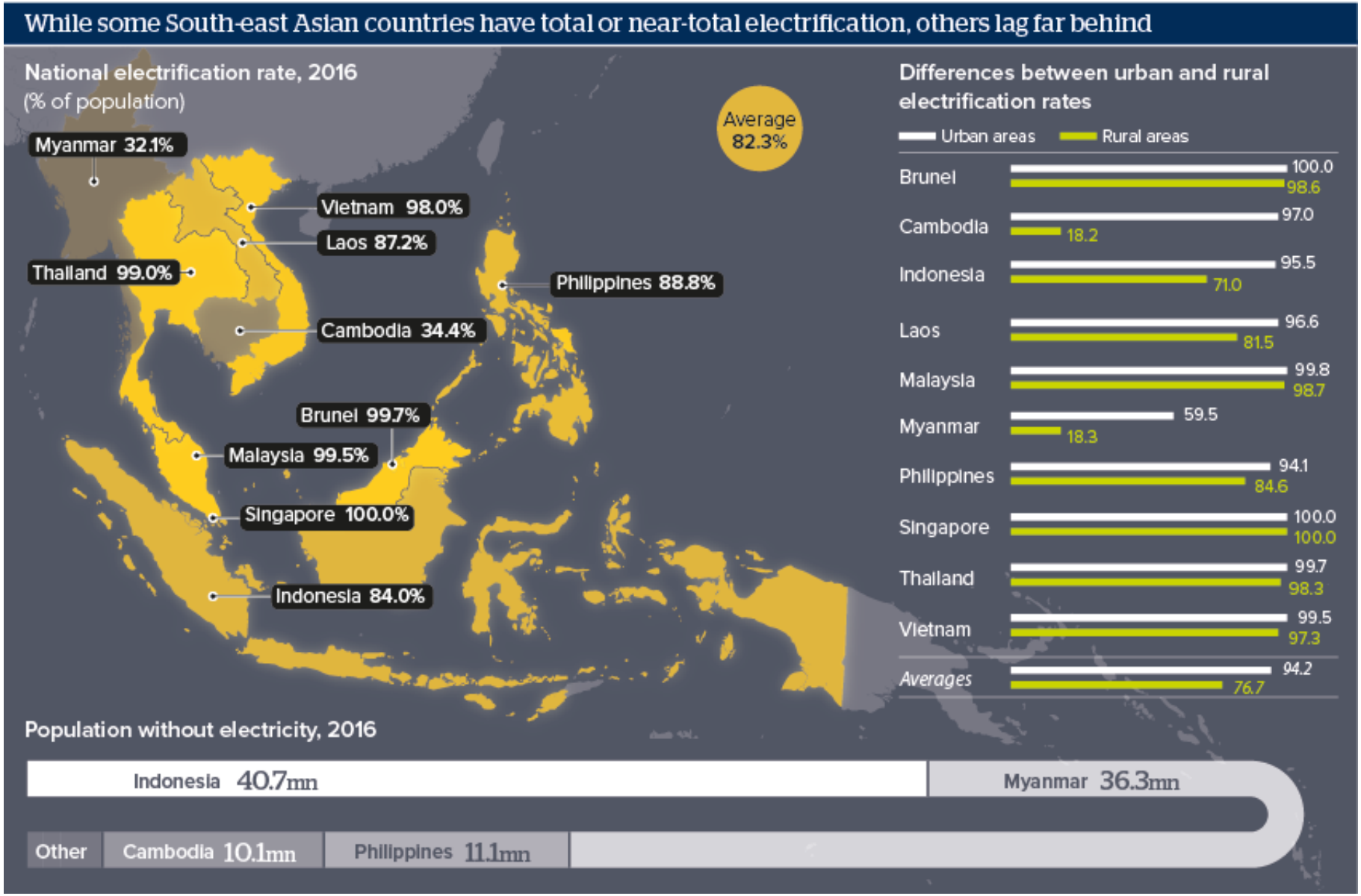
Rural Electrification Workshop

Date: June 24, 2019

Venue: Hilton double tree Kuala Lumpur

Time	Agenda
9:00	Registration of Participants
9:30	Welcoming Speech by Prof. Nasurdin (UMPEDAC)
	Introduction to the workshop by Prof. H. Ohgaki
9:45	Rural electrification experience sharing by Sarawak Energy Berhad
10:15	“Our Findings on the Impacts of Rural Electrification in ASEAN”, H. Ohgaki (Kyoto University)
10:45	“Power Sector Policy in Myanmar: lessons from stakeholder engagement”, M. Numata (University of Tokyo)
11:00	Tea break
11:30	Round Table Discussion
12:30	Lunch Break
13:30	Wrap up by R. Fukuhara (Kyoto U)
14:00	Workshop ends

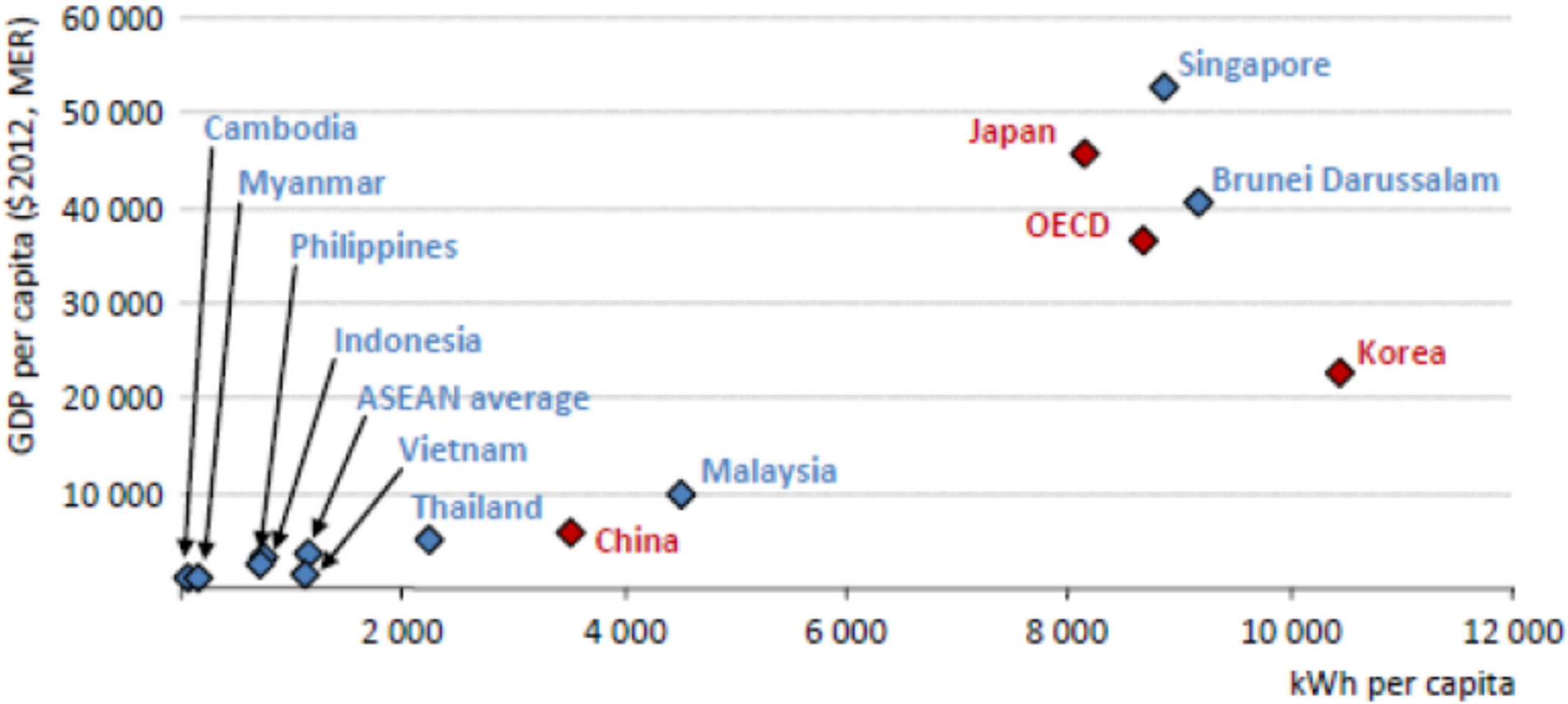


https://dailybrief.oxan.com/Analysis/GA220581/Uneven-electrification-will-affect-ASEAN-competition

Challenges

- *Lack of appropriate policy framework*
- *Lack of Financial feasibility (too low demand and high installation cost)*
- *Technical Capacities (local or sometimes poor products)*
- *Lack of knowledge and social acceptance*
- *Poor Technology Choice or Mismatching*

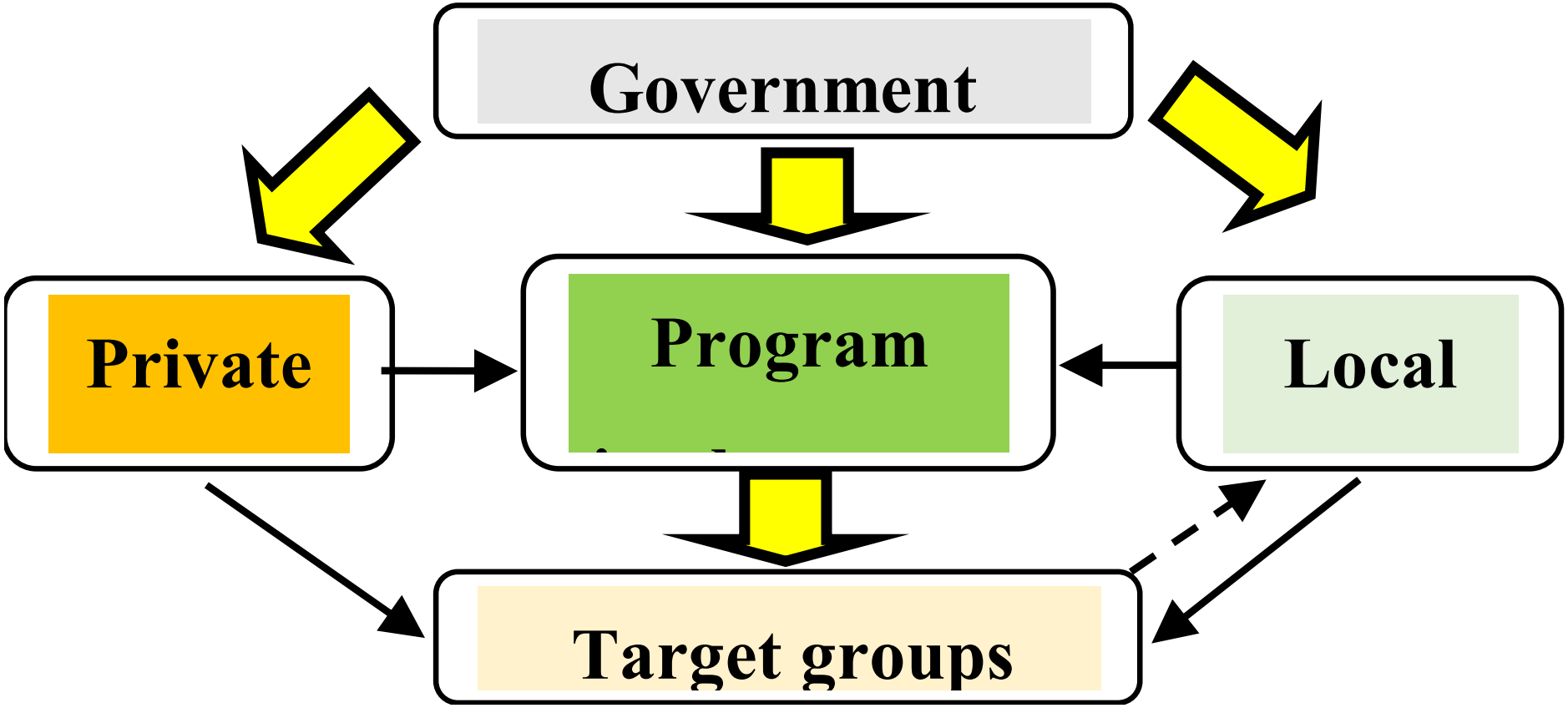
Per-Capita electricity demands and income in ASEAN, 2011



Notes: MER = market exchange rate. Lao PDR is not included as the data are not available.

Source: OECD/IEA 2013

Program Implementation Framework



Kapsali, Maria, “How to Implement Innovation Policies through Projects Successfully”, Technovation, 31, 2011, pp. 615–626.

Purpose of the workshop

1. To clarify each sector’s goal
2. What we can or can not
3. (if needed) To find better scheme

JASTIP-net projects on rural electrification

Yosuke NAKANISHI	Waseda	Optimal design platform for smart integration of renewable energy in rural area	NECTEC, NSTDA
Wint Wint Kyaw	TUH	Minigrid using Renewable Energy Sources for rural electrification in Myanmar	Chiang Mai Rajabhat University, Kyoto
Nasrudin Abd Rahim	UM	Rural Electrification using Renewable Energy: Towards Better Sustainability for Rural Community	Kyoto
Anugerah Yuka Asmara	LIPI	Realizing Feasible Solar Cell Project through Appropriate Funding Mechanism and Awareness of Local People in Indonesia	Ritsumeikan
Long Bun, Kinnaleth VONGCHANH	ITC	Innovative DC grid for improving the quality of life of rural area in Cambodia	Kyoto

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JASTIP
Japan - ASEAN Science, Technology and Innovation Platform

Our Findings in Impact of Rural Electrification in ASEAN

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Background

Southeast Asia (SEA): Fast growing economic region

Still significant portion of the populations not electrified

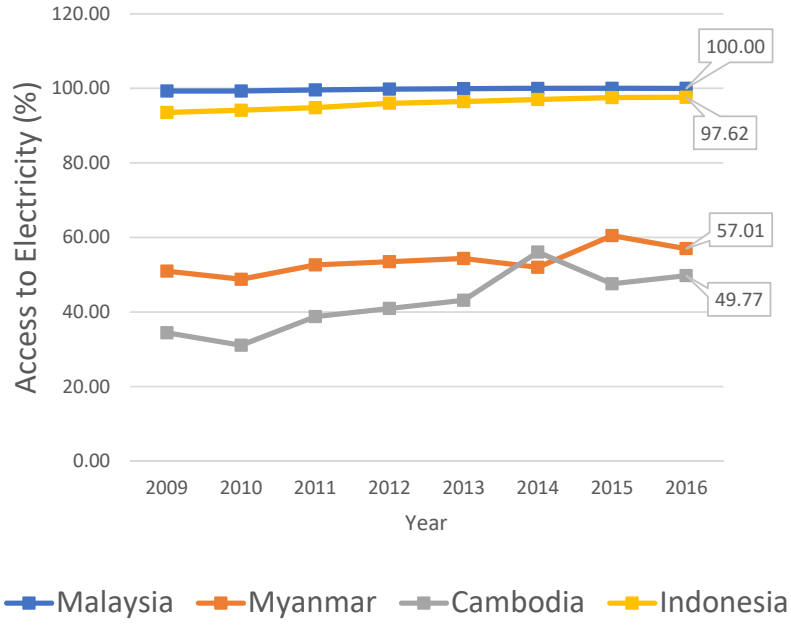
Ongoing efforts on the electrifications of rural communities to **increase villagers' QoL**

⇒ Renewable Energy (Solar PV), grid extension

⇒ Unclear benefit

⇒ How to measure the benefits?

⇒ Objective social index, subjective well-being



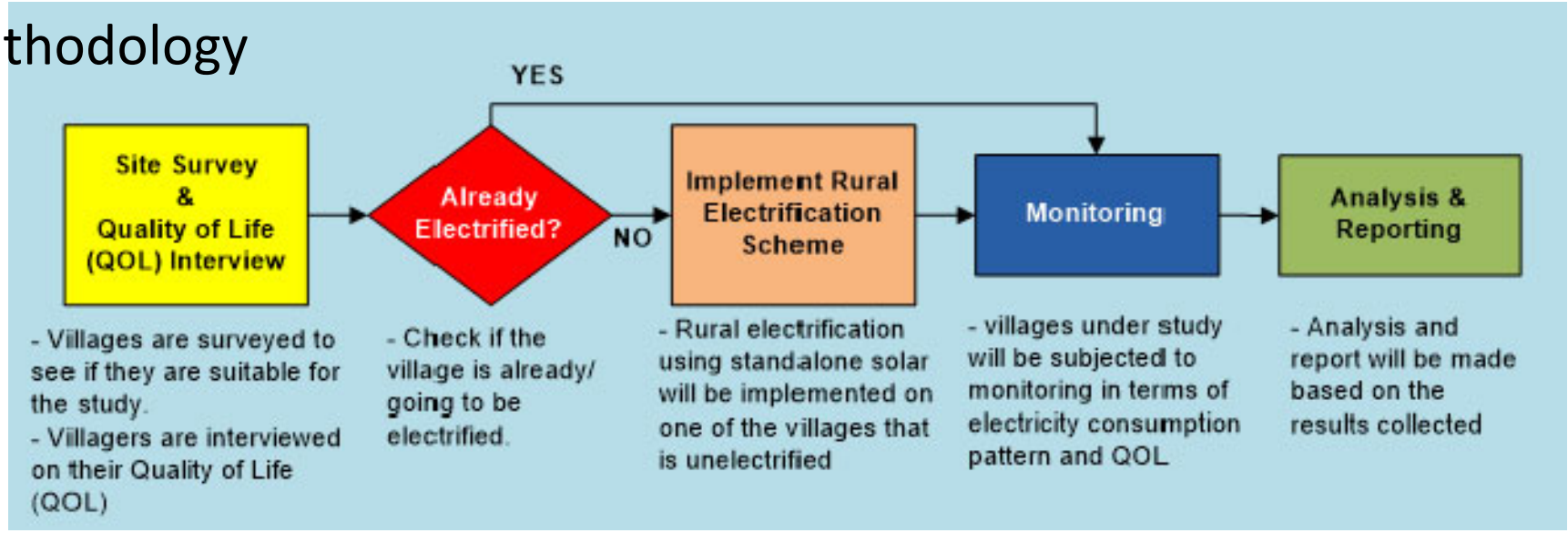
Reference [1]

Objective

Study on the impacts of different rural electrification schemes on QoL

- based on “before-and-after” interview data
- using objective indicators and subjective QoL
- different rural electrification schemes
  (grid extension, solar home system, centralized solar system)

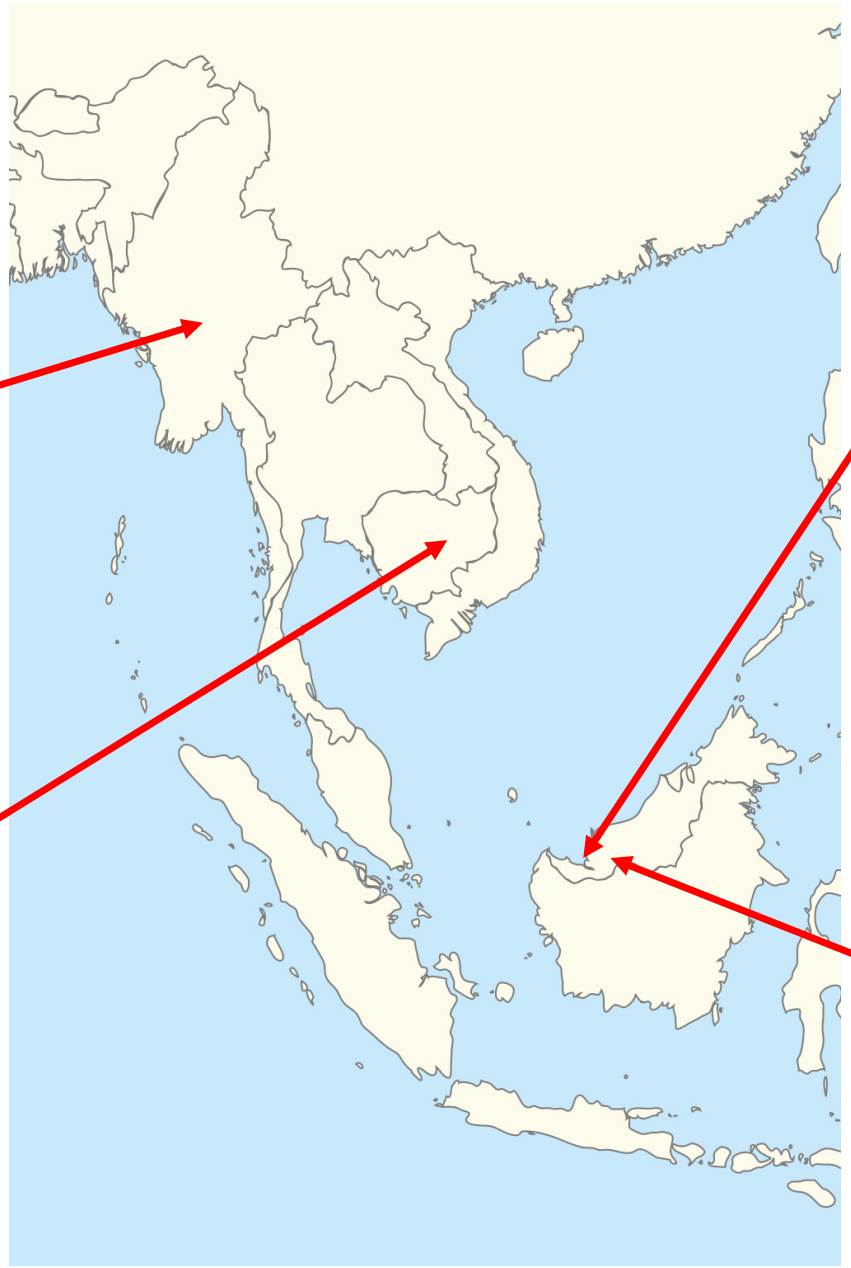
Methodology



Survey sites

Oak Pho, Myanmar

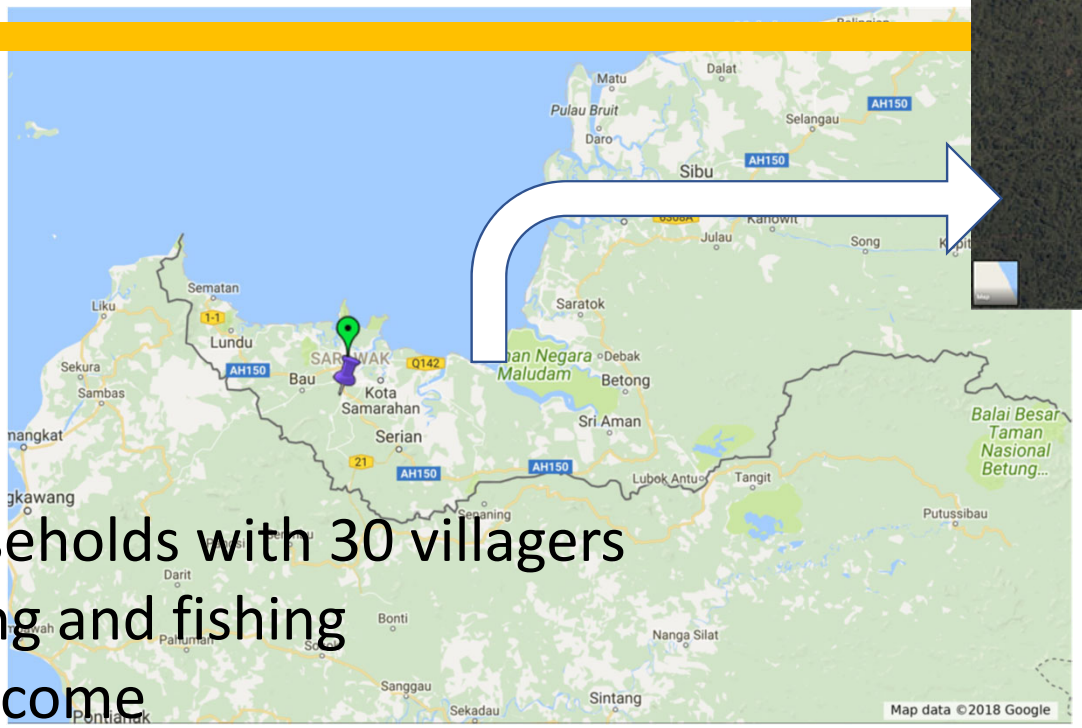
Thmor Keo, Cambodia



Kampung Sungai Merah, Malaysia

Menangkin, Malaysia

Kampung Sungai Merah



1. 5 households with 30 villagers
2. Farming and fishing
3. Low income
3. **Willing to pay for electricity**

   Agrees to collect 30 RM/m/house for battery replacement

Installed SHS in Kampung Sungai Merah

5 SHS systems have been installed in **Feb. 2017**.

~6,000 USD / 5 systems

Item	Unit Specifications
PV Panel	305W, V_{mpp} = 37.8 V, I_{mpp} = 8.34A, V_{oc} = 45V, I_{sc} = 8.85 A
Battery	AGM sealed lead-acid battery, 12V, 150Ah
Inverter	Stand-alone type, 200W, Input: 12/24 V, 20/10 A_{max} Output; 230V 50Hz
Solar charge controller	PWM-type 12/24 V, 20/10 A

UM and JASTIP budget

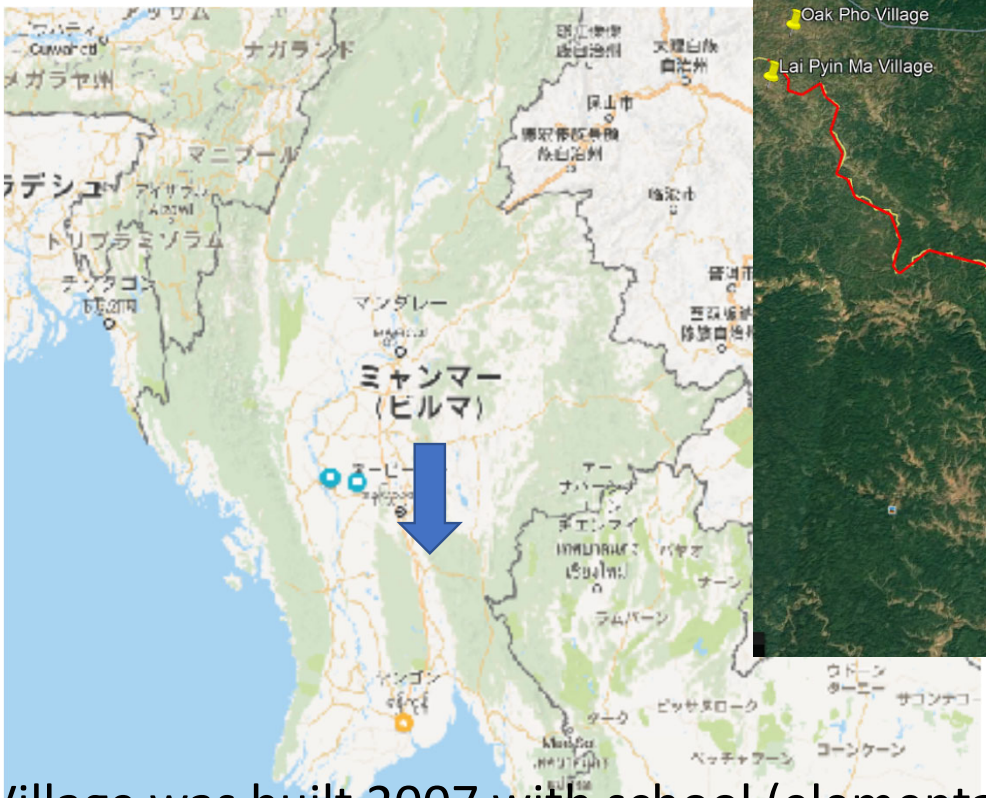
Feb. 2017

Menangkin (before grid connection, 2016)

Grid power has been extended in 2017.
Interview was done in July 2018.

After (2018) 11 households interviewed

Myanmar case : Oak Pho Village mini-grid project



Interviewed 1 village, 25 villagers

- Village was built 2007 with school (elementary, branch of middle school), temple
- ~400 Houses, population ~ 2,000
- Road construction : 2012
- **Mini-grid installation : 2017.07**

Installed system

- 20 kW(solar) + 30 kW(Diesel) (Backup System)
  - 260 Wp Polycrystalline Solar Panel : 80
  - MPPT Charge Controller : 4
  - Pure Sine Wave Inverter 6 kW : 6
  - Generator (30 KVA 415 V 3P4W 50 Hz : 1
  - Deep Cycle Lead Acid Battery, 48V 2000AH : 1
- Main distribution line
- Installed 2017, 07
- Budget : about 200k USD, 60% government, 20% community, 20% company (Talent and Technology Co., Ltd)

Installed system cont.

- 10W Street light, 220VAC 50Hz : 18
- Service wire For Water Pump, school, monetary : 4
- Smart card type single phase prepaid meter, 220V, 50Hz, 1(6)A
  - Power limit
  - 1100 Watt : 10 + 158, 2200 Watt : 10, 3300 Watt : 4, 4400 Watt : 2, 6600 Watt : 2
- Installed 120 HHs (not all houses)
- Price : 500 (0.37 USD) MMK/kWh

20 kW Solar Plant

Power House

30 kW Diesel Generator

Controller, Inverter,

Battery

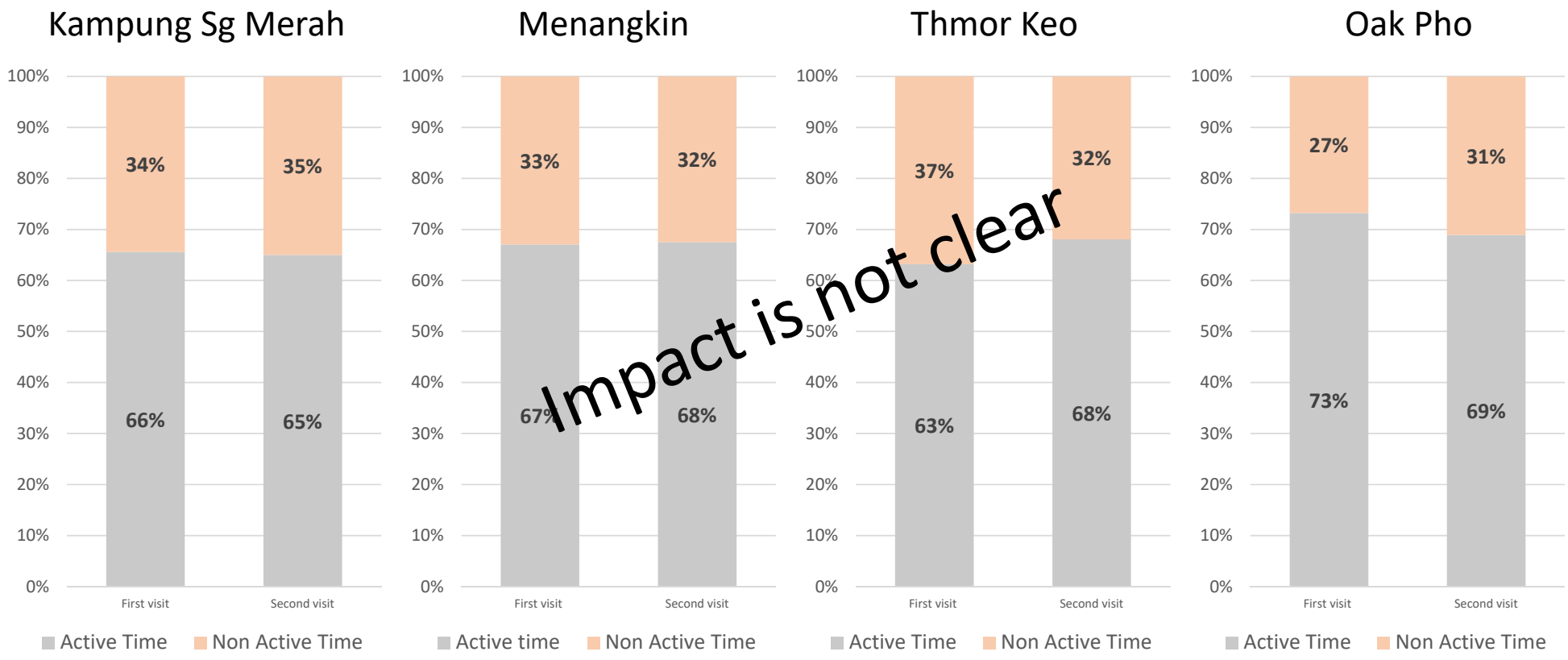
Distribution Line

Prepaid Meter, Switch CB

Table I: Rural Electrification Sites and Survey Details

Village	Country	Cultural profile	Demographic	Electrification Scheme	Survey
Kampung Sungai Merah	Malaysia	Iban	5 HHs (20 inhab.) Farmers	Solar Home System	Before: 6 HHs
					After(~17 months): 5 HHs
Menangkin		Iban	22 HHs (100 inhab.) Farmers	Grid Extension	Before: 19 HHs
					After(~18 months): 12 HHS
Oak Pho	Myanmar	Barmar	400 HHs (2000 inhab.) Farmers	Centralized Solar System (hybrid mini-grid)	4 months after : 19 HHs
					After(~15 months): 35 HHs
Thmor Keo	Cambodia	Khmer	215 HHs (1200 inhab.) Farmers	Grid Extension	Before: 17 HHs
					After(~13months): 21 HHs

Result: Active/Non-Active Time usage



Impact is not clear

Quality of Life Survey

Classified into two categories:

1) Objective social indicators (more common)

   infant mortality rate, life expectancy, mean years of schooling, gross domestic product, gross national income and water access

2) Subjective well-beings

We focus on the ***Subjective Well-being Aspects of QoL.***

QoL Index (QoLI)

The calculation of QoLI here follows the similar procedures of the Wisconsin Quality of Life Index coding method [2].

Quality of Life Interview

Table II: Ten Domains Used in the Interview.

No	Domains	Scope
1	Background Information	• Demographic information, such as age, gender, education, family member, living place, and occupation
2	General Satisfaction	• General level of satisfaction as well as level of importance on time spent, housing, food, clothing, neighborhood, family and personal safety • Answers are in 5 level Likert scales
3	Occupational activities	• Current occupation and feeling toward these activities. • Answers in 5 level Likert scales
4	Psychological Well-Being	• Perceptions/ feeling on life • Answer in the form of yes/no response.
5	Symptoms /Outlook	• Outlook on life as well as symptoms of stress/anxiety • Answers in yes/no as well as 5 level Likert scale
6	Social Relations	• Social relation between neighborhood, family member, and outsiders • Answers in 5 level Likert scale
7	Money	• Satisfaction level and importance in 5 level Likert scale
8	Personal (family) Properties & Daily Life pattern	• Personal (family) belonging, including TV/radio, refrigerator, cell phone, bicycle/motorbike/car, livestock etc. • The fuel and method for cooking is also asked.
9	Electricity Demand & Affordability	• Electricity demand, current and affordable expenditure for the future expansion
10	Perceived Quality of Life	• The interviewee is asked to rate his/her quality of life on the scale of 1-10, with 1 being terrible and 10 being excellent.

Six domains used for computing the QoLI

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Calculation of the QoLI (1)

a. Satisfaction & importance question.

Satisfaction level (SL)

-1 to 1 on a 5 level Likert scale (-1: very dissatisfied, 1: very satisfied)

Importance level (IL)

0 to 1 (0 not important, 1: extremely important)

b. Multiple-choice question

Multiple-choice score (MS)

1: positive response, -1: negative response

c. "Yes-or-No" question

Accomplishment Score (AS)

Positive outlook question: 1: Yes, 0: No

Negative outlook question: -1: Yes, 0: No

Calculation of the QoLI (2)

Domain Score (DS): For Domain 2

$$DS = \frac{(\sum_{i=1}^{m} IL_i \times SL_i) + \left(\frac{\sum_{j=1}^{n} MS_j + \sum_{k=1}^{p} AS_k}{n+p}\right)}{\sum_{i=1}^{m} IL_i}$$

m: satisfaction & importance, *n:* multiple-choice, *p:* Yes-or-No questions

For Domains 3, 4, 6 and 7

$$DS = \frac{\sum_{j=1}^{n} MS_j + \sum_{k=1}^{p} AS_k}{n+p}$$

Calculation of the QoLI (3)

Importance level

Weighting factor (w): Domains 3 to 7: 0 to 1 given on a 5 level scale

Domain 2: Average Domain Score (ADS)

$$ADS_2 = \frac{\sum_{i=1}^{m} SL_i}{m}$$

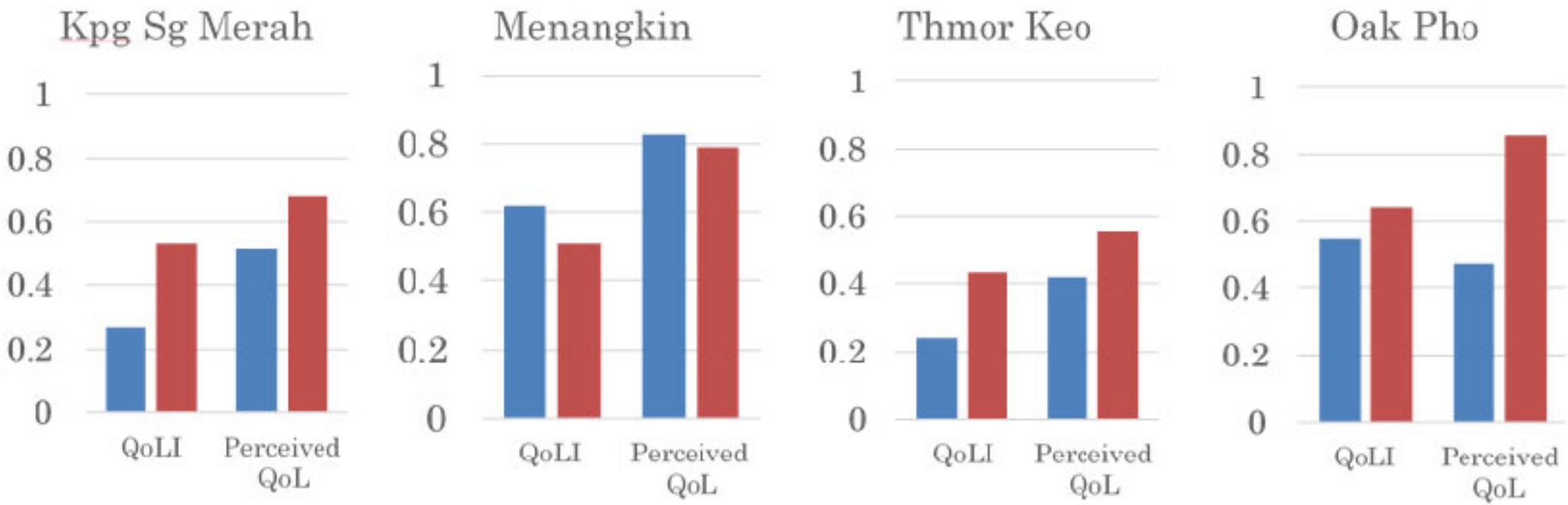
Average Weight Score (AWS), defined as

$$AWS_2 = \frac{\sum_{i=1}^{m} IL_i}{m}$$

The overall quality of life index (QoLI) :

$$\boldsymbol{QoLI = \frac{ADS_2 + \left(\sum_{i=3}^{i=7} w_i DS_i\right)}{AWS_2 + \sum_{i=3}^{i=7} w_i}}$$

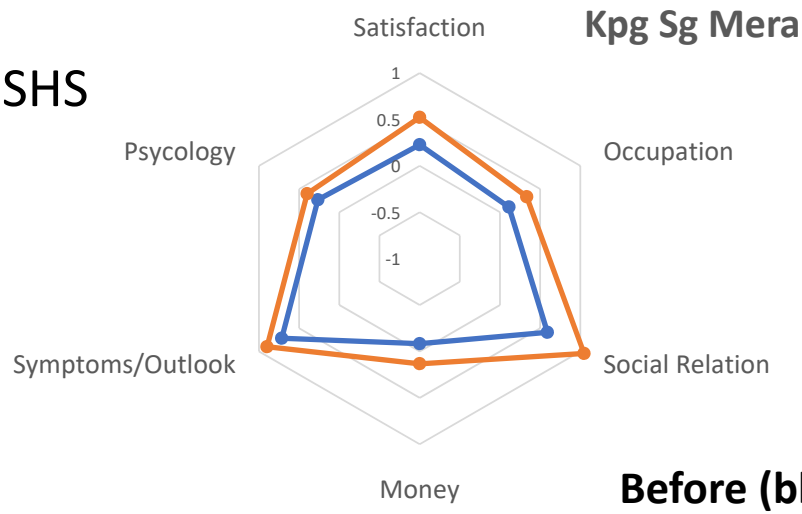
Result: QoLI and Perceived QoL



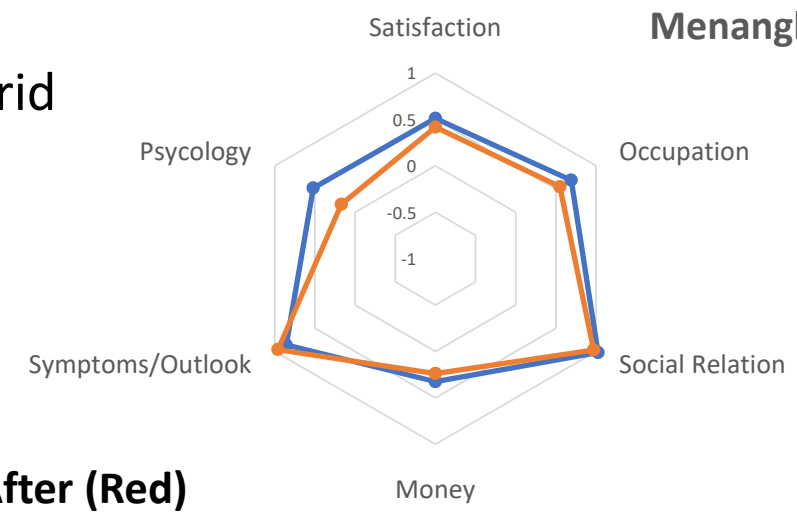
- QoLI shows the same trend as perceived QoL
  => QoLI reflects the subjective well being felt by the villagers
- Positive changes in most of villages, but drop in Menangkin

Result: Breakdown of six domains of QoLI

SHS

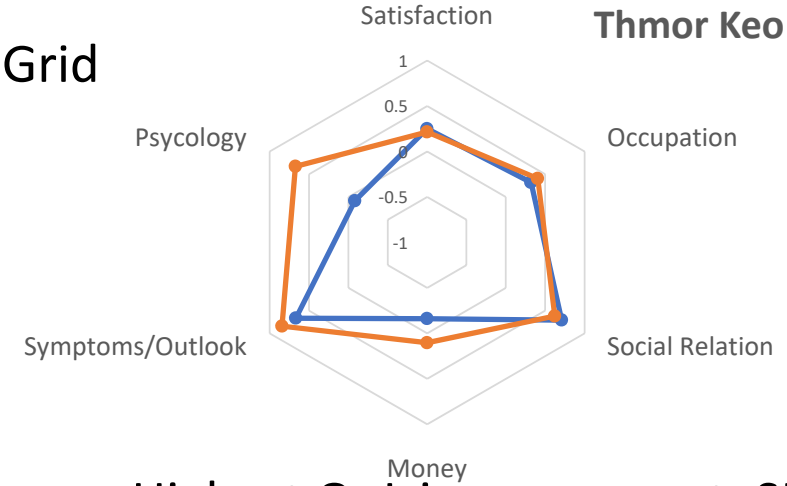


Grid

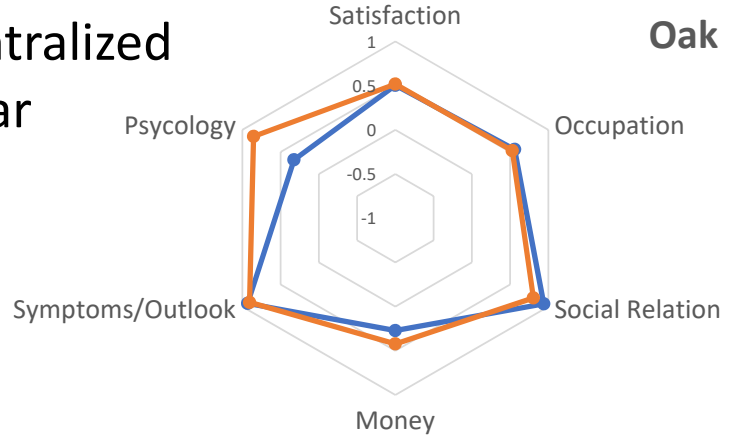


Before (blue) and After (Red)

Grid



Centralized Solar



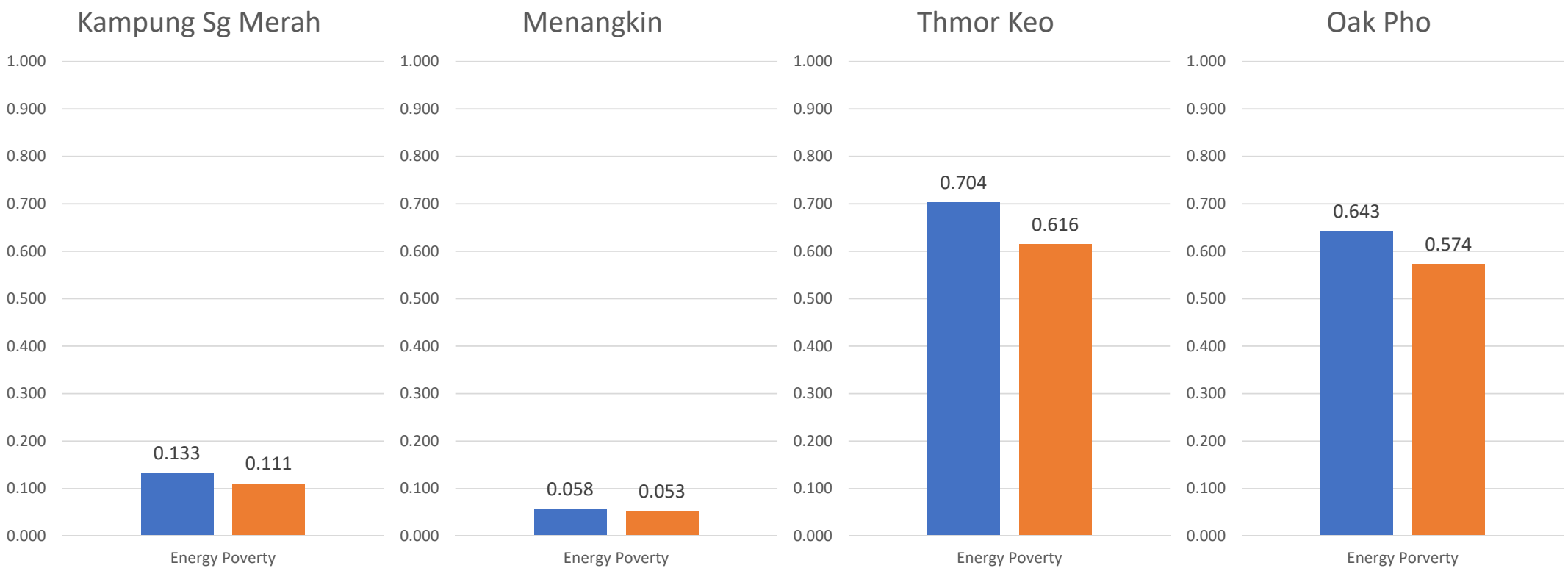
- Highest QoL improvement: SHS (Kampung Sungai Merah)

Discussion: Multidimensional Energy Poverty Index (MEPI)

Reference [3,4]

Energy Service	Indicator	Condition to be considered	Weight
Cooking	Modern cooking fuel	Using any fuel besides electricity, LPG, kerosene, natural gas or biogas	0.2
	Indoor pollution	Food cooked on stove or open fire (no hood/chimney) if using fuel beside electricity, LPG, natural gas or biogas	0.2
Lighting	Electricity access	Does not have access to electricity	0.2
Service provided by household appliances	Household appliances ownership	Does not have a fridge	0.13
Entertainment / Education	Appliances ownership	Does not have a radio / television	0.13
Communication	Telecommunication means	Does not have a phone land line / a mobile phone	0.13

Result: MEPI



- Improvement in MEPI in all schemes
- MEPI condition before electrification is important.

Conclusions

- Study on the impacts of rural electrification on the quality of life in Malaysia, Cambodia, and Myanmar by multidimensional approach
- Different rural electrification schemes, “grid extension”, “centralized solar system” and “solar home system” with before and after interview sessions.
- Data analysis: QoLI and MEPI
- No meaningful difference of the impacts on the communities’ quality of life between three electrification schemes.
- The energy poverty level of the villagers plays essential roles on the effect of any electrification scheme.

On going survey

- Cambodia
  - Grid extension sites: Thmor Keo, Kong Meas
  - SHS sites: 2019
- Myanmar
  - Mini-Grid sites: Byat Kaley, Nwah Chan Khone
- Indonesia
  - SHS and centralized solar: Pamekasan regency (East Java)
    - Different financial mechanism
- Philippines
  - SHS site: Rawang community
    - 2019: in collaboration with local NGO
- Thailand
  - SHS: Akha upland community in Mae Salong Nai, Chiang Rai (2014)

Acknowledgements

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References

[1] OECD, 2018. Economic Outlook for Southeast Asia, China and India 2019 TOWARDS SMART URBAN TRANSPORTATION

[2] R. Diamond, M. Becker, and R. Becker, "Wisconsin Quality of Life Index (W-QLI): A Multidimensional Model for Measuring Quality of Life," J Clin Psychiatry, vol. 60, pp. 29–31, 1999.

[3] P. Nussbaumer *et al.*, "Global Insights Based on the Multidimensional Energy Poverty Index (MEPI)," *Sustainability*, vol. 5, no. 5, pp. 2060–2076, May 2013.

[4] S. Pelz, S. Pachauri, and S. Groh, "A critical review of modern approaches for multidimensional energy poverty measurement," *Wiley Interdiscip. Rev. Energy Environ.*, vol. 7, no. 6, p. e304, Nov. 2018.