

**MINI GRIDS: REGULATIONS,
SUBSIDIES, AND GRID
INTEGRATION AND EXIT
STRATEGIES FOR LOW COST AND
TIMELY ACCESS TO ELECTRICITY
SERVICES**



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Topics in Mini Grid Regulation

Regulation is the supervision and control of economic activities of private entities by government, in the interest of economic efficiency, fairness, health, and safety (Bannock & Baxter, 2011, Penguin Dictionary of Economics)

Key topics in mini grid regulation include:

- **Entry** to the market
- **Retail tariff**—tariff charged to customers
- **Service standards**—quality of power, quality of supply, quality of commercial services
- **Technical standards**—safety, equipment or construction quality, connection with the main grid, environmental sustainability
- **Relationship with the main grid**—commercial options available for the mini grid developer when the main grid arrives

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Service standards:

- Quality of power: e.g. voltage stability, frequency stability
- Quality of supply: e.g. hours of service, reliability,
- Quality of commercial services: e.g. customer service, accuracy in meter reading

Technical standards

- Safety: e.g. safety distances and protection corridors, pole height
- Equipment or construction quality: e.g. types of inverters, expected longevity of solar panels
- Connection with main grid (or between mini grids):
 - Distribution network poles, conductors, and insulators to ensure the network can handle the quantities of electricity that flow when energized by the main grid
 - Generation synchronization, to ensure safe and reliable operation of the grid when connected to the mini grid generator
- Environmental sustainability: e.g. toxic waste management

An Analytical Framework Based on Six Case Studies

Location			People served by private mini grids	Average tariff for private mini grids
Bangladesh			21,000	US\$0.36/kWh
Cambodia			5,900,000	US\$0.24/kWh
Kenya			6,000	US\$1.89/kWh
Nigeria			9,000	US\$0.60/kWh
Tanzania			45,000	US\$0.97/kWh
Uttar Pradesh, India			230,000	US\$1.19/kWh

³ Conference case studies are available on the World Bank Open Knowledge Repository: <https://openknowledge.worldbank.org/>



Solar and battery mini grid in Char Baghutia, **Bangladesh**

Diesel mini grid in Kontut Commune, Preah Vihear Province, **Cambodia**

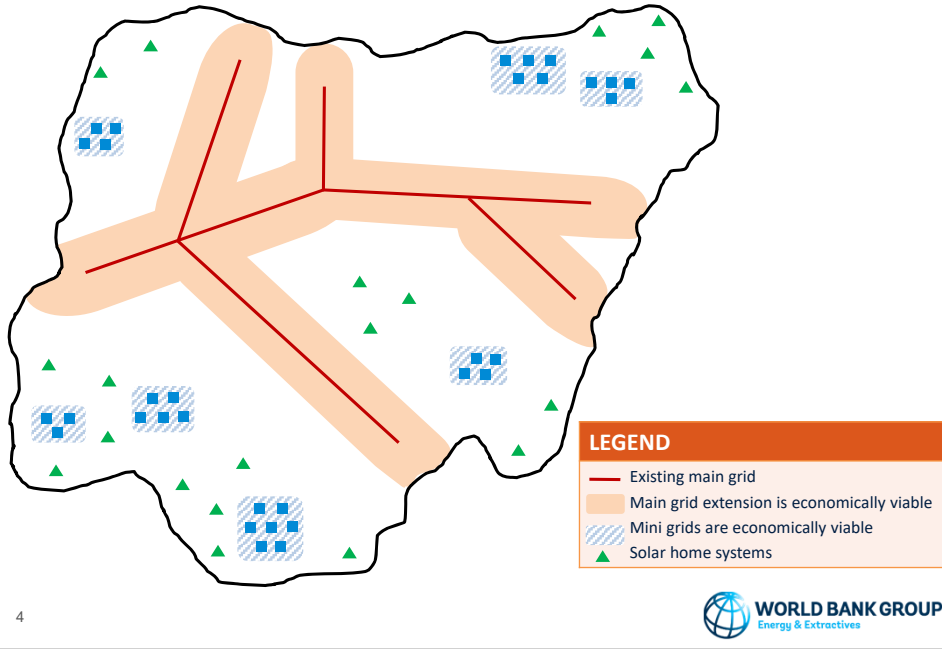
Inhabitant in Busia county, served by a mini grid, **Kenya**

Clinic powered by a mini grid, Mpale village, Korogwe province, **Tanzania**

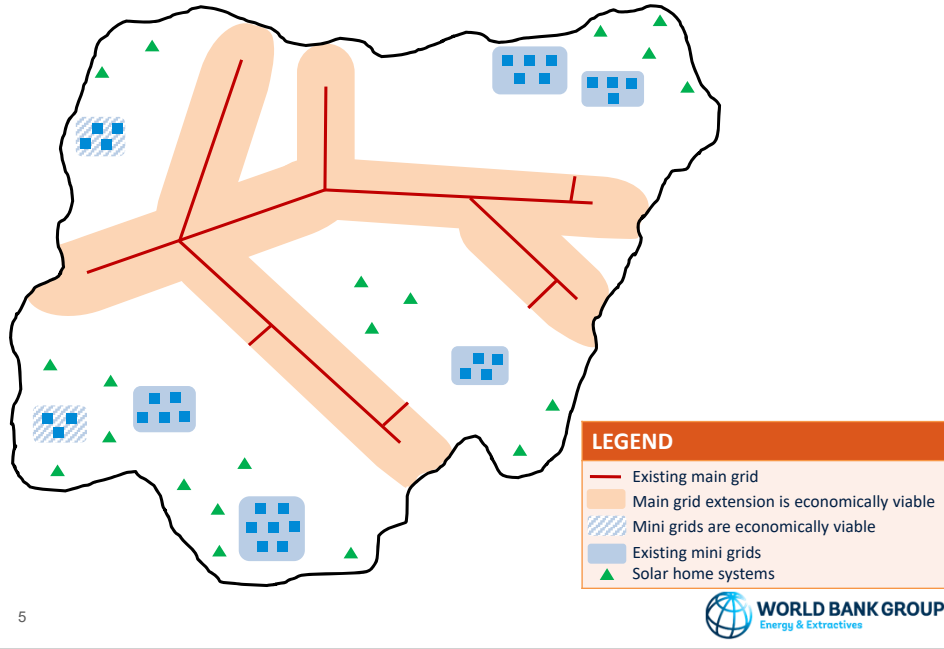
Solar and battery mini grid in Bisanti operated by GVE, **Nigeria**

Private mini grid operating alongside the main grid, Hardoi District, **Uttar Pradesh, India**

Mini Grids Evolve Over Time

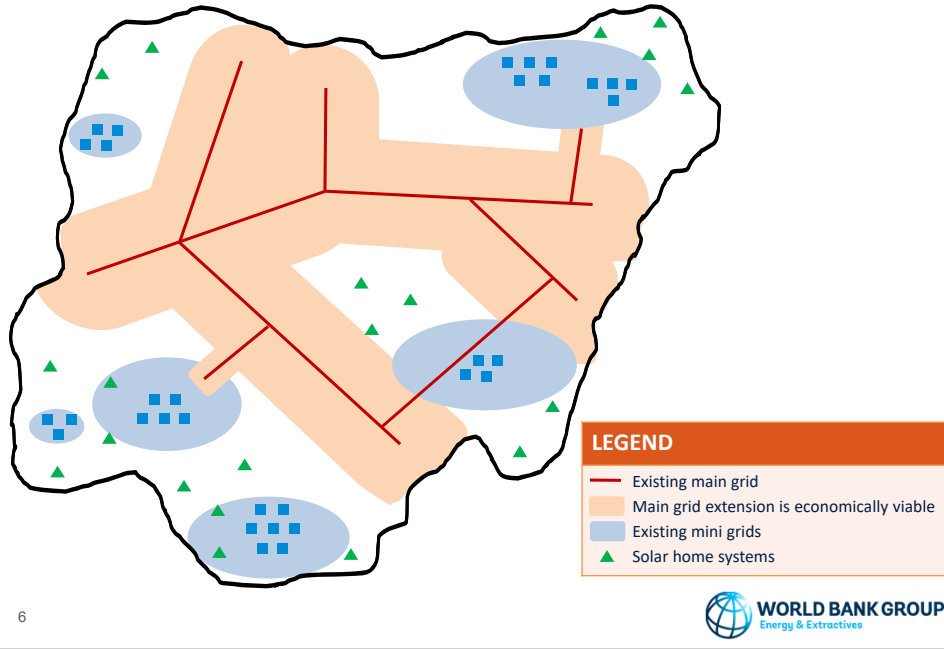


Mini Grids Evolve Over Time

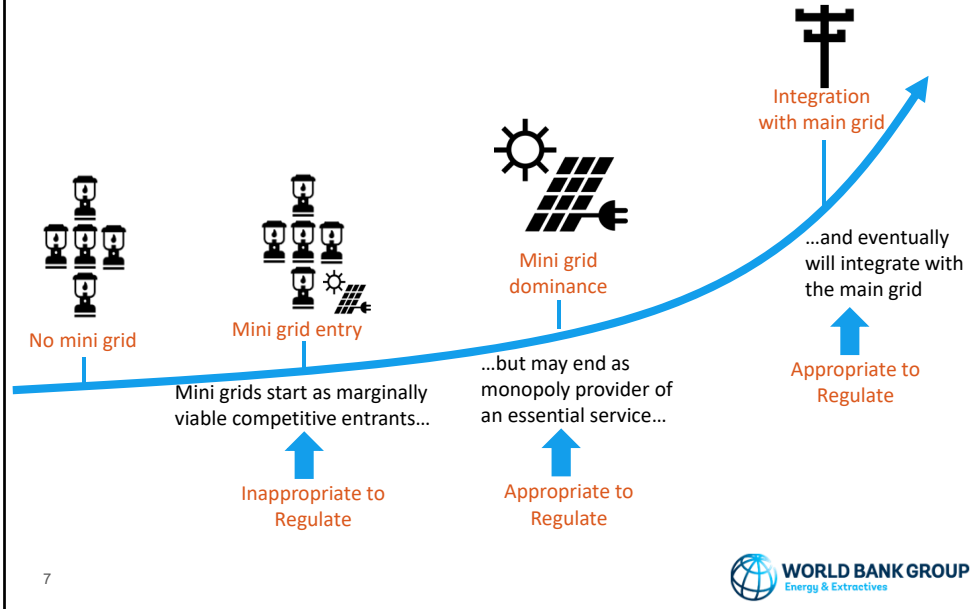


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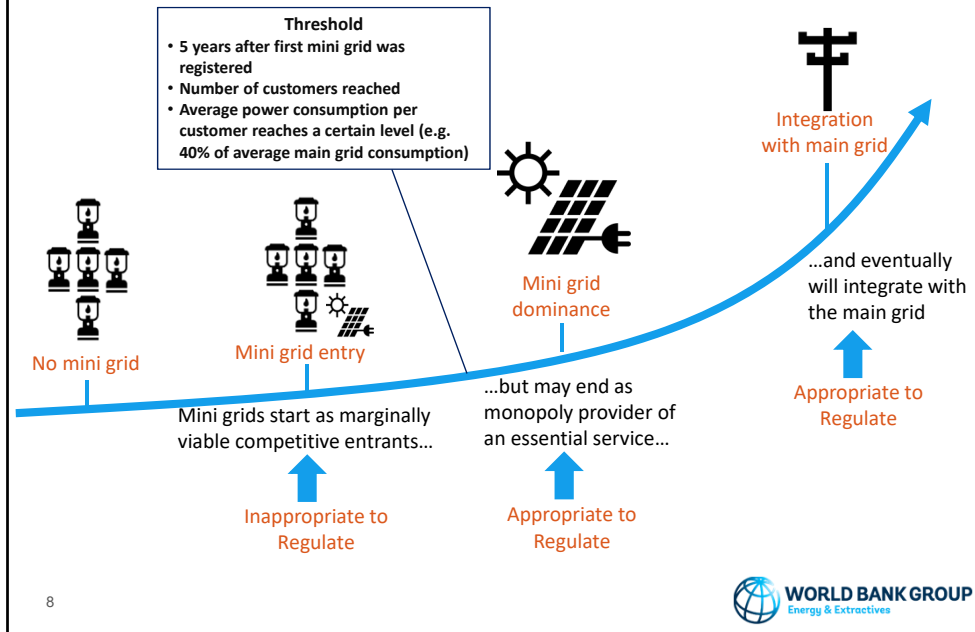
Mini Grids Evolve Over Time



Regulations Should Evolve Too



Regulations Should Evolve Too



Mini Grid Regulation: Scenario Recommendations

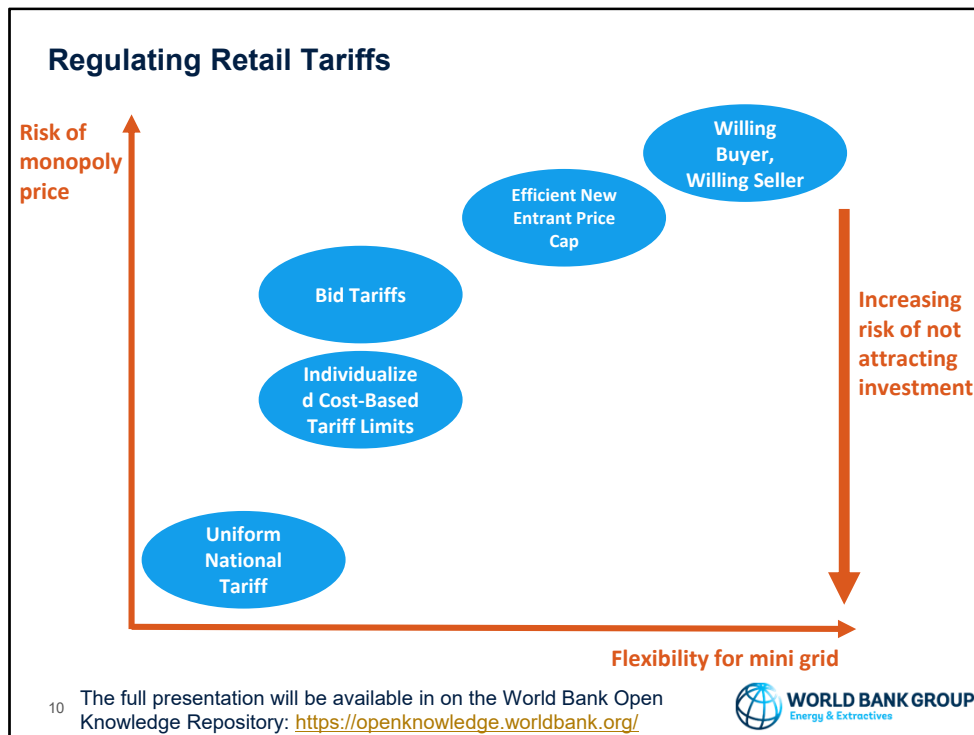
Scenario: rapid electrification goal, low government capacity, low fiscal capacity

Topic	Entry	Dominance	Integration
Entry	Registration	Permit/license	Permit/license
Tariffs	Willing buyer, willing seller	Individualized cost-based tariffs	Individualized cost-based tariffs
Service standards	Reporting	Uniform mini grid-specific standards	Main grid-level standards
Technical standards	Safety standards Optional grid compatible standards	Safety standards Optional grid compatible standards	Safety standards Grid compatible standards
Commercial options for integration	SPP, SPD, SPP+SPD, asset buyout	SPP, SPD, SPP+SPD, asset buyout	Mini grid chooses one option among SPP, SPD, SPP+SPD, asset buyout

SPP : Small Power Producer
 9 SPD: Small Power Distributor



- **Entry:** permit/licenses create barriers to entry, especially for competitive entrants that are on the edge of commercial viability. This is not desirable in countries with rapid electrification goals. In some instances, registration may even create barriers for mini grids to develop (e.g. small remote developers)
- **Tariff and service standards:** light or no regulation of tariffs and service standards recommended where mini grids are unlikely to make supernormal profits (e.g. nascent market, small mini grids)—however tighter regulation is recommended where mini grids are likely to make supernormal profits (e.g. mini grid dominant, big mini grids)
- **Technical standards and commercial options for integration** should be regulated from the start to provide certainty to investors and ensure that mini grids can integrate to the main grid later



- **Why regulate retail tariffs?** Retail tariffs on the main grid are commonly regulated to protect customers from monopoly power, due to customers typically having only one electricity supplier; however, there may be reasons not to regulate tariffs for mini grids
 - **Key rationales not to regulate tariffs:**
 - Mini grids face competition in supplying energy services (especially when they enter the market)
 - Mini grids cannot raise prices far above cost of supply because of customers’ limited willingness to pay, and are often barely commercially viable in remote areas
 - The cost of regulating mini grids may be excessive (both compliance cost of mini grids, and the cost to the regulator)
 - **Key rationales to regulate tariffs:**
 - Mini grids have gained pricing power: this would be the case where mini grids have become dominant providers of energy services in the local market and driven out of the market other providers (like kerosene supplier, entrepreneurs providing phone charging services)
 - Mini grids benefit from government subsidies, and regulators want to ensure that subsidies go to consumers through lower tariffs rather than to mini grid’s profits

- When there is a uniform retail tariff policy, regulators will need to regulate tariffs to enforce such policy
- **Approaches to retail tariff regulation can be grouped into 5 options.** In the following order, these options create increasing flexibility for mini grid in setting their tariff and thus increasing chances to attract investment, but at the same time increase the risk of monopoly pricing:
 - Uniform national tariff
 - Individualized cost-based tariff (similar to the method used to regulate tariffs for electricity utilities)
 - Bid tariffs (mini grid investor gains the right to serve an area by bidding the lowest tariff in a competitive tender)
 - Efficient new entrant price cap (regulator sets a single benchmark tariff for all mini grids, estimated to be the cost of service of an efficient new entrant in the business)
 - Willing buyer, willing seller (tariff set at a price that mini grid and customer agree on)
- **These five options address the level of retail tariff but not the tariff structure** (for instance, consumption-based tariff calculated per kWh versus capacity-based tariffs which is a fixed amount per kW of peak demand). This is because it is generally recommended to leave the flexibility to developers to adopt the tariff structure that best fits their technology and market
- **Next slides:** The next two slides present in detail each option, including examples, where they are suitable and their disadvantages

Regulating Retail Tariffs

Option	Description	Examples
Willing Buyer-Willing Seller	<ul style="list-style-type: none"> Tariff set at a price that the mini grid and the customer agree on Variants include: i) individually-negotiated agreement; ii) tariff set by mini grid and customer chooses to sign up or not; iii) tariff agreed between mini grid and community 	<ul style="list-style-type: none"> Cambodia (pre 2001) Uttar Pradesh (mini grids without state subsidies—all as of 2017) Nigeria (isolated mini grids below 100kW of distributed power) Tanzania (below 100kW)
Efficient New Entrant Price Cap	<ul style="list-style-type: none"> A single benchmark tariff is used for all mini grids Regulator sets this benchmark tariff at a level estimated to be the cost of service of an efficient new entrant in the market 	<ul style="list-style-type: none"> Bangladesh (all solar PV-diesel mini grids must charge a tariff capped at BDT 30 (US\$0.36) per kWh)
Individualized Cost-Based Tariff Limits	<ul style="list-style-type: none"> Regulator sets limits on tariffs for each mini grid individually, based on an estimate of the cost-recovery tariff for that mini grid 	<ul style="list-style-type: none"> Cambodia (as of 2017) Nigeria (isolated mini grids above 100kW of distributed power) Kenya (all mini grids as of 2017) Tanzania (mini grids above 100kW)
Bid Tariffs	<ul style="list-style-type: none"> Mini grid investor gains the right to serve an area by bidding the lowest tariff in a competitive tender 	<ul style="list-style-type: none"> Madagascar (as of 2015, 65 mini grids projects bid out) Uganda (one tender in 2003, and one in 2017 to electrify 25 villages)
Uniform National Tariff	<ul style="list-style-type: none"> Mini grid tariff is set at the national main grid tariff 	<ul style="list-style-type: none"> Cambodia (grid-connected SPDs as of 2017)

¹¹ The full presentation will be available in on the World Bank Open Knowledge Repository: <https://openknowledge.worldbank.org/>



Regulating Retail Tariffs

Option	Suitable Where	Disadvantages
Willing Buyer-Willing Seller	<ul style="list-style-type: none"> ✓ Mini grids are unlikely to make supernormal profits if given pricing freedom ✓ Policy objective to expand electrification quickly ✓ Distribution company provides unreliable supply of electricity ✓ Willingness to maximize tariff flexibility and investors' returns ✓ Low administrative capacity 	<ul style="list-style-type: none"> X Could result in monopoly pricing X May be difficult to adjust tariffs over time X Asymmetry between customers and developer X One-sided adhesion contracts difficult politically
Efficient New Entrant Price Cap	<ul style="list-style-type: none"> ✓ Cost of service expected to be uniform across communities ✓ Monopolies need to be controlled without the cost and complexity of individualized utility-style control ✓ Moderate to high administrative capacity 	<ul style="list-style-type: none"> X Costs will vary between service areas, so a single tariff will not reflect cost everywhere X Monopoly pricing may remain in some areas X Level of tariff may be controversial
Individualized Cost-Based Tariff Limits	<ul style="list-style-type: none"> ✓ Monopolies need to be protected against while allowing reasonable returns ✓ Cost of service not expected to be uniform across communities ✓ High regulatory capacity 	<ul style="list-style-type: none"> X Setting individual tariffs is labor and time intensive X Creates risk of misuse of regulatory discretion

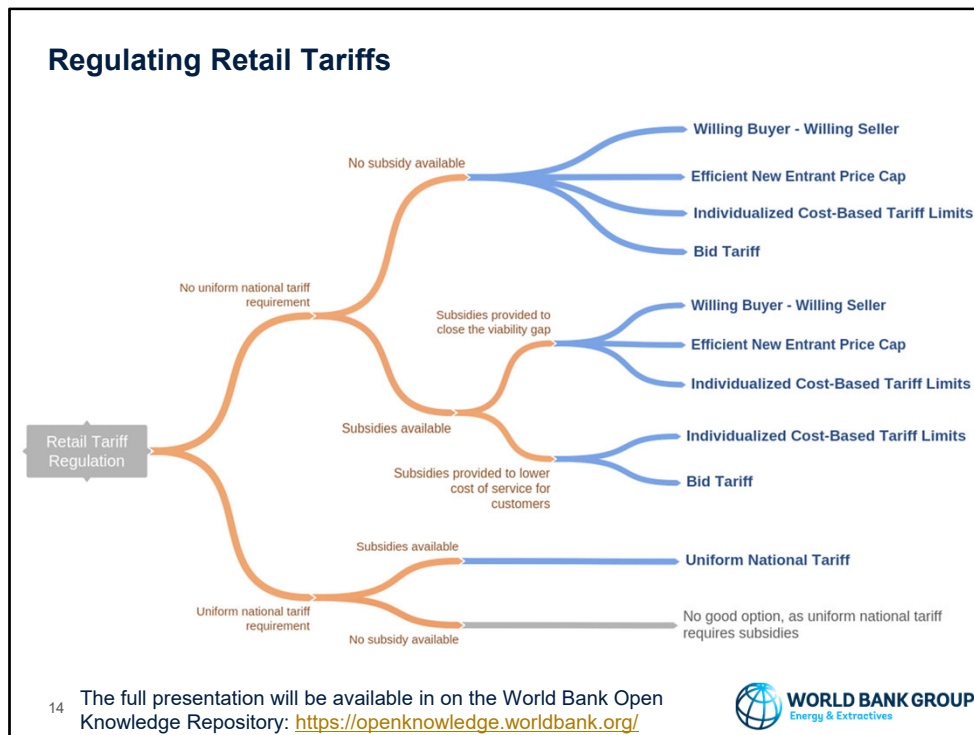
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Regulating Retail Tariffs (cont.)

Option	Suitable Where	Disadvantages
Bid Tariffs	<ul style="list-style-type: none"> ✓ Centrally coordinated approach to scale up electrification through mini grids ✓ Monopolies need to be protected against while allowing reasonable returns ✓ Enough mini grid developers to compete for each area ✓ High administrative capacity 	<ul style="list-style-type: none"> X Changing the tariff over time cannot be done through bidding X Running a tender can be costly and complex
Uniform National Tariff	<ul style="list-style-type: none"> ✓ Strong political pressure for uniform electricity prices ✓ Subsidy provider is creditworthy ✓ Expanding electrification quickly is not a priority ✓ High administrative and financial capacity that can be sustained over time 	<ul style="list-style-type: none"> X Requires ongoing subsidy X High risk of not attracting investment and not sending efficient price signal X Administratively complex X Driven by political considerations

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- **The decision tree provides guidance to regulators** on how to choose the regulatory approach that suits their objectives and context, and given legal and policy constraints. The decision tree is not exhaustive or prescriptive but does aim to indicate what might make sense in certain common scenarios
- **The key questions that will guide the regulator's choice are the following:**
 - Whether there is a policy requirement of uniform national tariff
 - Whether subsidies are available
 - If subsidies are available, what are the subsidies objectives: to expand access by closing the viability gap, or to ensure equity of affordability by lowering the cost of service for customers ?
 - If the goal is to close the viability gap to maximize access, efficient new entrant price cap and individualized cost-based tariffs are most appropriate. Willing buyer willing seller is an option but may be politically hard to implement (subsidies are provided but no tariff regulation). Bid tariff is not appropriate because subsidies may go to profits instead of expanding access.
 - If the goal is to reduce the cost of service below customers' willingness to pay, tariff regulation is warranted to ensure that subsidies do translate into lower tariffs
- **Other key criteria for regulators to evaluate their options are:**
 - **Tariff accuracy** (whether the tariffs set is cost-reflective): Individualized cost-based tariff limits ensure high tariff accuracy unlike a uniform national tariff.

If mini grids can set cost-reflective tariffs, this will increase the chances of attracting private investment.

- **Risk of monopoly pricing:** willing buyer willing seller presents a high risk of monopoly pricing unlike individualized cost-based tariff limits
 - **Suitability to rapidly expand access:** a bid tariff approach is suitable given that it aims to rapidly scale up access in specific areas; while uniform national tariff may not be appropriate to scale up quickly, since this option primarily aims to ensure equity among customers in the country
 - **Regulatory capacity needed:** willing buyer-willing seller would require little to no regulatory capacity, while design of competitive tender or individual cost-based tariffs would require a lot.
 - **Compliance cost for the developer:** efficient new entrant price cap would impose little compliance costs while submitting a bid in a competitive tender would impose high costs on the developer
- **Regulators may opt for different options for retail tariff regulation between small and large mini grids.**
 - **Tiered-approach** as in Nigeria and Tanzania: willing buyer - willing seller option for smaller mini grids, and individualized cost-based tariff limits for larger mini grids
 - **Two-track electrification approach**, with two coexisting methods to set mini grid tariffs, as in Kenya: some mini grids in the North of the country will be developed under contract with the utility and charge the uniform national tariff, while in the rest of the country they develop spontaneously and are subject to individualized cost-based tariff limits

Main Takeaways

1. **Mini grids are complementary to the main grid**—regulation may be designed to ensure that mini grids built now can be integrated to the main grid later
2. **Mini grids evolve from competitive entrants to monopoly providers of an essential service**—regulation should evolve too
3. **There is no one-size fits all solution to mini grid regulation**—regulation should be adapted to a country's electrification objectives, maturity of mini grid market, government administrative and fiscal capacity

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