### Quality of Electrification in Off-Grid Philippine Islets Using the World Bank's Multi-Tier Framework of Energy Access: Case Study of Cobrador, Gilutongan and Pangan-an Islands

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## Outline

- Electricity access and development
- Status of electricity access: Philippines
- Multi-Tier Framework of electricity access
- Study environment
- Methodology
- Key results and findings
- Disruptive technologies and electricity access







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### **Electricity access and development**

**SDG 7** Ensure access to affordable, reliable, sustainable and modern energy for all by **2030** 

AFFORDABLE AND CLEAN ENERGY

**Philippine DOE Goal** 

100% electrification by **2022** 



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### Status of electricity access: Philippines







RG) Southampton



### Status of electricity access: Philippines

#### **Electrification Status (Binary Metric)**



#### Usual interpretation:

- Electrified areas enjoy the full-range of electricity services
- Non-electrified areas have
  no access to any form of
  electricity at all

**Reality**: usual interpretation is **not true**; electricity access exists in a **continuum** 

#### Need identified by World Bank/ESMAP:

Monitor and evaluate electricity access using a multidimensional approach







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### **ESMAP Multi-Tier Framework of EA**



Multidimensional description of electricity access: Attributes and **Tier Levels** 



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### **ESMAP Multi-Tier Framework of EA**

			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
ATTRIBUTES		Power		Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2kW
		capacity ratings (in W or daily Wh)		Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 3.4 kWh	Min 8.2 kWh
	1. Peak Capacity	OR Services		Lighting of 1,000 lmhr/day	Electrical lighting, air circulation, television, and phone charging are possible			
	2. Availability (Duration)	Hours per day		Min 4hrs	Min 4hrs	Min 8hrs	Min 16hrs	Min 23hrs
		Hours per evening		Min 1hr	Min 2hrs	Min 3hrs	Min 4hrs	Min 4hrs
	3. Reliability				Max 14 disruptions per week	Max 3 disruptions per week of total duration <2 hrs		
	4. Quality				Voltage problems do not affect the use of desired appliances			
	5. Affordability					ndard consumption package of 365 % of household income		
	6. Legality (Formality)				Bill is paid to the utility, prepaid card seller, or authorized representative			
	7. Health & Safety					Absence of past accidents and perception of high risk in the future		

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### **ESMAP Multi-Tier Framework of EA**

- Having an electricity connection does not necessarily mean having access to electricity under the new definition
- Satisfactory household electricity access is the ability to avail electricity that is adequate, available when needed, reliable, of good quality, affordable, legal, healthy and safe for all required energy services
- Global survey for multi-tier energy access tracking has been designed, with the major objectives of:
  - 1) Establish a global baseline of energy access
  - 2) Transfer capacity to national statistical offices to keep tracking progress
  - **3) Continue improving tools and capacities** for tracking progress towards reaching the objective of universal access to modern energy services by 2030
  - 4) Provide reliable data on energy sector that can meet needs of multiple stakeholders, including government, regulators, utilities, project developers, civil society organizations, developmental agencies, financial institutions, appliance manufacturers, international programs and the academia







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### Study environment





**Cobrador Island** Romblon, Romblon 12°39'32.63"N 122°14'23.51"E



#### Pangan-an Island

Lapu-lapu City, Cebu 10°13′08.30″N 124°02′21.33″E





Gilutongan Island Cordova, Cebu 10°12′24.24″N 123°59′18.91″E







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## Study environment

Name of island	Gilutongan	Pangan-an	Cobrador	
Administrative classification	Island barangay of Cordova, Cebu	Island barangay of Lapu-lapu City, Cebu	Island barangay of Romblon, Romblon	
Land area	11 ha	42 ha	264 ha	
# of households	342	375	239	
Population	1,875	1,765	856	
Primary livelihood	Fishing, seaweed farming, seafood vending, labor/services	Fishing, shell craft making, labor/services	Fishing, boat-making, small-scale marble mining, labor/services	
Main electricity supply for households	155 kW diesel generator	30 kW diesel generator	Hybrid (30 kWp solar PV, 180 kWh battery, 15 kW diesel generator)	
Electrical system operator	Barangay local government unit	Multipurpose cooperative: PICCD	Electric cooperative: ROMELCO	
Operating hours	6-10pm (4 hrs)	6-10pm (4 hrs)	24 hrs	
Electricity rate	PhP 7 per lamp, PhP 8 per outlet (collected daily)	PhP 250 for first 7 kWh, PhP 25 per excess kWh	PhP 15 per kWh	







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## Methodology

- Data-gathering tools: survey questionnaire, observation, face-to-face interviews
- Survey questionnaire to obtain data on: electricity-powered HH appliances/devices, electricity supply, operating hours, power disruptions, damage to appliances, payment amount, collection method, electricity-related accidents, and other relevant data
- Number of survey respondents: Gilutongan 145 out of 342; Panganan – 175 out of 375; Cobrador – 123 out of 239
- Sampling method: stratified random sampling







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#### **Gilutongan Island**

			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
	1. Peak Capacity		3.4%	2.1%		93.8%		0.7%
	2. Availability	Day	94.5%	4.8%			0.7%	
	(Duration)	Evening	4.8%			<mark>95.2%</mark>		
UTES	3. Reliability				3.4%	96.6%		
TTRIB	4. Quality			2.8	97.2%			
A	5. Affordability		99.3%				0.7	7%
	6. Legality (Formality)		4.8%					<b>95.2%</b>
	7. Health & Safety		6.9%				<mark>93.1%</mark>	







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#### **Pangan-an Island**

			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
	1. Peak Capacity		26.9%	4.0%	4.0%	<mark>65.1%</mark>		
	2. Availability	Day	38.3%		60.6%	0.6%		0.6%
	(Duration)	Evening	32.0%				31.4%	36.6%
UTES	3. Reliability				9.1%	90.9%		
ATTRIB	4. Quality			40.	<b>59.4%</b>			
	5. Affordability			92.	8.0	0%		
	6. Legality (Formality)		29.7%					70.3%
	7. Health & Safety		5.1%				94.9%	







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#### **Cobrador Island**

			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
	1. Peak Capacity		8.2%	6.6%		85.2%		
	2. Availability	Day	18.7%		6.5%	24.4%	5.7%	44.7%
	(Duration)	Evening	10.6%		4.1%	4.1%	2.4%	<b>78.9%</b>
UTES	3. Reliability				6.5%	<b>93.5%</b>		
TTRIB	4. Quality			20.3	79.7%			
A	5. Affordability			73.	26.8%			
	6. Legality (Formality)		5.7%					94.3%
	7. Health & Safety				11.4%			88.6%







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Electricity access attributes with low MTF ratings

	Gilutongan	Pangan-an	Cobrador	
Peak Capacity	Tier 3	Tier 3	Tier 3	
Availability	Tier 0	Tier 2		
Affordability	Tier 0	Tier 0	Tier 0	

- MTF affordability criterion: Cost of a standard consumption package of 365 kWh/year <5% of household income</p>
- Electrical energy rates:

Gilutongan: approx. PhP 75 per kWh Pangan-an: PhP 35 per kWh (1<sup>st</sup> 7 kWh) Cobrador: PhP 15 per kWh

 None of the 3 islands in this study benefit from government subsidy (Universal Charge for Missionary Electrification or UCME)







- Low Availability and Peak Capacity affects use of labor-saving devices
- Example: rice cooker (1 in Gilutongan, 3 in Pangan-an, 27 in Cobrador)
- Electricity cost for cooking rice: approx. PhP 3 (grid-connected)
- Attributes necessary for rice cooker to operate: Peak Capacity, Availability, Reliability, Voltage Quality, Affordability









# Disruptive technologies and EA

#### Opportunities

- Disruptive technologies that worked in other areas applied in the context of remote off-grid communities
  - Renewable energy
  - Energy storage
  - Distributed generation
  - Prepaid
  - Internet of Things
- Disruptive innovations
  - Electricity as a service in a sharing microeconomy









# Disruptive technologies and EA

### Challenges

- Political, economic, social, technical, legal, environmental
- Existing policies that hinder innovation
- Influencing policy change
- Collaboration among interdisciplinary researchers

### Risks

- Opportunism
- Social costs of electricity access









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