



**Is a grid connection the best solution?  
Frequently overlooked arguments assessing  
centralized electrification pathways**

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- Insufficient power generation facilities in many regions
- Expensive power generation costs
- Outdated infrastructure
- Unreliable grid electricity access
- Dependence on fossil fuel imports



Energy kiosk – Extreme Nord, Cameroon (Cader, 2014).



Broken power pole – Hatiya Island Bangladesh (Bertheau, 2014).



Diesel generator with diesel storage tank – Arusha, Tanzania (Cader, 2015).



Diesel generator repair shop – Dar es Salaam, Tanzania (Cader, 2015).

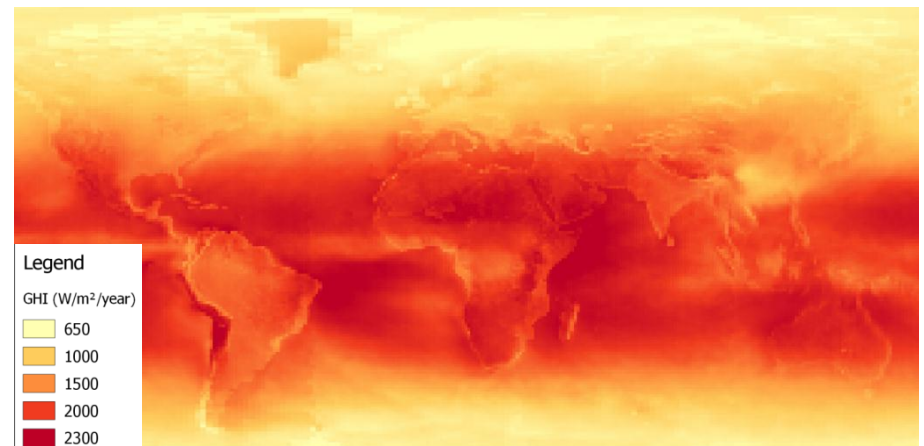
- Renewable energy potentials
- Technology development
- Governmental incentives
- In many regions “the grid” is still perceived as most desirable solution
- New pathways to providing sustainable electricity are developing



Power pole without the grid – Village near Morogoro, Tanzania (Cader, 2015).

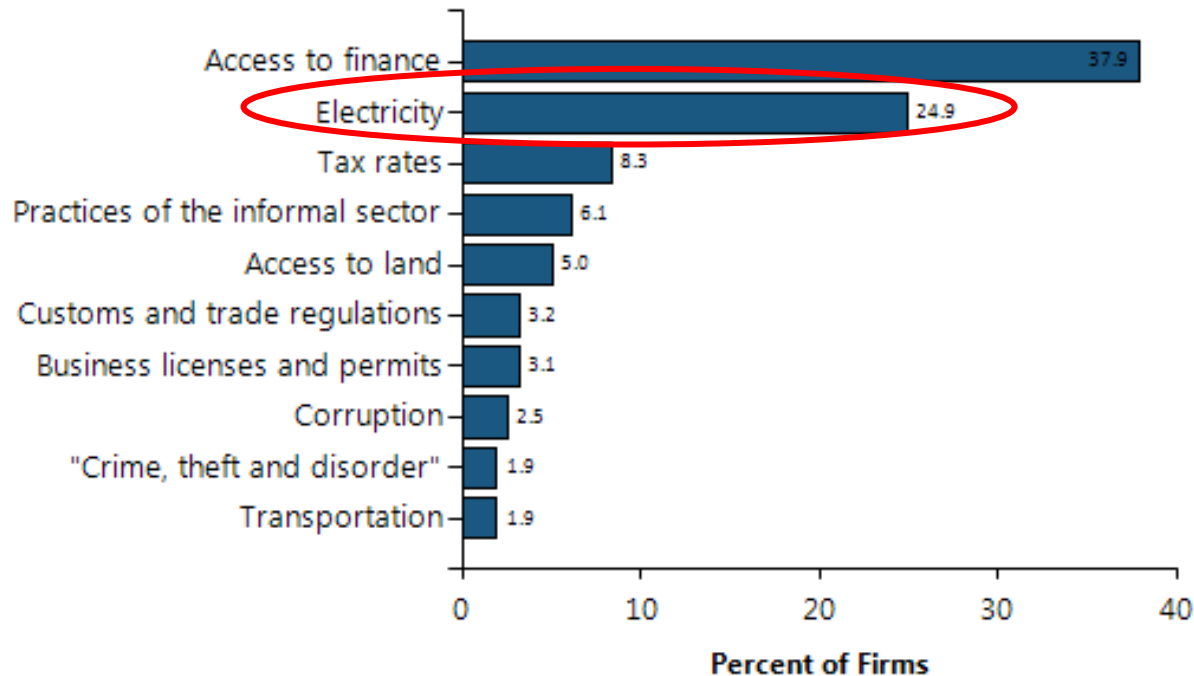


Solar home system & distribution grid, Hatiya Island Bangladesh (Bertheau, 2014).



Average global horizontal irradiance.

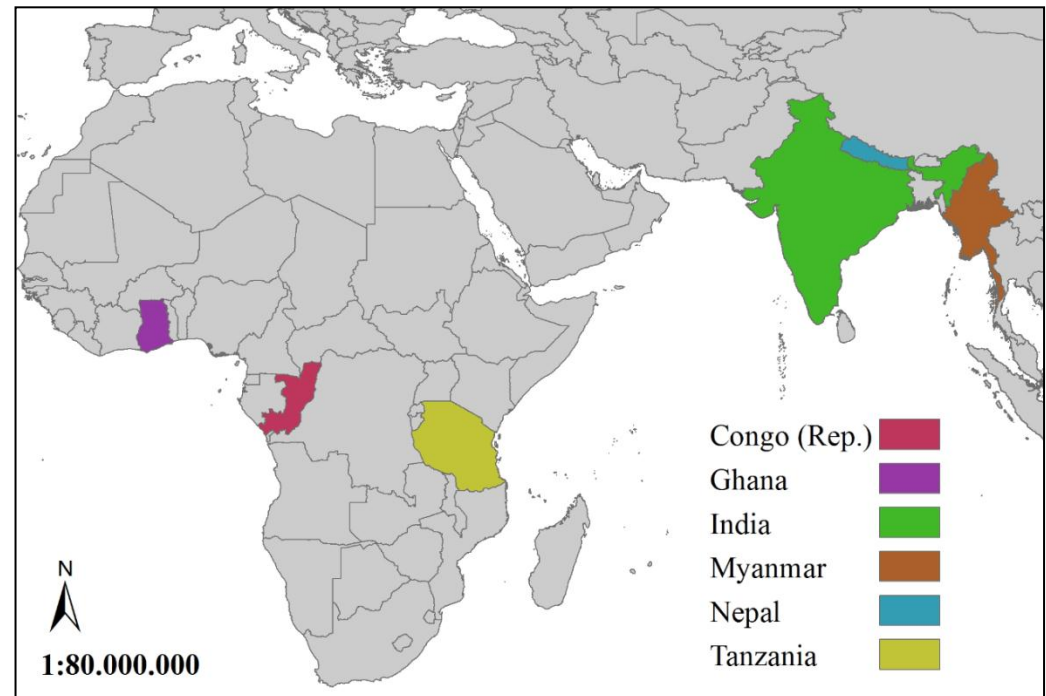
- World Bank Enterprise Surveys:  
Top 10 Business Environment Constraints in Tanzania in 2013



Source: Enterprise Surveys: <http://www.enterprisesurveys.org/data/exploreconomies/2013/tanzania>

Different countries with insufficient electricity supply were chosen to reflect a diverse sample of countries.

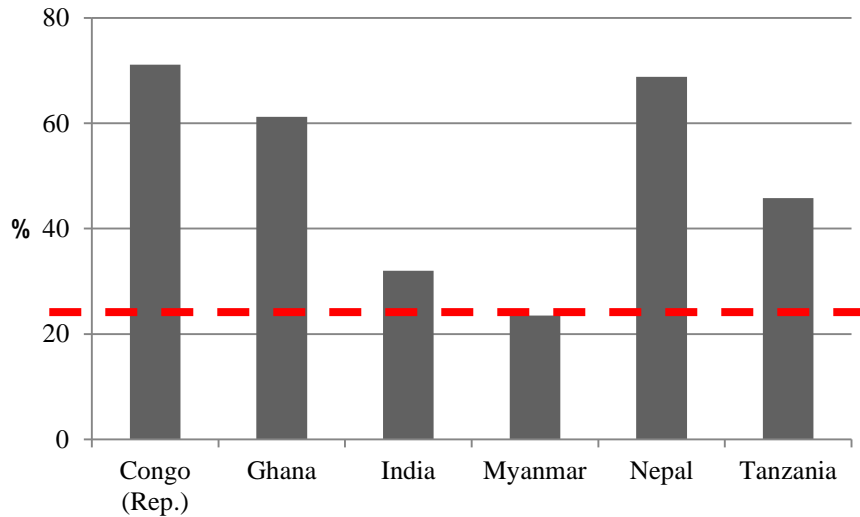
Country	El. rate total (%) <sup>1)</sup>	El. rate rural (%) <sup>1)</sup>	HDI Rank <sup>2)</sup>
Congo (Rep.)	37	9	140
Ghana	61	38	138
India	75	67	135
Myanmar	49	28	150
Nepal	76	72	145
Tanzania	15	4	159



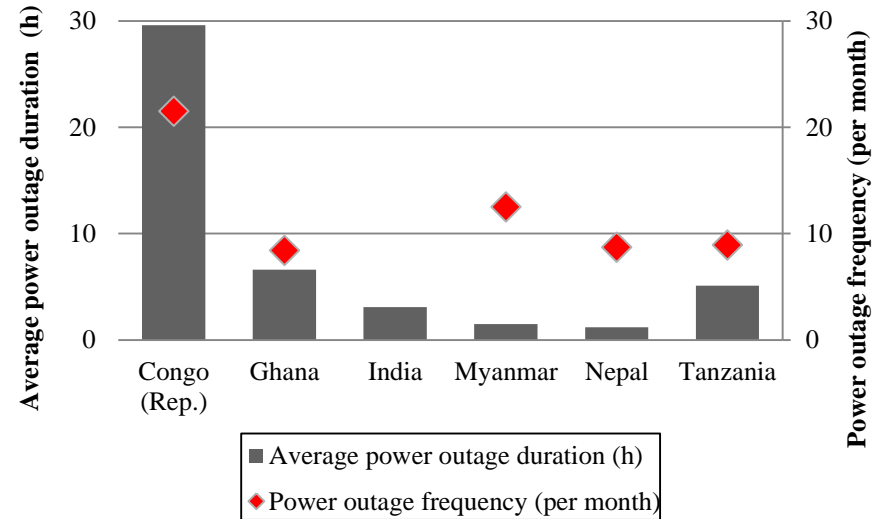
<sup>1)</sup> IEA World Energy Outlook 2013 Electricity Database

<sup>2)</sup> HDI refers to the Human Development Index 2013. <http://hdr.undp.org/en/data>

- Electricity use opens up business opportunities – a lack is a huge constraint



Percentage of firms identifying the lack of electricity as a major constraint



- When looking at power outage frequency and duration a discussion about the definition of electricity access is inevitable

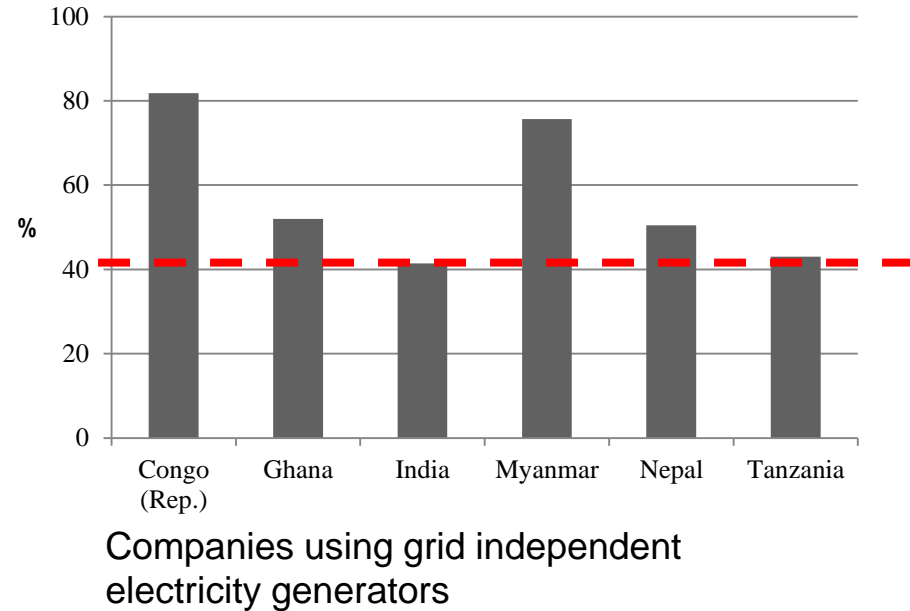
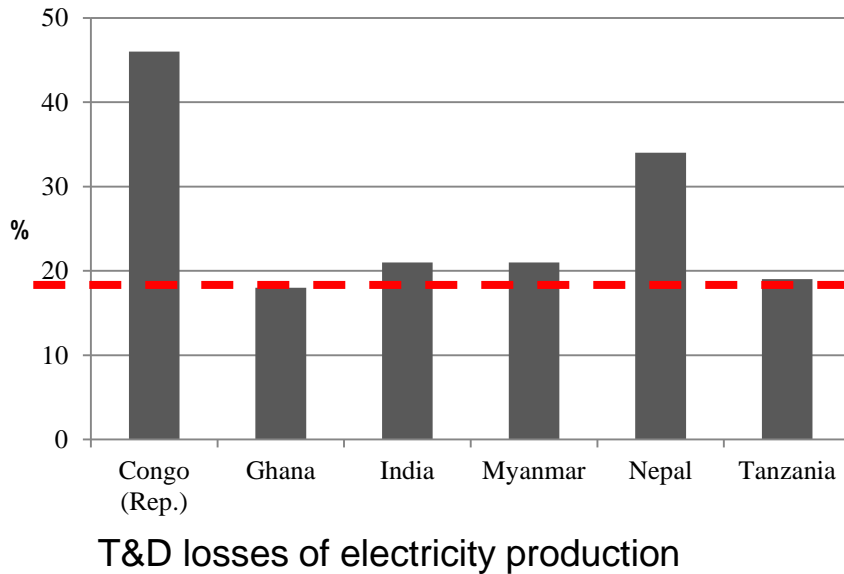
→ 5 tier framework of ESMAP

## MULTI-TIER MATRIX MEASURING ACCESS TO HOUSEHOLD ELECTRICITY

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity	No electricity	1-50W	50-500W	500-2000W	>2000W	
Duration	<4hrs	4-8hrs		8-16hrs	16-22hrs	>22hrs
Reliability	Unscheduled outages				No unscheduled outages	
Quality	Low quality			Good quality		
Affordability	Not affordable		Affordable			
Legality	Not legal			Legal		
Health & Safety	Not convenient				Convenient	

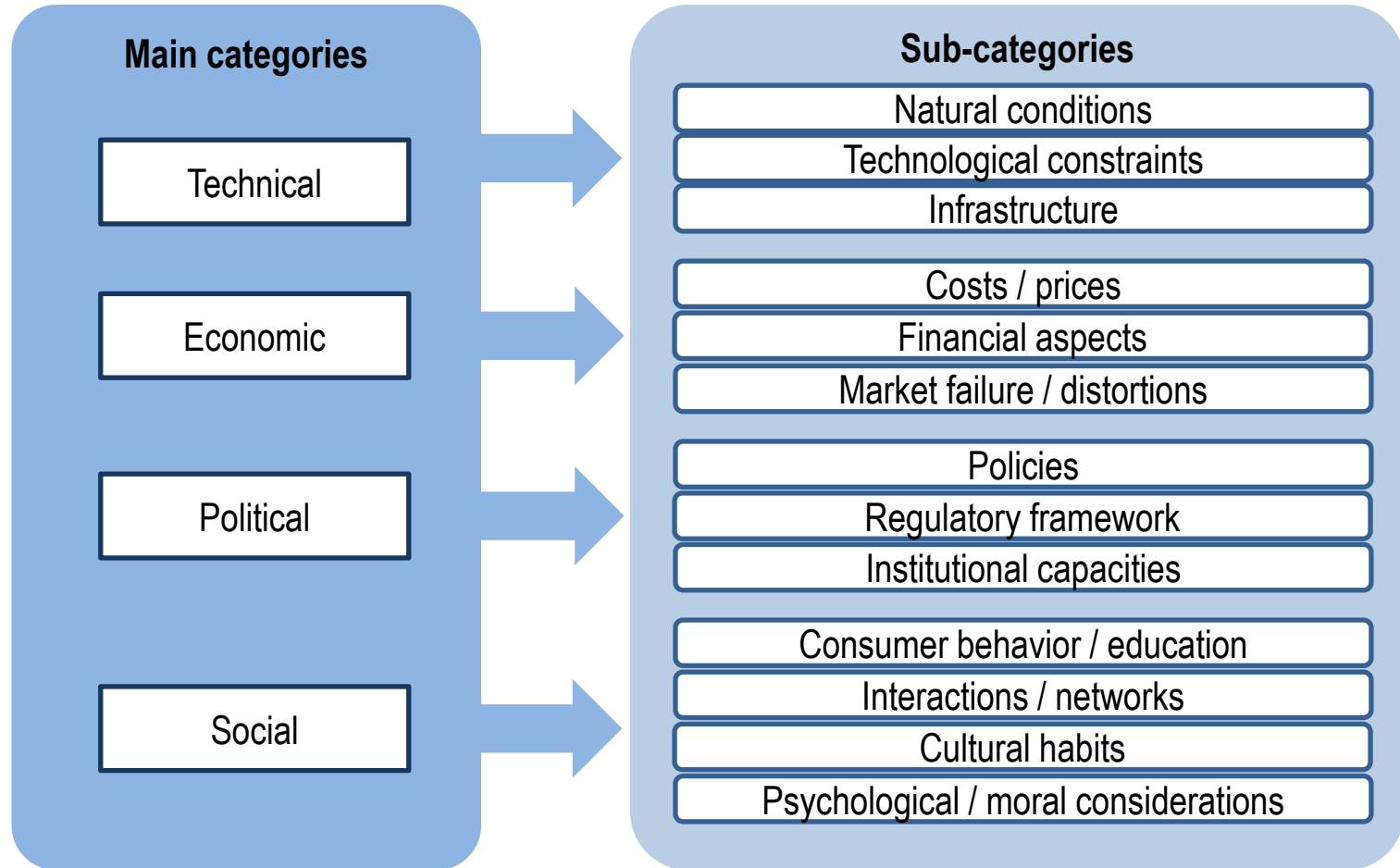
Source: ESMAP, 2014. [http://www.esmap.org/sites/esmap.org/files/DocumentLibrary/Multi-tier%20BBL\\_Feb19\\_Final\\_no%20annex.pdf](http://www.esmap.org/sites/esmap.org/files/DocumentLibrary/Multi-tier%20BBL_Feb19_Final_no%20annex.pdf)

- Grid electricity has many challenges:
  - Theft, technical losses
  - Heavy reliance on subsidies



Independent installed systems are decentralized energy supply systems  
- installed from the bottom up for productive use!





Source: Blechinger et al. (2014): Barriers and solutions to the development of renewable energy technologies in the Caribbean

- In the past, central generation with respective transmission infrastructure has proven to be functional in many places
- Today, grid connection does not necessarily refer to reliable electricity supply
- Independent self-generation is a consequence of weak grids already in place
- Barriers of RE and decentralized energy systems need to be addressed



PV-Battery System, Tanzania (Cader, 2015).

With addressing barriers of RE and decentralized energy systems sustainable economic and ecologic) electrification pathways can be developed



# Thank you!



## Main categories

### Technical

## Sub-categories

Natural conditions

Technological constraints

Infrastructure

Costs / prices

Financial aspects

Market failure / distortions

## Barriers

1.1.1 Land use competition on islands

1.1.2 RE impact on landscapes and ecosystems

1.1.3 Natural disasters

1.1.4 Lack of evidence-based assessment of RE potentials

1.2.1 Lack of technical expertise and experience

1.2.2 Low availability of RE technologies

1.3.1 Inappropriate transport and installation facilities

1.3.2 Unsuitable transmission system and grid stability issues with decentralized RE

2.1.1 High initial investments

2.1.2 High transaction costs

2.1.3 Diseconomy of scale

2.2.1 Lack of access to low cost capital or credit

2.2.2 Lack of understanding of project cash flows from financial institutions

2.2.3 Lack of private capital

2.3.1 Utility monopoly of production, transmission and distribution of electricity

2.3.2 Small market sizes

2.3.3 Lock-in dilemma

2.3.4 Fossil fuel subsidies and fuel surcharge

### Economic

