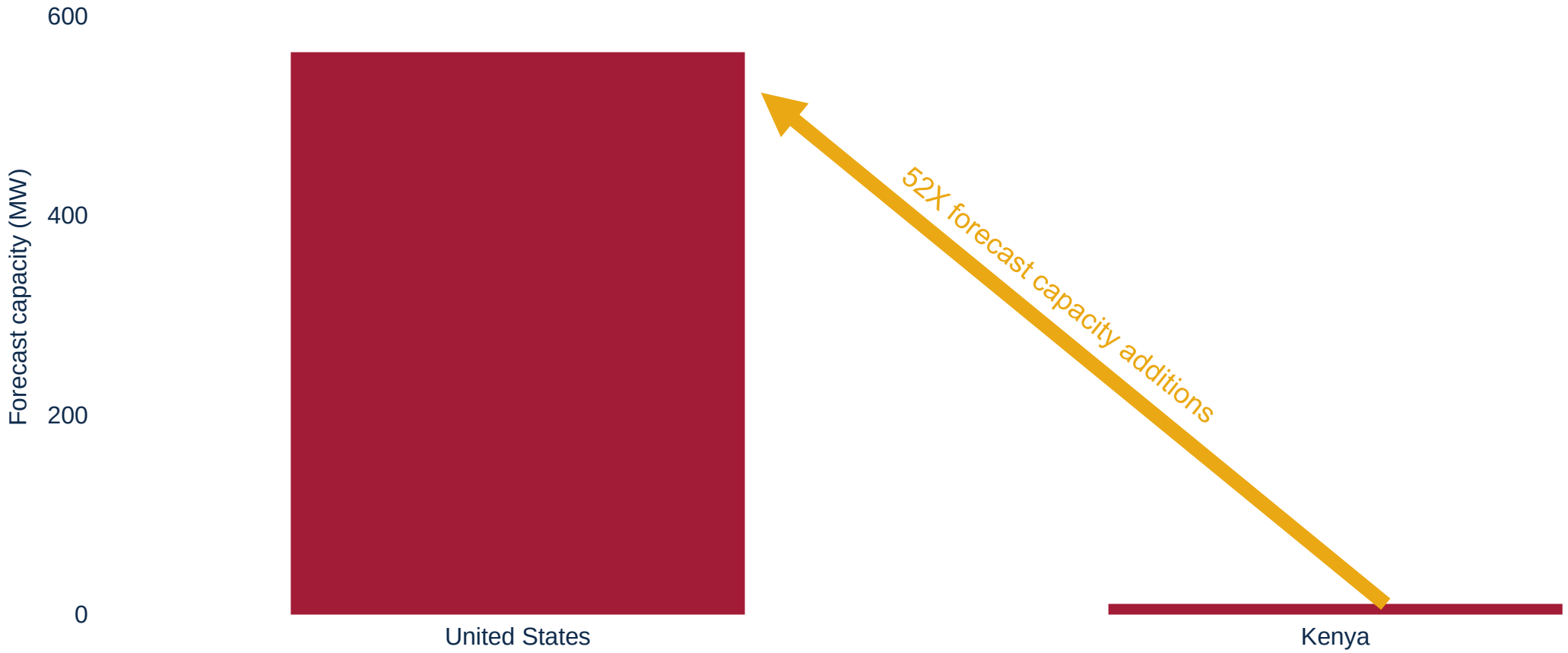
	Economics	~~Resilience~~ Reliability	Sustainability
SMEs, Commercial, Industrial	Hedge against persistently high and rising diesel prices	Price certainty vs intermittent power, fluctuating diesel prices and availability, etc	ESG / CSR or emissions targets have yet to play a major role in the minigrid sector, but likely grow as grid defection increases
Residential, Energy Access	Energy expenditure savings against low quality, costly fuels like kerosene, traditional biomass, or in some cases, diesel	Lack of access to reliable electricity (if any at all) + high utility from kWh = high willingness to pay for reliable power	High WTP driven by the livelihood benefits access to electricity offers (notably, increasingly core to strategic investor transformations)

Source: Wood Mackenzie Grid Edge Service, EIA, CERES

4. Comparisons

The US is a larger market by an order of magnitude

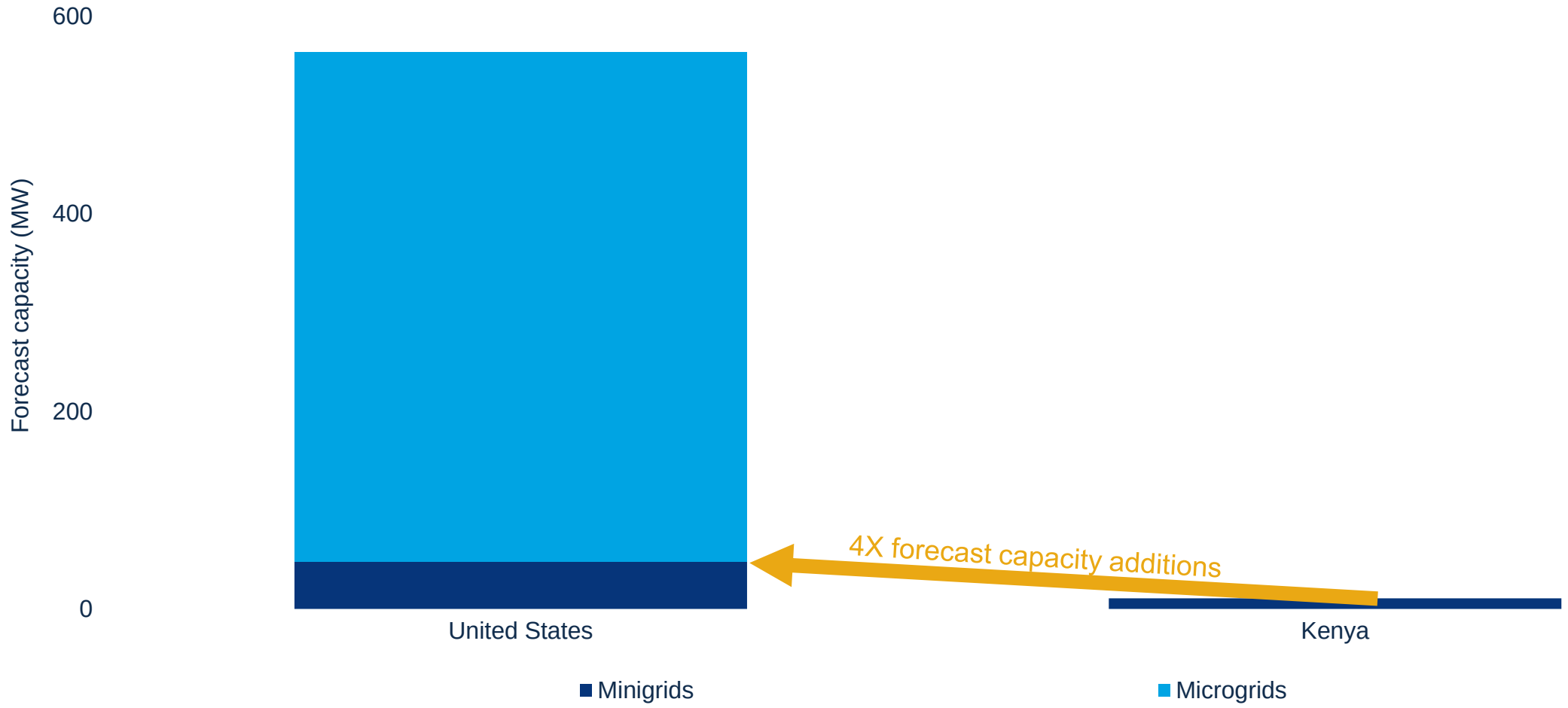
Forecast capacity additions in 2020



Source: Wood Mackenzie Energy Transition Practice

Comparing minigrids, a more nuanced conclusion

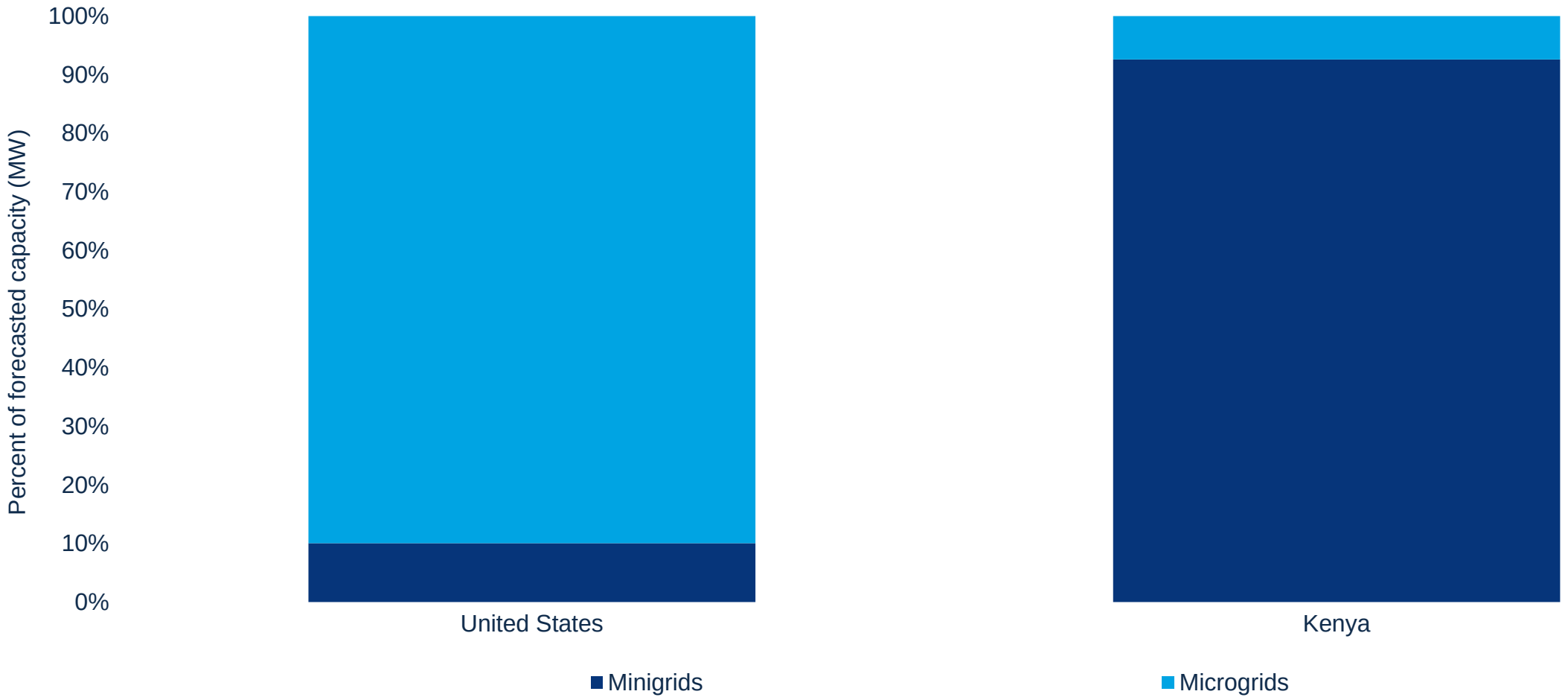
Forecast capacity additions in 2020



Source: Wood Mackenzie Energy Transition Practice

Forecasted minigrid and microgrid capacity additions from 2020 to 2025

US market will be led by grid-synchronous projects, while Kenya's will be led by grid-isolated projects



Source: Wood Mackenzie Energy Transition Practice

What is driving this market?

Three motivations for each market

	Economics	Resilience / Reliability	Sustainability
United States	Solar and storage cost declines	Increasing extreme weather	Renewables targets
Kenya (energy access segment)	Strong value proposition against kerosene, diesel, traditional biomass, or unreliable grid	Reliable electricity drives a high WTP	Access to energy yields myriad livelihood benefits and fuels a virtuous cycle

Source: Wood Mackenzie Energy Transition Practice, EIA, CERES

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