

Mini-grids and (rural?) electrification

Dr. Herena Torio



Agenda

Part I - The Context

- The power of mini-grids
- Where and which?
- Types of mini-grids

Part II - The challenges

- Investment and costs
- The forgotten spot



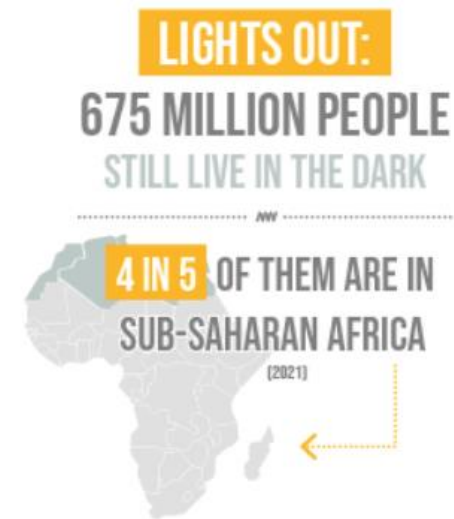
The context

The „power“ of mini-grids

“*Access to Energy is at the Heart of Development*” (Source: World Bank 2018)...
...the world bank says

But about

- 750 million people lack access to electricity
- 1.4 billion people are not connected to their national electricity grids (Ikejemba et al., 2017)



Source: UN, [Goal 7](#) | Department of Economic and Social Affairs ([un.org](#))

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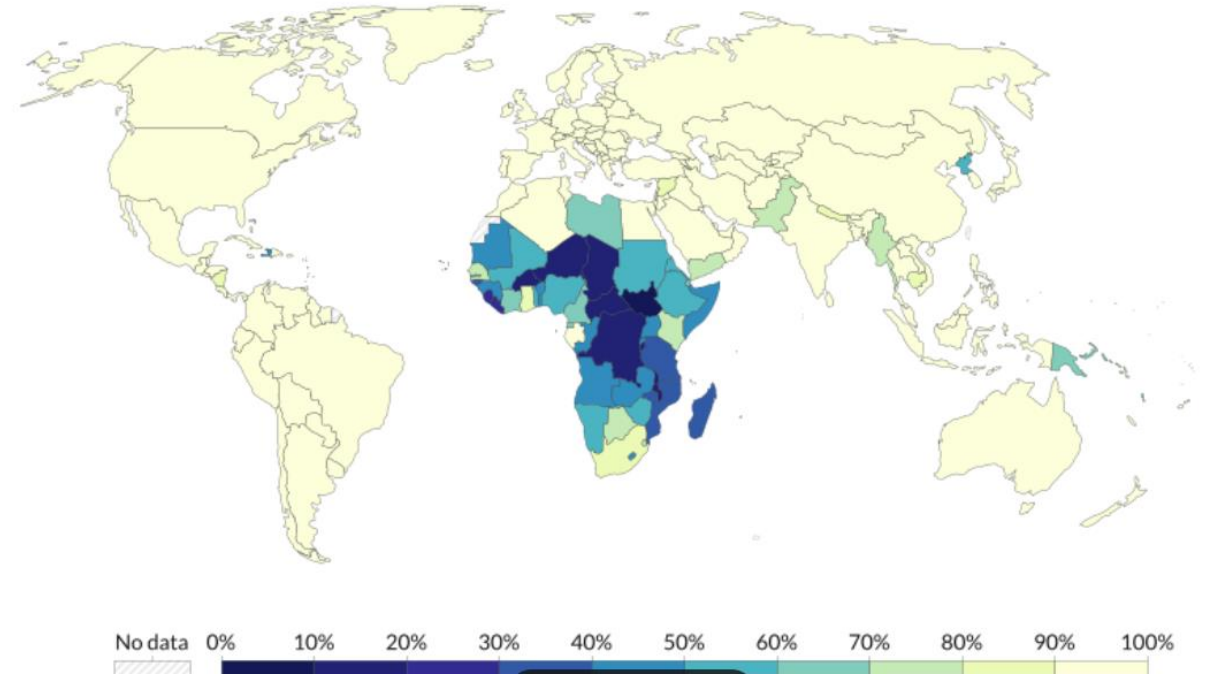
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Electricity access, 2020

Share of the population with access to electricity. The definition used in international statistics adopts a very low cutoff for what it means to 'have access to electricity'. It is defined as having an electricity source that can provide very basic lighting, and charge a phone or power a radio for 4 hours per day.

Our World
in Data



Source: ourworldindata.org

The context

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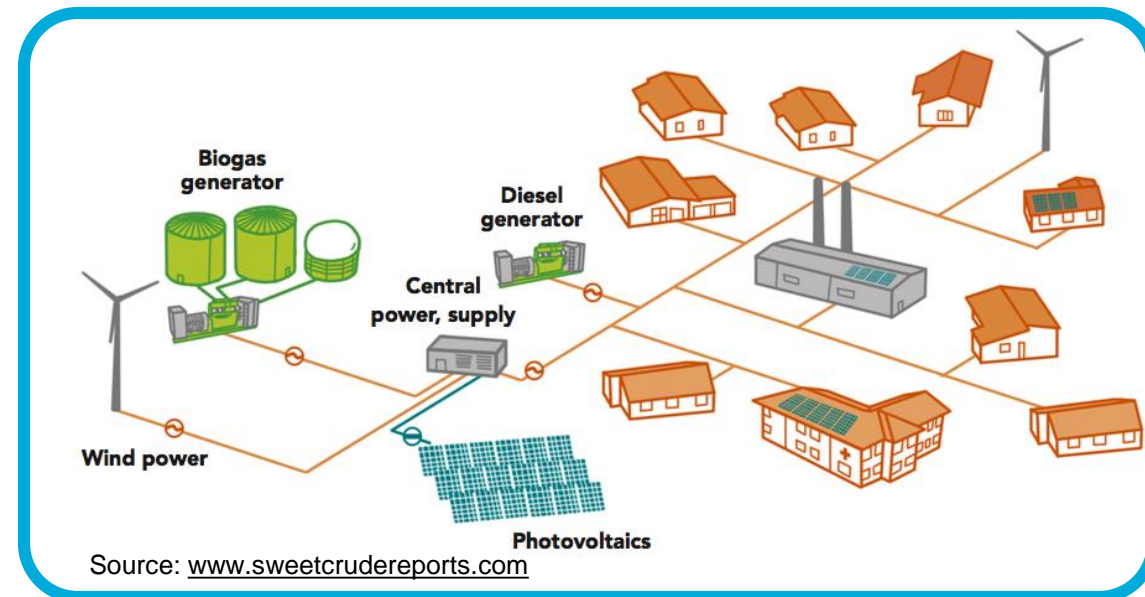
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And a mini grid is...

... **“anything other than the main grid”**
(Source: World bank, 2020, p.2)



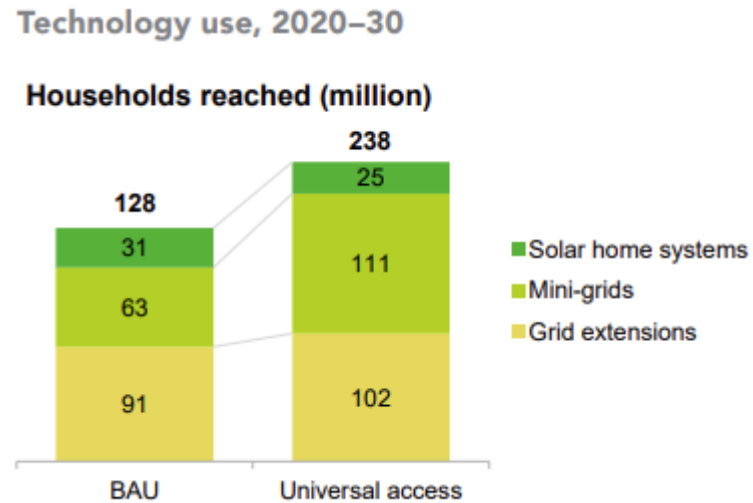
Source: www.sweetcrudereports.com

The context

The „power“ of mini-grids

To ensure universal electricity access, 238 million households need to get “connection”

- Mini-grids can provide nearly 50% (136 households with the WB definition, 62%)
- Mini-grids are a middle way in terms of costs:
lower than SHS – but higher than grid extension



Source: SE4All, 2020

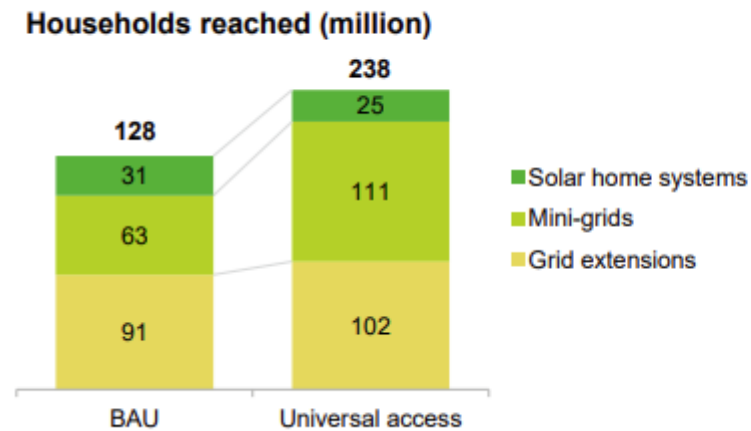
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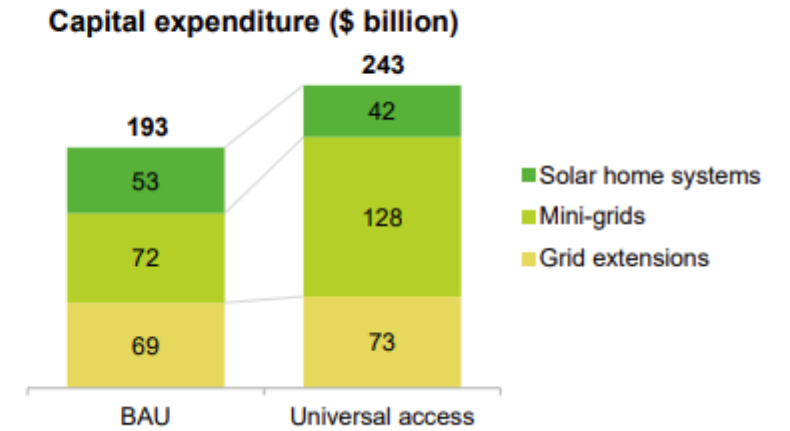
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Technology use, 2020–30



Estimated capital expenditure, 2020–30



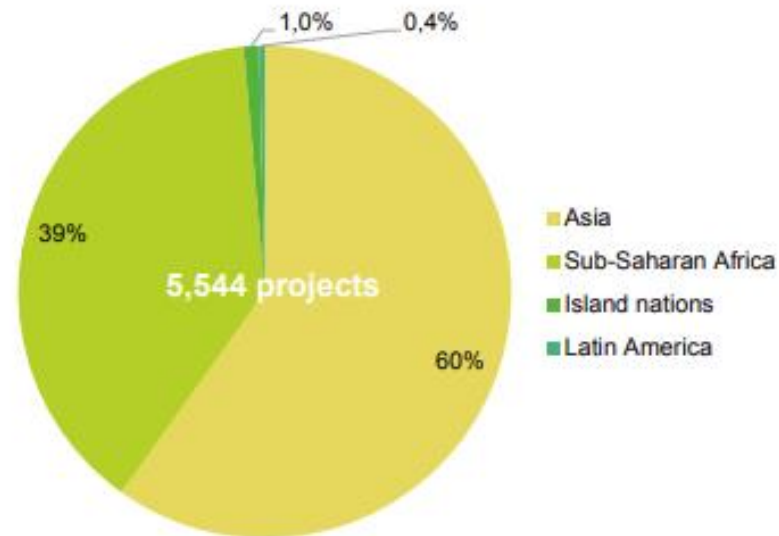
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The context

The „power“ of mini-grids

Where are mini-grids installed?

Installed mini-grids by region

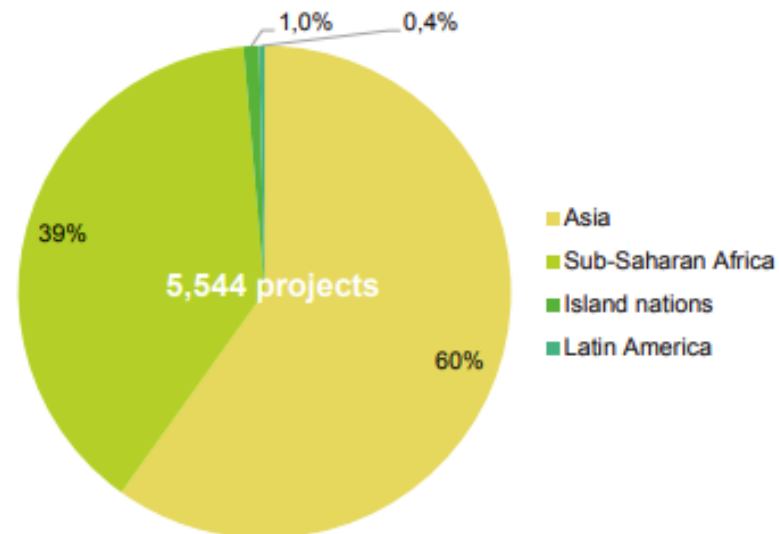


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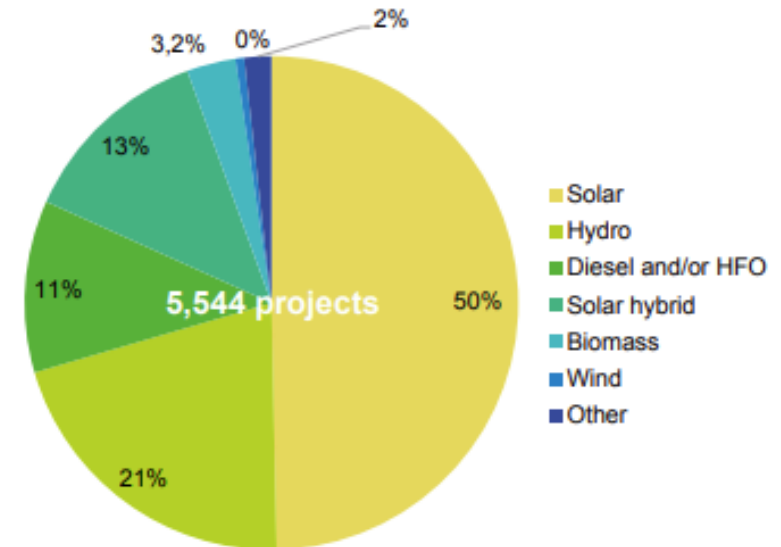
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Installed mini-grids by region



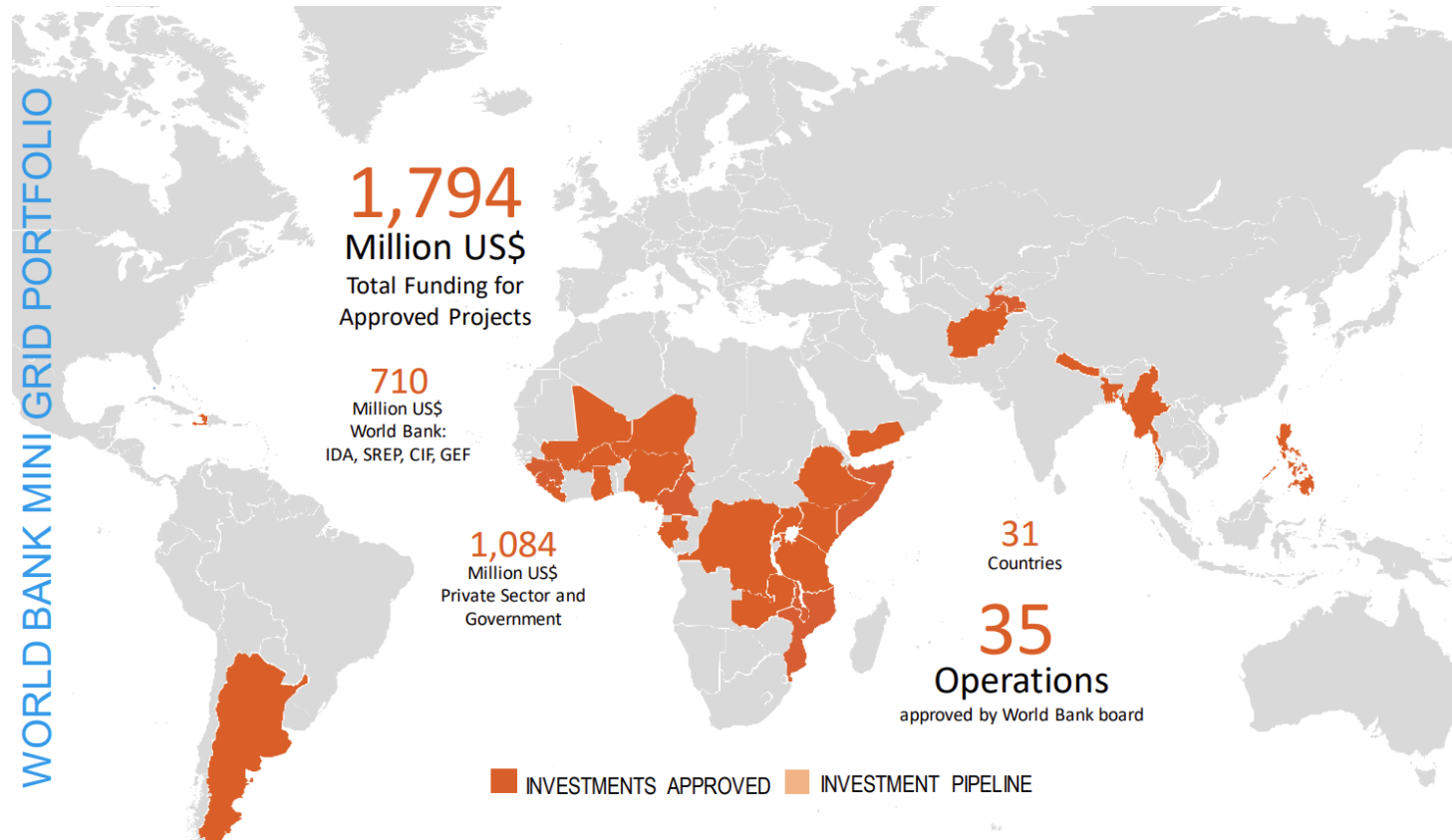
What type of mini-grids are installed?

Installed mini-grids by technology



The context

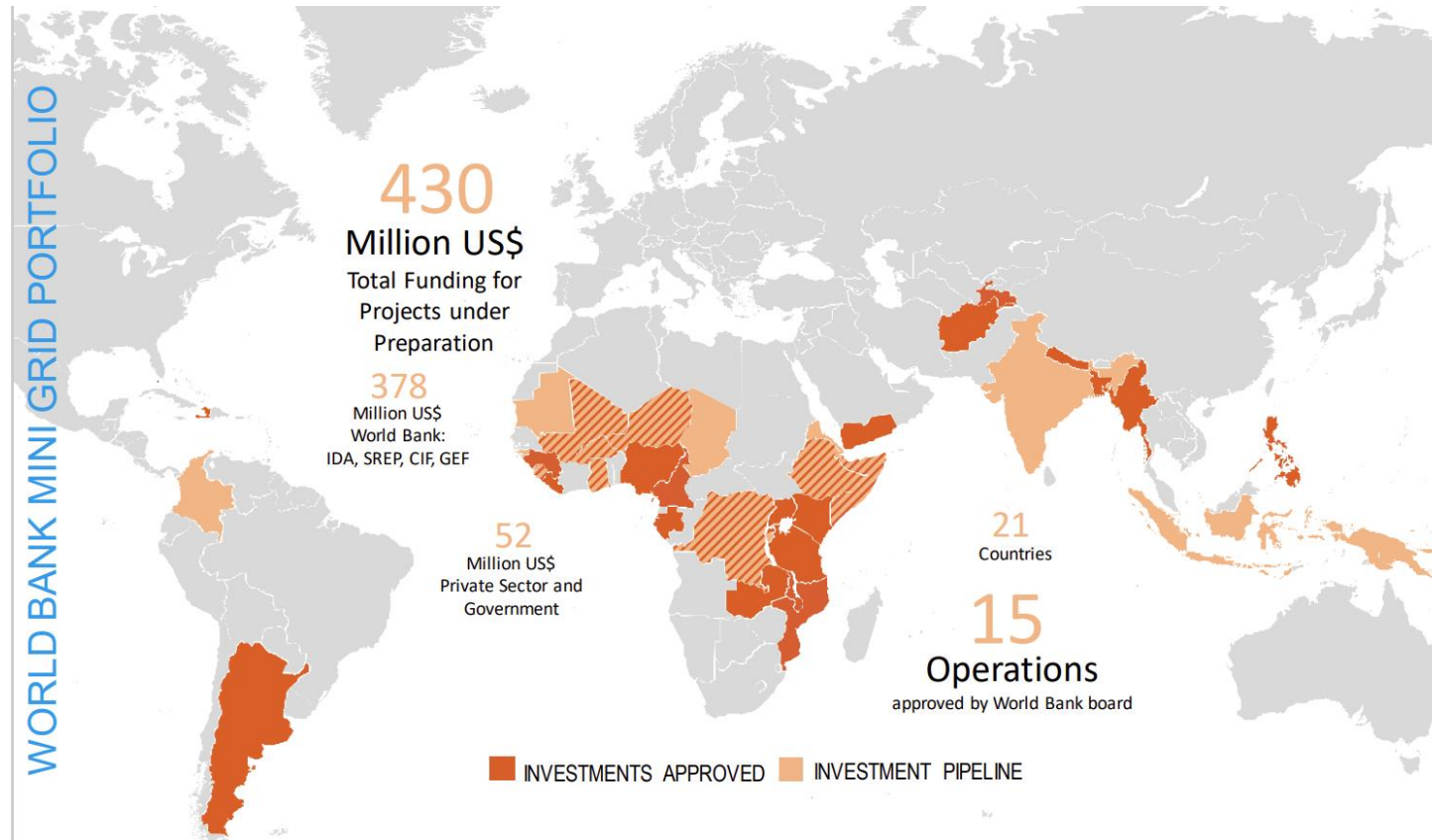
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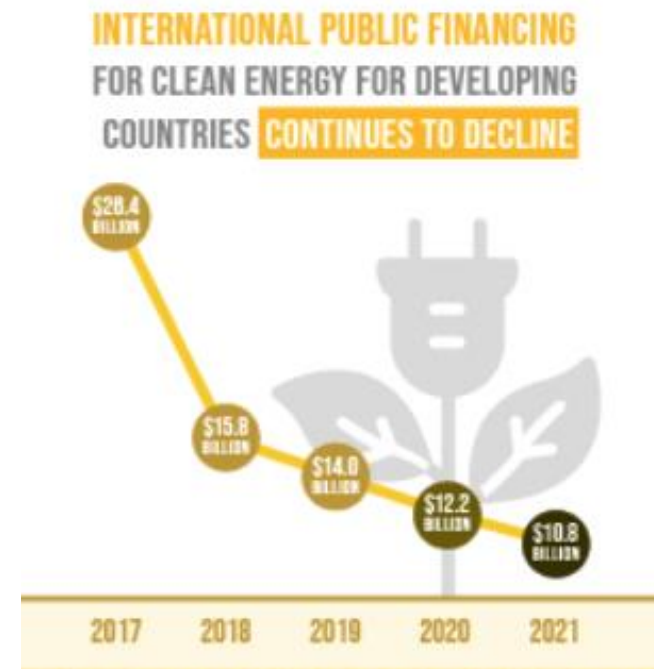
The challenges

The bad side of mini-grids?

- About 10% population without access to energy
- Mini-grids may provide about 50-60% of the missing access

But:

- Public investment in the field of RE energy access declining!
Reminder: WB investing 1,7 billion in 2020 and 0,4 billion planned



Source: UN, Goal 7 | Department of Economic and Social Affairs (un.org)

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- Mini-grids are getting ever less costly!

For comparison:
electricity prices in many countries
worldwide around 0.1-0.2 \$/kWh

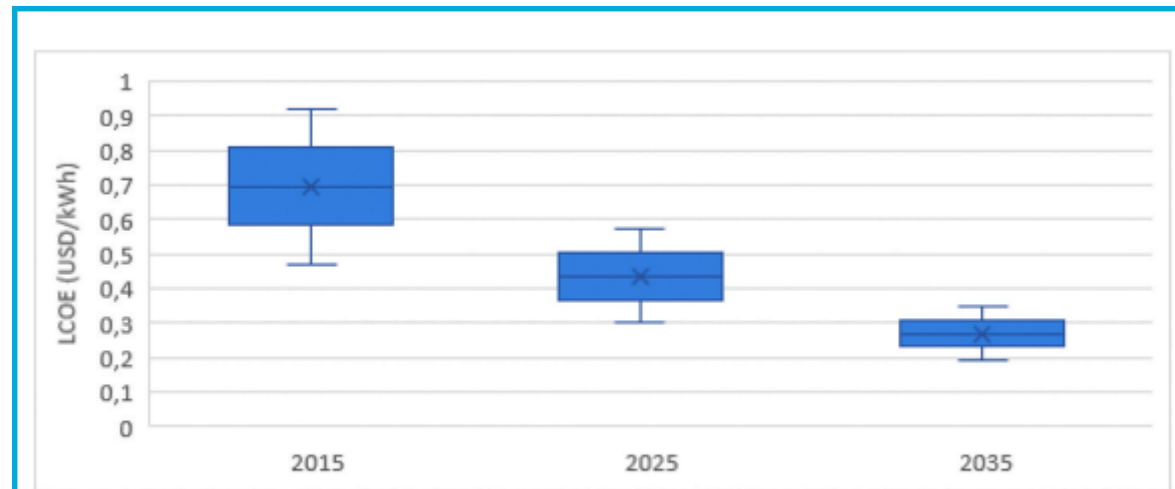


Fig. 2. LCOE for mini-grids in general (2015–2035). Based on IRENA [22].

Source: Come Zebra et al. 2021

The challenges

Technology specific costs

- For all RE technologies costs are reducing
- Mini-grids are getting ever less costly!

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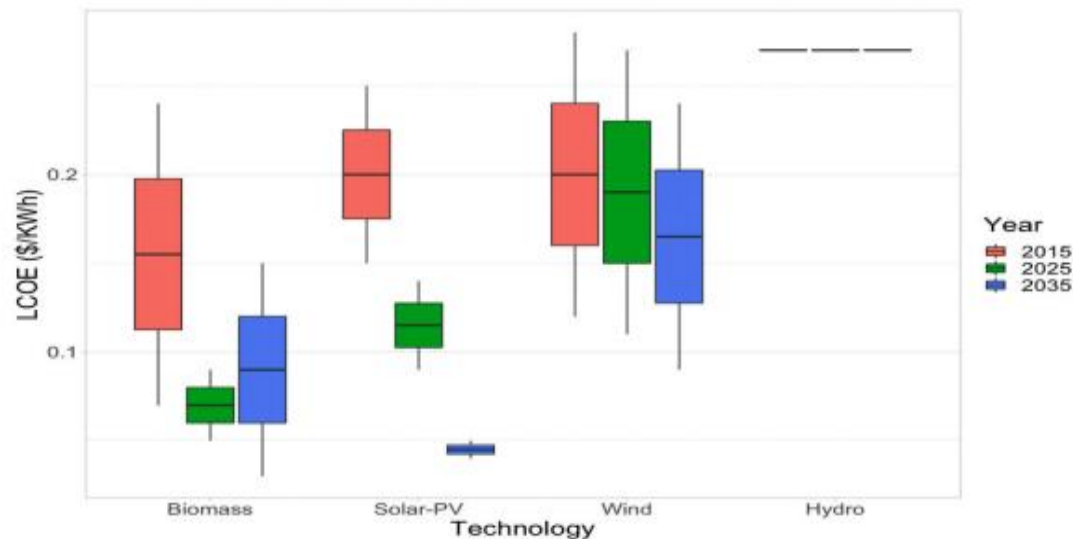
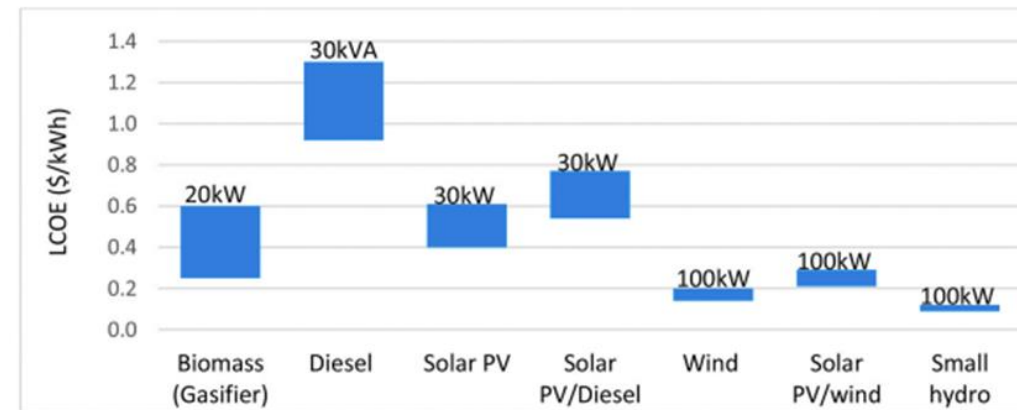


Fig. 3. LCOE for different mini-grids (2015–2035). Based on IRENA [22].

Source: Come Zebra et al. 2021

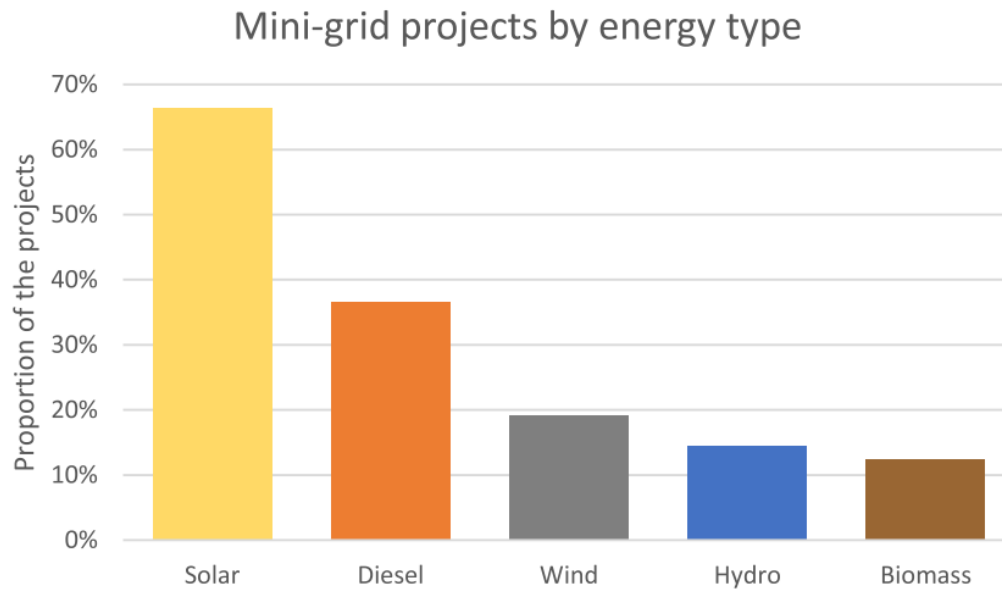


Source: Come Zebra et al. 2021

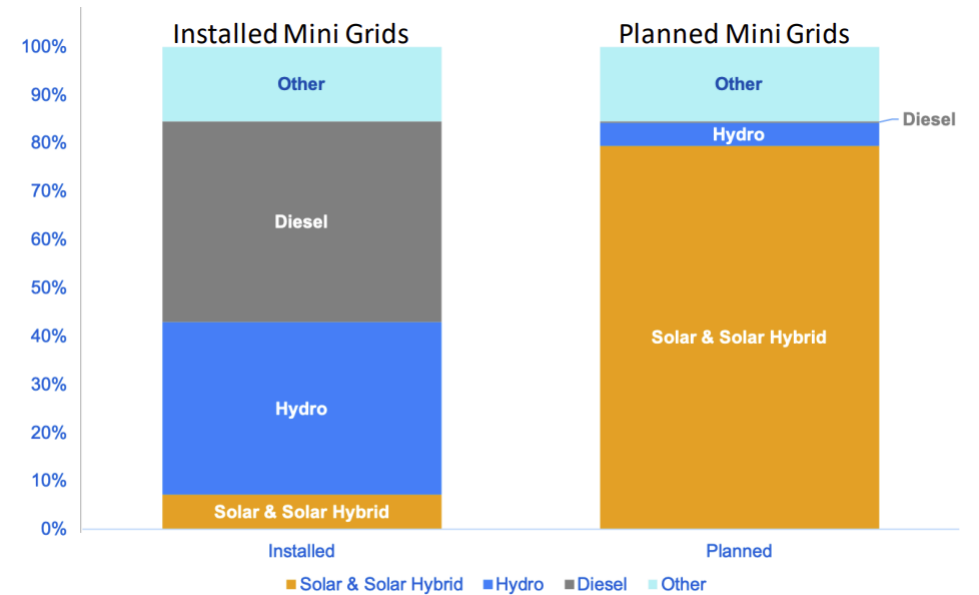
The challenges

Technology specific costs and plans

- For all RE technologies costs are reducing
- Mini-grids are getting ever less costly!
- **And nearly all plans are RE based!!**



Source: Duran and Sahinyazan 2021



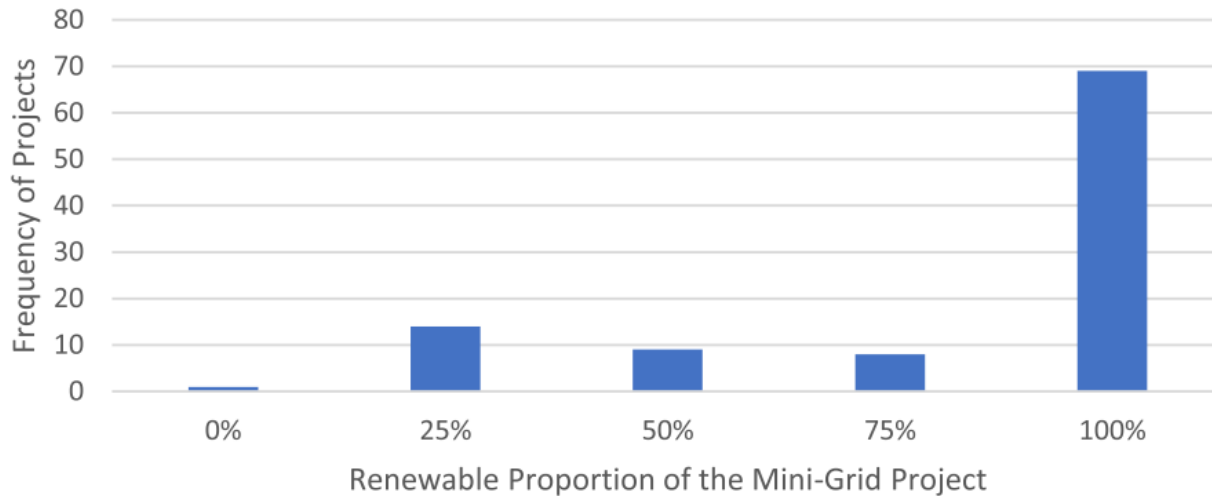
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Technology specific costs and plans

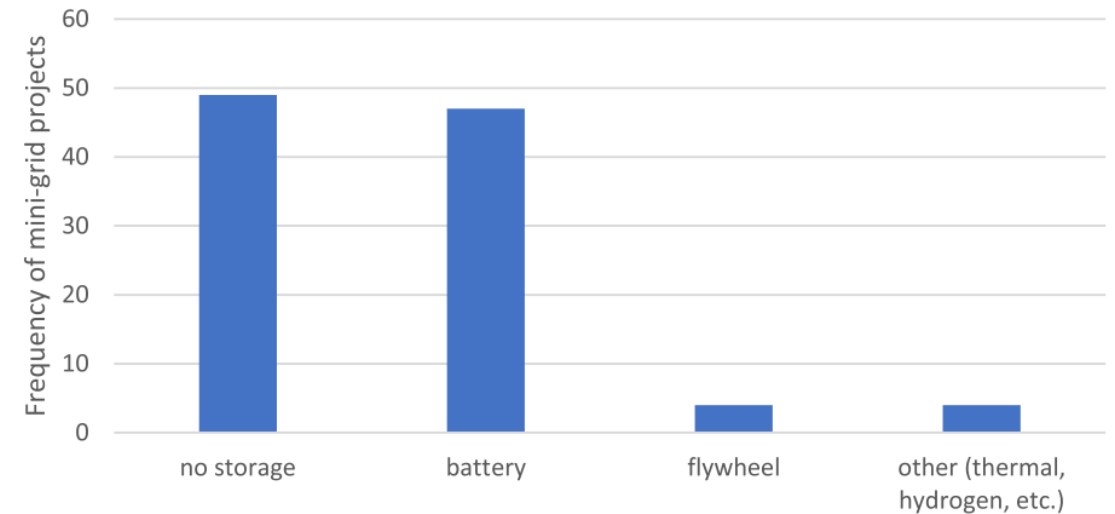
- **Batteries:** - high capital costs → decreasing trend!
- but also higher energy supply rate

Histogram of the proportion of renewable generation in the mini-grid



Source: SE4All 2020

Mini-grid projects by energy storage types

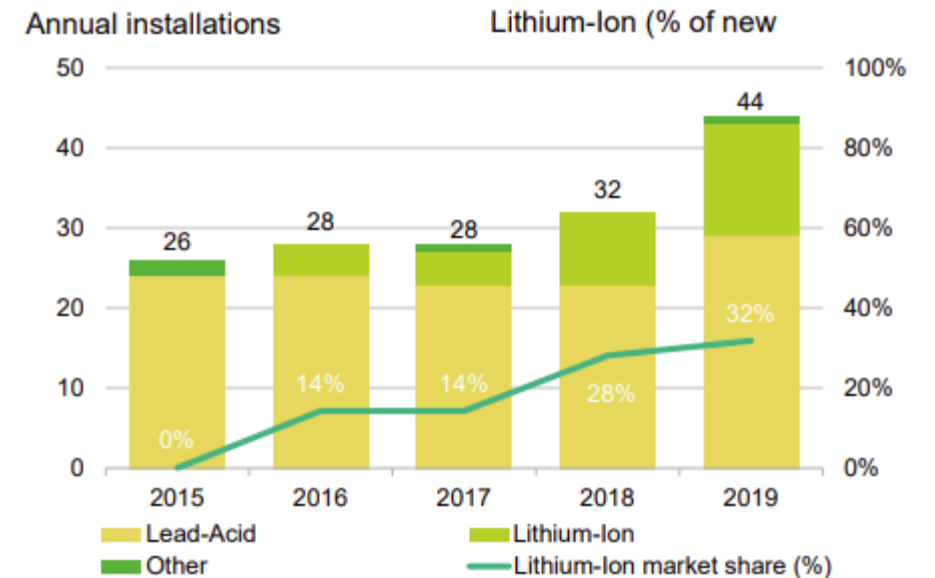


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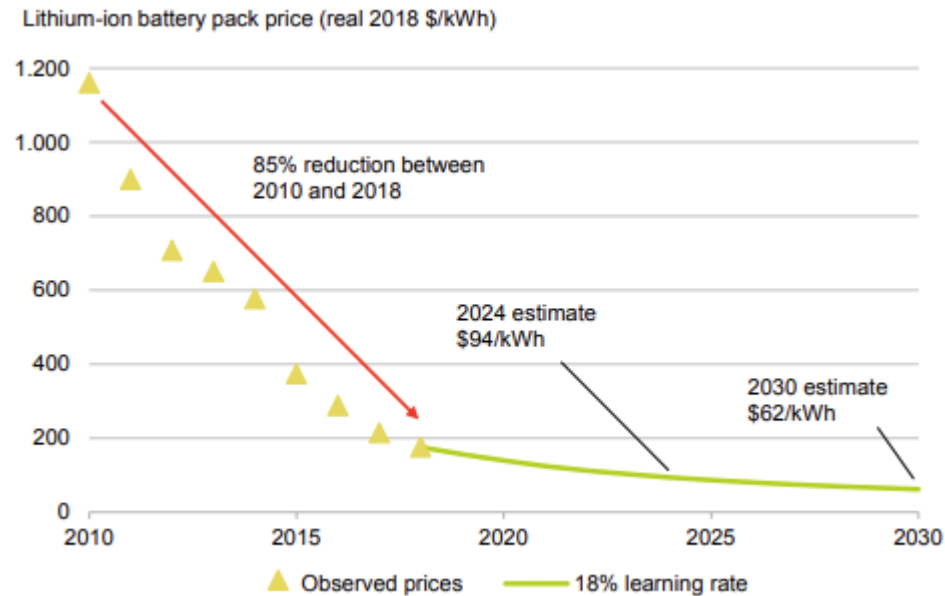


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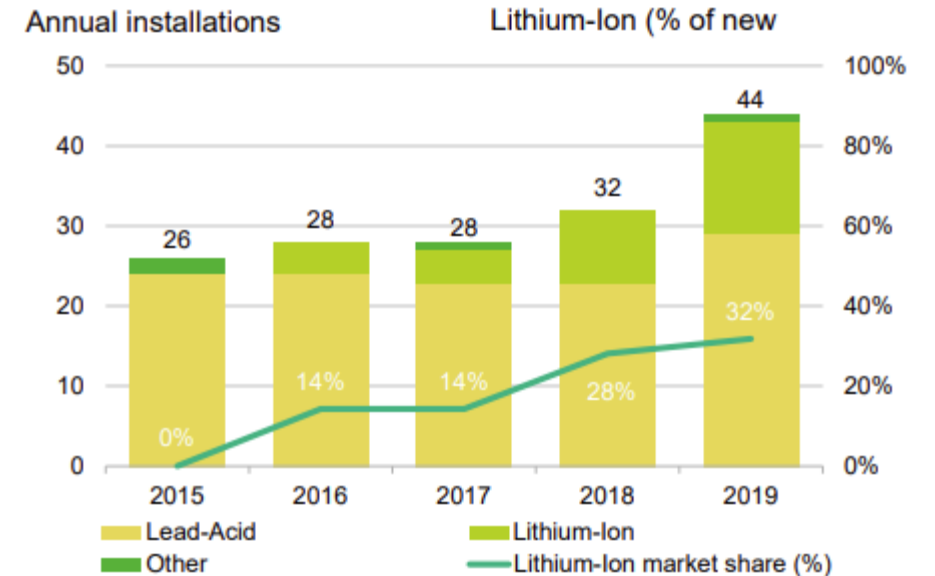
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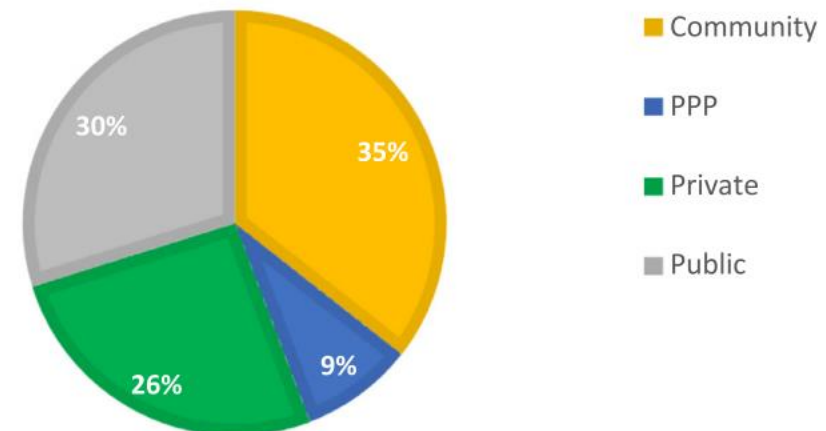
Source: SE4All 2020

The challenges

The forgotten spot: social integration

- Research on 29 projects in sub-Saharan Africa showed that 60% of the minigrids are abandoned six months after being implemented! (Ikejemba 2017)
- Main reasons: Publicly funded and yet now “owned” by the community
 - Lack/absence of **local maintenance**
 - Lack of **acceptance** of the technology
 - Lack of **knowledge transfer** about the system from the installation organization to the locals leading to overload

Ownership distribution of the mini-grid projects



Source: Duran and Sahinyazan, 2021

The challenges

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 - Lack/absence of local maintenance
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Success determinants:

*“On the other hand, **successful projects** all across the globe share one common property: **having local community ownership**. Top-down approaches that exclude the community’s voices in project development almost always fail over the long term”*

(Duran & Sahinyazan, 2021, [Why renewable energy 'mini-grids' in remote communities fail and how to avoid it \(theconversation.com\)](#))

Source: SE4All 2020

Recap

- Mini-grids have the potential to provide universal energy access
 - Cost effectively
 - Renewable based
 - Decentralized
- But...
 - Investment costs are often very high
 - Funding schemes are required
 - **AND: projects need to be community owned to be successful on the long term**



References

Come Zebra et al. 2021. A review of hybrid renewable energy systems in mini-grids for off-grid electrification in developing countries. *Renewable and Sustainable Energy Reviews* Volume 144, July 2021, 111036, <https://doi.org/10.1016/j.rser.2021.111036>.

Duran and Sahinyazan. 2021. Meta-analysis data of 104 renewable mini-grid projects for rural electrification. *Data in Brief* 34 (2021) 106739. <https://doi.org/10.1016/j.dib.2021.106739>; 10.1016/j.seps.2020.100999.

Ikejemba et al. 2017. *The empirical reality & sustainable management failures of renewable energy projects in Sub-Saharan Africa (part 1 of 2)*. *Renewable Energy*. Volume 102, Part A, March 2017, Pages 234-240. <https://doi.org/10.1016/j.renene.2016.10.037>

World Bank 2018. Access to Energy is at the Heart of Development. FEATURE STORY APRIL 18, 2018 Link: <https://www.worldbank.org/en/news/feature/2018/04/18/access-energy-sustainable-development-goal-7#:~:text=The%20World%20Bank%20has%20a%20long%20track%20record,for%20example%2C%20through%20programs%20such%20as%20Lighting%20Global>. (Last accessed: 20.09.2023)

World Bank (Jon Exel) 2020. Mini Grids: Lessons Learned from Around the World. World bank presentation and report. Link: [3.1 Mini Grids Overview - Jon Exel - Addis.pdf \(esmap.org\)](https://www.esmap.org/sites/default/files/Presentations/3.1%20Mini%20Grids%20Overview%20-%20Jon%20Exel%20-%20Addis.pdf), <https://www.esmap.org/sites/default/files/Presentations/3.1%20Mini%20Grids%20Overview%20-%20Jon%20Exel%20-%20Addis.pdf> (Last accessed: 20.09.2023)

SE4ALL. State of the Global Mini-grids Market Report 2020. Trends of renewable energy hybrid mini-grids in Sub-Saharan Africa, Asia and island nations. 2020. Link: <https://www.seforall.org/system/files/2020-06/MGP-2020-SEforALL.pdf> (Last accessed: 20.09.2023)