Turning on Myanmar's Lights

Integrated Energy Development Study: Phase Two Fieldwork Initiative

The University of Tokyo
KWR International (Asia) Pte. Ltd.
Economic Research Institute of ASEAN and East Asia

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Phase 1 Fieldwork- Background

Following-up on initial Integrated Energy Development ("IED") research conducted by University of Tokyo ("UT") in cooperation with KWR International (Asia) Pte. Ltd. ("KWR") in 2012 and early 2013, Phase One Fieldwork was conducted from May–August, 2013.

This work served as energy contribution for MCDV and included identification of data gaps & further evaluation of environment for IED in Myanmar.

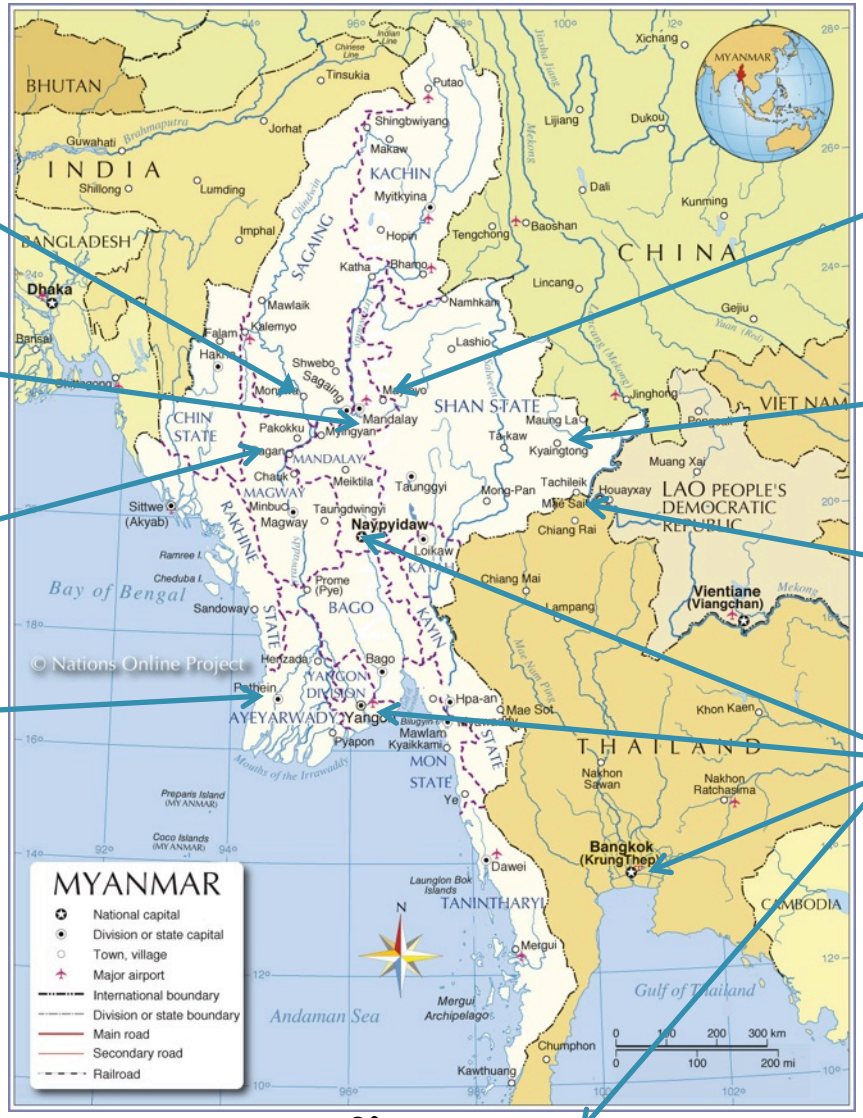
A special emphasis was placed on evaluating prospects in different geographic areas around three themes:

1) **Grid Extension**,

2) **Regional Integration & International Cooperation, and**

3) **Off-Grid Development**.

Fieldwork included 100+ interviews during one or multiple visits to:



Including over 50+ meetings and interviews held in **Yangon**, **Naypyitaw**, **Bangkok**, **Singapore** and other locations

Visited Sites and Observed Themes

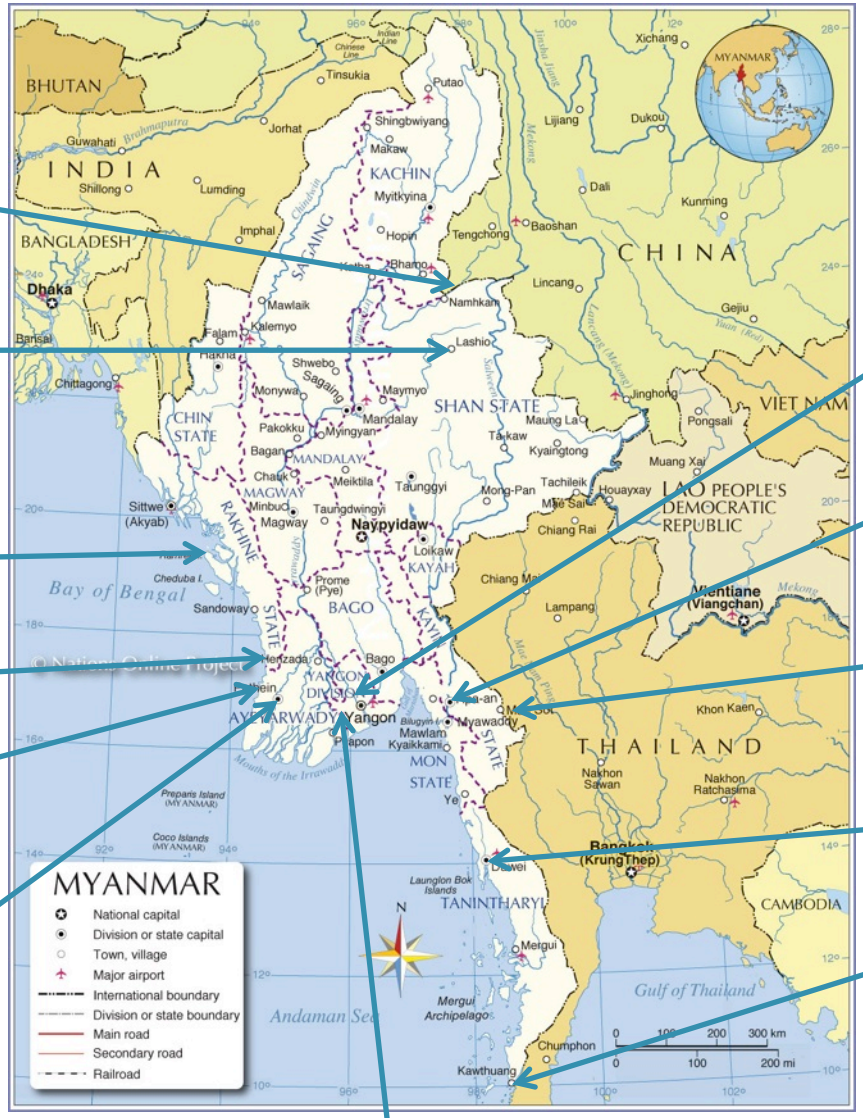
- ***Bagan/Nyaung-U: Accommodating Tourism Growth and Agricultural Viability***
- ***Monywa: Examining the Potential for Off-Grid Alternatives including Solar***
- ***Mandalay: Balancing the Needs of Urban Industry with Rural Agriculture***
- ***Pathein: Powering Economic Development through Grid Extension & Gasification***
- ***Pyin Oo Lwin: Examining the Feasibility of Off-Grid Mini-Hydroelectric Schemes***
- ***Tachileik: Obtaining Electrical Capacity Through Cross-Border Arrangements***
- ***Kengtung: Powering Off-Grid Locations Beyond the Micro-Level***

Phase 2: Looking in Depth to Facilitate Rural Electrification

Objective: *To develop a more comprehensive understanding of potential rural electrification strategies and technologies in Myanmar through fieldwork visits designed to provide quantitative/qualitative insight into geographical differences, comparative costs and trends, including:*

- **Required Generation:** providing insight into estimated demand through data generated from targeted villages and regions.
- **Cost Estimates**: evaluating comparative costs of different electrification strategies within targeted villages and regions through integration of location-specific data and estimated national assumptions.
- **Village Data:** generating village data to evaluate cost and other potential indicators that can be refined/developed through additional research.
- **Summary Reports:** construction of model/methodology that can generate/ analyze fieldwork data to support evaluation of potential rural electrification strategies and policy approaches to promote integrated energy development in Myanmar.

Phase 2 Fieldwork: Proposed Locations



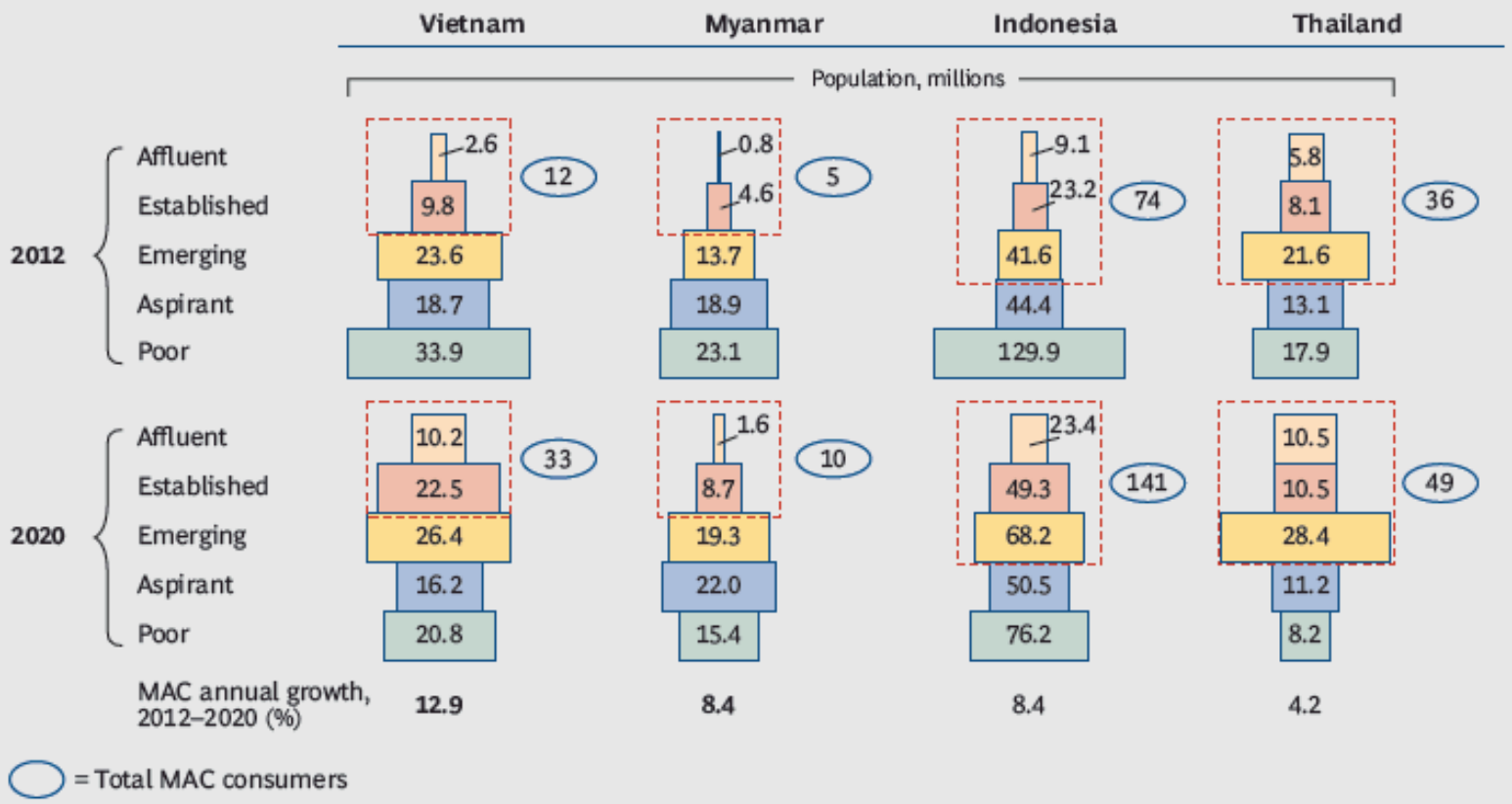
Village Surveys

Interviews will be conducted to survey for data points potentially including:

- Total Population (#) • Households (#) • Streetlights (#) • Generator (Transmission)
- Distance from City (km) • Distance from Town (km)
- Non-household demand from buildings such as
  •Schoolhouse (#) • Administrative (#) •Healthcare/Clinic (#) • Storage Facility (#) • Restaurant/Teashops/Café (#)
- Existence of Small or Medium Industry (Yes/No)
- Distance from
  • National Grid (mi) •Potential River Source (mi)
- Sources of Biomass
  •Manure Source (Yes/No) • Rice Husk Source (Yes/No) •Other Biomass (Yes/No)
- Natural Resource Access (Yes/No)
- Land Cost per square meter or square kilometer

Methodology: Demand Analysis

EXHIBIT 2 | Vietnam and Myanmar Have Fast-Growing MAC Populations



Sources: BCG CCCI models; BCG analysis.
Note: In Vietnam and Myanmar, the MAC population comprises the affluent and established segments. In Indonesia and Thailand, the MAC population also includes the emerging segment; this is owing to differences in the point at which consumer spending takes off in these markets. The MAC cutoff is monthly per capita income of $190 in Vietnam, $120 in Myanmar, and $150 in Thailand. For Indonesia, the MAC cutoff, which is expressed in spending rather than income, is $40 per month.

Source: BCG

Translating Consumer to Energy Demand in Myanmar

Demand has been categorized into the following five levels:

Poor	• 120 W*
Aspirant	• 500 W
Emerging	• 1000 W
Established	• 2500 W
Affluent	• 5000 W

*120w minimal rural electrification household target level provided by Ministry of Livestock, Fisheries and Rural Development

Phase 2 – 1st Fieldwork Visits – Ayerwaddy Division

Pathein District

1) Tha Yet Taw
2) Kyar Kan Daung

Chaungthar District

3) Aung Mingalar Kyun
4) U To
5) NEDO Hybrid Facility in Chaungthar

Nyaungdon District

6) Me Za Li Ywar Ma

Tha Yet Taw - *Satisfied with the Status Quo*

Population	*150 -200*
Number of Households	*48*
State/Division	*Ayerwaddy*
District, Township	*Pathein, Pathein*
Distance from Grid	*11 miles*
Nearest City with Access to Grid	*Pathein City*
Main Economy	*Fishing and farming*
Preferred Electrification Strategy	*Solar*
Recommended Electrification Strategy	*Solar and Diesel Gen-set*
Classification	*Poor - 95% Aspirant - 5%*

- Small Buddhist village
- Little communal unity
- On average, it is reported that villagers make about 100,000 kyat a month
- No value added in their commercial activities
- A few solar home systems; solar battery rentals available
- Grid extension is too expensive given size of village and distance from connection point; biomass is not readily available and mini-hydro is not feasible

Kyar Kan Taunt - *Benefiting from Leadership and Strong Community*

Population	*~300*
Number of Households	*72*
State/Division	*Ayerwaddy*
District, Township	*Pathein*
Distance from Grid	*8.7 miles*
Nearest City with Access to Grid	*Pathein City*
Main Economy	*Fishing and farming*
Preferred Electrification Strategy	*Solar*
Recommended Electrification Strategy	*Solar and Diesel Gen-set*
Classification	*Poor - 96% Aspirant - 4%*

- Christian Karen village
- Tight knit community under leadership of Mrs. Esther Moe
- On average, it is reported that villagers make less than 100,000 kyat a month
- No value added in their commercial activities
- Communal solar panels available through funding from Christian society; some battery rentals, though less than Tha Yet Taw
- Grid extension is too expensive; biomass is not readily available and mini-hydro is not feasible

Aung Mingalar Kyun – *A Fishing Village on the Verge of a Tourist Boon*

Population	*~560*
Number of Households	*110*
State/Division	*Ayerwaddy*
District, Township	*Chaungthar*
Distance from Grid	*38 miles*
Nearest City with Access to Grid	*Pathein City*
Main Economy	*Fishing and farming*
Preferred Electrification Strategy	*Solar*
Recommended Electrification Strategy	*Solar and Diesel Gen-set*
Classification	*Poor - 95% Aspirant - 5%*

- Small 15 KW diesel- based mini grid set up - 35 households pay for 3.5 hours of electricity per night
- A few households own private solar home systems; battery rentals also available
- Proximity to Chaungthar means potential for tourism
- Grid extension is too expensive; biomass is not readily available and mini-hydro is not feasible
- Growth extremely difficult to forecast given potential for dramatic growth due to tourism development

U To - *Public-Private Cooperation and Being in the Right Place at the Right Time*

Population	*~500*
Number of Households	*120*
State/Division	*Ayerwaddy*
District, Township	*Chaungthar*
Distance from Grid	*37 miles*
Nearest City with Access to Grid	*Pathein City*
Main Economy	*Fishing and farming*
Preferred Electrification Strategy	*Mini-hydro*
Recommended Electrification Strategy	*Mini-hydro*
Classification	*Poor - 90% Aspirant -10%*

- Small 15 KW diesel- based mini grid set up – all households receive 4 hours of electricity per night
- A few households own private solar home systems
- Successful solar battery rental business – 70 batteries rented a day in a 120 household village
- Prime location: on a main road and by the U To bridge
- Grid extension is too expensive; biomass is not readily available
- Enterprising community and individuals

Me Za Li Ywar Ma – *Primed for Gasification*

Population	*~300*
Number of Households	*94*
State/Division	*Ayerwaddy*
District, Township	*Maubin, Nyaungdon*
Distance from Grid	*7 miles*
Nearest City with Access to Grid	*Sarmalauk*
Main Economy	*Daily Laborers*
Preferred Electrification Strategy	*Grid extension*
Recommended Electrification Strategy	*Gasification*
Classification	*Poor - 11% Aspirant – 42% Emerging 45% Established – 2%*

- Privately owned rice mills at the edge of village – powered by gasifiers
- Gasifiers are in need of environmental controls – to limit water use and water pollution
- UNICEF-provided 10 KVA generator supplies electricity for 90 household units in the village , including monastery Makeshift distribution lines with huge losses; likely 20 -30% increase in efficiency with better distribution lines
- Grid extension potentially viable due to aggregate population of village tract (3 – 5,000) and vicinity to grid (7 miles)

First Impressions

- Maintenance, maintenance, maintenance!
- Leadership
- Entrepreneurship
- Amateur installations
- Training on systems and equipment management is critical
- Financial planning
- Potential for pilot projects

Preliminary Conclusions from the Delta Region

- Great potential for gasifier powered mini-grids in villages given strong agricultural production and existence of mills, inconsistent water flow for hydro and mixed outlook for solar
- But, present gasification technology in Myanmar is antiquated and unsustainable, and environmental concerns must be addressed

Case Study: NEDO project in Chaungthar

The Critical Importance of Maintenance and Planning

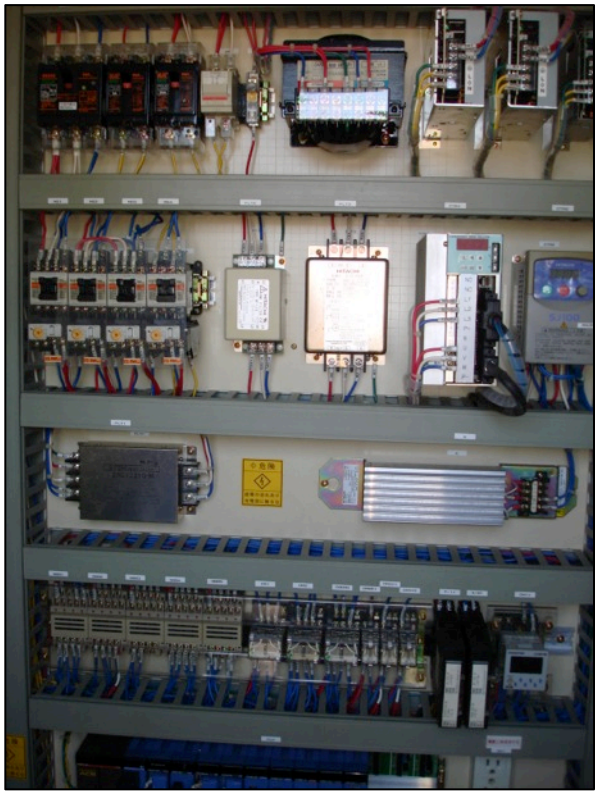
- After surveying in 2000, construction began the following year in 2001. Technicians held a yearlong wind survey and the project was online in 2003.
- Systems & equipment were top of the line – Hitachi control systems, Sharp photovoltaic panels
- Technologies included:
  - Solar PV – 80 kW
  - Wind – 40 kW
  - Diesel Generator – 60 kW
  - Storage batteries – 2 V x 204 cells
  - 3 ice making units with 2 ton refrigeration unit

Challenges:
Site is Now Dormant

- ***A Mismatch of a Well-Intentioned Design***
  - *Relocation of wind turbine from intended area leads to lower output – wind is discontinued in 2008*
  - *Technology & capacity mismatch*
  - *Locals do not take to ice cubes – prefer blocks*
- ***Systems Failure***
  - *Control system for solar PV fails – solar is discontinued in 2011*
- ***Population Growth***
  - *Number of households in villages have grown nearly 5 times in almost a decade*
  - *Original 60 kW generator is insufficient and replaced with 300 kVa Italian generator*

Looking Ahead

- Automated but advanced systems can backfire due to lack of local capacity
- Use of modern, advanced technology requires associated training in operations, maintenance and repair
- Local input
- Political factors and local dynamics must be recognized and incorporated into planning
- Most equipment is still usable – potential for the hybrid system to be used again in the future



Presentations and Meetings in Naypyidaw and Yangon

UMFCCI 3rd Stakeholders Meeting

"မြန်မာနိုင်ငံရှိ ကျေးလက်ဒေသမီးလင်းရေးအတွက်ကဏ္ဍပေါင်းစုံမှ
ပူးပေါင်းပါဝင်ဆောင်ရွက်နိုင်ရေးဆိုင်ရာတတိယအကြိမ်ဆွေးနွေးပွဲ"

"Third Stakeholder Meeting To Improve Rural Electricity Access in Myanmar"

Organized in cooperation with

Economic Research Institute for ASEAN and East Asia
Myanmar Engineering Society
Myanmar Industries Association
Investment & Industrial Development Committee, Pyithu Hluttaw

1.4.2014
(Tuesday)

Conference Hall
UMFCCI Office Tower

Schedule

Jan	• Planning & Model Development
Feb	• Fieldwork Scheduling and Preparation
Mar	• First Fieldwork and Analysis; ADB & WB Seminars; Naypyidaw/Yangon Meetings
Apr	• Stakeholder Meeting in Naypyidaw and Yangon • Thingyan
May	• Fieldwork and Analysis
Jun	• Fieldwork; Report preparation; Wrapping up; Preparation for Next Phase

Next Steps?

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