Appendix 1: Workshop Report

The Energy Policy Workshop

Date	Wednesday, March 28, 2018
Venue	Hilton Hotel, Nay Pyi Taw
Hosted by	Central Economic Committee (CEC) National League for Democracy (NLD) Policy Alternatives Research Institute (PARI), the University of Tokyo
Supported by	The Association for Overseas Technical Cooperation and Sustainable Partnerships (AOTS) Economic Research Institute for ASEAN and East Asia (ERIA)
Language	English

Date	Morning		Afternoon	
28 MAR. (WED)	Ceremony (11:00–13:00) Inauguration Ceremony	*Lunch (13:30-14:30)* *Coffee Break(15:30-15:40)*	**Lecture 1 (15:00–17:00)** **Overview of Energy Policy** 1) Global Trend and Opportunities in Myanmar 2) Some Key Issues: - Black-out - Rural Electrification - Electricity Tariff - etc 3) Planning and Operation **Prof. Hisashi Yoshikawa** **Project Professor** **Policy Alternatives Research Institute** **The University of Tokyo**	*Welcome Dinner (18:00-)*

29 MAR (THU)	**Lecture 2 (10:00–12:30)** **Brainstorming (Group Discussion)** 1) Energy for Peace 2) Demarcation amongst Stakeholders - Parliament - Public Administration	*Lunch (13:00-14:00)*	**Lecture 3 (14:30–16:30)** **Session Wrap-up (Group Presentation)** 1) Group Presentation 2) Response from Lectures 3) Way Forward - Action Plan

Appendix 2: Model Parameters for Energy Planning Model

Resource Potential: Refers to the total energy potential of each resource in the region

Available Portfolio: Refers to the total energy potential remaining after installed capacity

Capacity Constraints under Scenario: This section allows the model to account for future planned capacity reported in regional planning policy documents. The model can choose to constrain itself to this future planned capacity

Capacity Factor: This refers to the annual capacity factor of each generation resource

Peak Contribution: The at-peak contribution (firm capacity) for each technology. For example, for an evening peak demand profile, solar should have a 0% contribution. This constraint can be relaxed by making all resource peak contributions 100%

Load: Refers to the local electricity demand for the region, excluding exports

Load + Exports: Refers to the local electricity demand for the region, including exports

Peak Demand: Refers to the local peak electricity demand in the region

Reserve Margin: This allows the generation portfolio to meet a surplus of demand, as is the standard for operating reliable grids

Cap Cost: Refers to the overnight capital cost of each technology

Annual Cap Cost: Refers to the annualised overnight capital cost of each technology, using a discount rate and estimated lifespan

Variable Cost: Refers to the operating and maintenance cost, plus fuel cost of each technology

Investment Decision: This is the decision variable of the OpenSolver. It refers to new generation capacity installed each year. This s``hould never be changed manually

Installed Capacity/Dispatch: This is the total installed generation capacity, assuming investment decisions are carried out

Average Dispatch: This refers to the dispatch multiplied by the capacity factors

Electricity Mix: This refers to the annual generation of the installed capacity

EneCost: Refers to the energy cost of the electricity mix, using total variable costs

CapCost: Refers to the capital cost of the electricity mix, using total capital costs

TotCost: This is the sum of the energy and capital costs of the electricity mix. This is the stream of cost that is discounted to NPV and used as the minimiser of the optimisation model

AvgCost: The average cost per electricity produced

LCOE: The levelised cost of electricity

Capacity at Peak: Refers to the contribution each resource's generation can make at peak. This value should be greater than or equal to the peak demand

Renewable Energy: Refers to the portion of annual generation that comes from renewable sources

RPS Energy: Excludes large hydropower generation

% RPS from Load: The percentage of RPS energy to the total local load of the region

Fossil Energy: Refers to the portion of annual generation that comes from fossil sources

DiffLoad: The difference between annual load and annual generation, ensuring constant power supply

DiffPeakDem: The difference between the capacity at peak and the peak demand, ensuring constant power supply

Spill: Refers to the excess annual generation in the mix

Discount Rate: The rate at which cash flows are discounted, typically 7%

Total Cost: The NPV of the stream of total cost values per year, discounted

Appendix 3 : Details of Field Survey on Mini-grids

Survey Details

Because the survey data included confidential information from companies, they were anonymised. The interview survey was conducted based on the questionnaire entitled, 'Questionnaire for Supplier/developer of Solar Home Systems (SHSs)/Solar Microgrids'. The numbers acquired were averaged and used in the levelised cost of electricity (LCOE) calculation. Table A1 shows the survey details.

Table A1. Survey details

Survey 1	
Date	February 2–3, 2017
Venue	Yangon Technological University
Method	Semi-structured interview
Interviewer	The authors
Number of interviewees (companies)	7
Survey 2	
Date	April to July 2017
Method	Questionnaire
Surveyor	Mitasu Consultants Group
Number of interviewees (companies)	2
Survey 3	
Date	19–24 October 2017
Method	Open interview
Interviewer	The authors
Number of interviewees (companies)	4

Questionnaire for Survey 1

Questionnaire for Supplier/Developer of
Solar Home Systems (SHSs)/solar Mini-grids

General questions (if you do not have a name card, please fill in)

1. Name of company:
2. Address:
3. E-mail:
4. Phone/mobile:

   (If this information is not on the website of your company, please fill in.)
5. Owner(s) of the company:
6. Number of staff:
7. Year company was established:

Your business field

8. What kind of products do you sell?
   - ☐ Solar lanterns
   - ☐ Solar-powered pumps
   - ☐ Solar home systems
   - ☐ Solar mini-grid/microgrid systems (capacity kW ~kW)
   - ☐ Solar modules
   - ☐ Inverters
   - ☐ Mounting systems
   - ☐ Batteries
   - ☐ Others (_____)

9. What kind of services do you provide?
   - ☐ Engineering (design, preparation of permit documents, project management)
   - ☐ Procurement
   - ☐ Construction
   - ☐ Operation of mini-grids
   - ☐ Maintenance
   - ☐ Manufacturing of (_____)

10. When did you start businesses related to solar lantern/solar home systems (SHSs)/mini-grids?
    ( )

11. Did you have any experience in the energy business before entering the (SHS)/mini-grid business?

( )

12. Does your company provide any other business products/services?
    ( )
13. How many mini-grids have you built? Or how many SHSs have you sold?
    ( )
14. How many mini-grid projects are you working on (pipeline)?
    ( )

15. Do you sell second-hand components? Yes/No
    If yes, from where do you procure them?
    ( )

16. In which country are the products made?
    i. Solar modules
    ( )

    ii. Inverters
    ( )

    iii. Mounting systems
    ( )

    iv. Batteries
    ( )

    v. Others in question 8
    ( )

17. From whom do you buy the components?
    i. Solar modules
        ☐ Maker
        ☐ Distributor
        ☐ Other (_____)
    ii. Inverters
        ☐ Maker
        ☐ Distributor
        ☐ Other (_____)
    iii. Mounting systems
        ☐ Maker
        ☐ Distributor
        ☐ Other (_____)

iv. Batteries

☐ Maker

☐ Distributor

☐ Other (_____)

v. Others in question 8

☐ Maker

☐ Distributor

☐ Other (_____)

18. For about how much do you sell products to your customers?

i. Solar modules

About ( ) kyat <100/1,000 units (*circle the number nearest to the units your consumers typically purchase)*

About ( ) kyat >100/1,000 units

ii. Inverters

( ) kW: About ( ) kyat

If there are other inverters, which you sell?

( ) kW: About ( ) kyat

iii. Mounting systems

About ( ) kyat/kW

iv. Batteries

( ) W: About ( ) kyat/unit

or About ( ) kyat/W

v. Systems as a whole

About ( ) kyat/kW (Including construction costs Yes/No)

vi. Others in question 8

( )

19. To whom do you sell the components?

☐ End users

☐ Distributors

☐ Developers

☐ Independent power producers

☐ Others (_____)

20. How much do you pay for electricity at the office?

i. Do you connect to the national grid? If yes, how much is the tariff?

( ) kyat/month

If you know, ( ) kyat/kWh

ii. Do you have a backup generator? If yes, what is its power source?
Diesel/Solar/Other ( )

21. What do you think is the barrier to your business?
(*Please answer freely—e.g., revenue collection risks, the potential for theft, and central grid extension.)*
**For mini-grid suppliers/developers, please continue to the next page.*

For Mini-Grid Suppliers/Developers
Your track record information

1. Where is this mini-grid? (GPS coordinates or address)
( )

2. What is the installed capacity?
( ) kW

3. What is the power source?
1. Solar 2. Hydro 3. Diesel 4. Combination of ( )
5. Other (_____)

4. Who owns this mini-grid?
   - ☐ Community
   - ☐ Distributor
   - ☐ Developer
   - ☐ Independent power producer
   - ☐ Other (_____)

5. How long did it take to construct?
( )

6. About how much was the investment cost?
   i. Equipment ( ) kyat
   ii. Construction ( ) kyat
   iii. Other ( ) ( ) kyat

7. Please write the contact info for the mini-grid operator, if possible.
( )

8. What is the tariff for the mini-grid's electricity?
( ) kyat/kWh or month (Please circle the appropriate option.)

9. If any, what kind of complaints do you receive from customers?

Questionnaire for Survey 2

Project Summary		
PV capacity		**kW**
Battery capacity		**kWh or Ah**
Diesel capacity		**kW**
Number of households		

Cost Breakdown			
Item	**Quantity**	**Unit Price (US$)**	**Cost (US$)**
Primary Components			
PV modules			
Inverters			
PV array rack			
Batteries (if any)			
Diesel generator (if any)			
Transportation to site			
Distribution to Households			
Lamps			
Prepayment meters			
Accessories			
Internal wiring			
Distribution cables			
Streetlight			
LED street light bulb			
Lamppost			
Cables			
Installation			
Site preparation			
Primary component installation			
Household distribution installation			
Others			
Studies and surveys			
Training			
Trials (Pretesting)			
Grand TOTAL			

Detailed Load Assumptions

Table A2. Load assumptions for scenario A

Electrical Appliance	Power Consumption	Quantity per Household	Hours of Use
Lamp inside (3W × 2, 7W × 1)	13 W	1 set	18:00–23:00
Lamp outside (streetlight)	5 W	1	18:00–24:00
TV	147 W*	0.75 (3 HHs/4 HHs)	1 hour at night
Total daily electricity consumption			20.5 kWh/day

Note: HH = household.

Assumptions without notes are based on the survey conducted by the authors.

Table A3. Load Assumption for Scenario B.

Electrical Appliance	Power Consumption	Quantity per Household	Hours of Use
Lamp inside	5 W	5	18:00–23:00
Lamp outside (streetlight)	5 W	1	18:00–24:00
TV	147 W*	1	1 hour at night
Rice cooker	584 W*	0.5	0.5* at night
Refrigerator	84 W*	0.1	24
Fan	58 W*	0.6	2.86* in the daytime
Iron	1,000 W*	0.5	0.27* in the daytime
Water pump	146 W*	0.15***	0.88* in the daytime
Computer	130 W*	0.03***	4.34* in the daytime
Printer	30 W	0.01***	2** in the daytime
Grinder	120 W**	0.03 (3 carpenters per village***)	9:00–17:00
Drilling machine	350 W**	0.03	9:00–17:00
Circular saw	1500 W**	0.03	9:00–17:00

Planer	450 W**	0.03	9:00–17:00
Sewing machine	120 W**	0.01	9:00–17:00
Total daily electricity consumption			227 kWh/day (daytime: 96, nighttime: 131)

Source: * (M. P. Aye, 2015) ; ** (Blum et al., 2013) ; *** Survey by the authors.

Appendix 4: Guidelines for Environmental Protection in Foreign Investment and Cooperation

February 18, 2013

Guidelines for Environmental Protection in Foreign Investment and Cooperation[18]

Source: Ministry of Commerce and Ministry of Environmental Protection of China

Article 1. These *Guidelines* are hereby formulated to direct enterprises in China to improve their regularisation of environmental protection in foreign investment and cooperation activities, to ensure timely identification and prevent environmental risks, to actively perform their social responsibilities regarding environmental protection, to set up a good international image for Chinese enterprises, and to support the sustainable development efforts of the host country.

Article 2. These *Guidelines* are applicable to the environmental protection of Chinese enterprises in foreign investment and cooperation activities, which shall be implemented consciously by enterprises.

Article 3. It is advocated that in the course of active implementation of their responsibilities on environmental protection, enterprises should respect the religious beliefs, cultural traditions, and national customs of local communities in the host country; safeguard the legitimate rights and interests of labor; offer training, employment, and re-employment opportunities to residents in the surrounding areas; promote harmonious development of the local economy, environment, and community; and cooperate to ensure mutual benefits.

Article 4. Enterprises shall adhere to the concepts of environmental friendliness and resource conservation, develop low-carbon and green economies, and implement sustainable development strategies so as to realise a 'win-win' situation, benefiting both corporate interest and environmental protection.

Article 5. Enterprises shall comprehend and implement all the provisions pertaining to the environmental protection laws and regulations of the host country.

For projects investing in construction and operation, enterprises shall file applications for environmental protection permits with the local government in accordance with the laws and regulations of the host country.

[18] See the original Guidelines in Chinese at http://www.mofcom.gov.cn/article/b/bf/201302/20130200039930.shtml and the official English translation at http://english.mofcom.gov.cn/article/policyrelease/bbb/201303/20130300043226.shtml

Article 6. Enterprises shall include environmental protection as well as production and operation plans in their enterprise development strategies; establish the corresponding rules and regulations for environmental protection; and manage all aspects related to the enterprise's environment, health, and production safety. In addition, enterprises shall be encouraged to utilise integrated environmental services.

Article 7. Enterprises shall establish a sound environmental protection training system to provide employees with appropriate education and training with respect to the environment, health, and production safety. Enterprises shall enable employees to understand the relevant laws and regulations of the host country regarding environmental protection and disposal of harmful substances, prevention of environmental accidents, and other environmental aspects, so as to improve employees' awareness on regulatory issues and environmental protection.

Article 8. Enterprises shall, in accordance with the requirements of the laws and regulations of the host country, conduct an environmental impact assessment on the development and construction of all projects, as well as their production and operation activities. Enterprises shall take reasonable measures to reduce possible adverse impacts based on the findings of such environmental impact assessments.

Article 9. Enterprises are encouraged to consider the impacts of their development and construction projects as well as production and operation activities on the social environment such as historical and cultural heritage, scenic spots, and folk customs. Enterprises shall take reasonable measures to reduce possible adverse impacts.

Article 10. Enterprises shall, attending to the requirements of the laws, regulations, and standards of the host country concerning environmental protection, install and operate pollution prevention equipment, implement pollution prevention interventions, and ensure that pollutant emissions, wastewater effluent, solid waste, and all other pollutants meet the pollutant emission/discharge standards of the host country.

Article 11. Enterprises are encouraged to, prior to the construction of the project, conduct environmental monitoring and evaluation for the proposed construction site, obtain an understanding of the environmental background of the project location and its surrounding areas, and publicly disclose the environmental monitoring and evaluation results.

Enterprises are encouraged to monitor the pollutants of primary concern, be cognisant of the pollution generated by the enterprises at all times, and disclose the monitoring results.

Article 12. Enterprises are advocated to conduct environmental due diligence activities for target overseas enterprises before acquiring them, focusing the evaluation on the hazardous waste formed as part of their previous/historical operation as well as soil and underground water pollution, and environmental legacies of the target enterprises. Enterprises are encouraged to undertake best environmental practices to reduce the potential environmental risks and liabilities.

Article 13. Enterprises shall establish management plans for hazardous waste that may be generated during production, the contents of which shall include measures to reduce the

amounts and risks of hazardous waste, as well as measures to store, transport, utilise, and dispose of them.

Article 14. Regarding potential risks of environmental accidents, enterprises shall formulate contingency plans for environmental accidents and other emergencies based on the nature, features, and possible environmental hazards of the same, and set up a reporting and communication system with the local government, regulatory environmental protection authority, the general public that may be affected by the project, and the headquarters of Chinese enterprises.

Contingency plans shall include the organisational system and responsibilities pertaining to emergency management, prevention, and early warning mechanism; handling procedures; emergency guarantees; and recovery and reconstruction after the emergency has been addressed. Enterprises are encouraged to organise emergency drills and make timely adjustments to the plans, as well as take measures such as environmental pollution liability insurance cover to reasonably insure themselves against risks associated with environmental accidents.

Article 15. Enterprises shall carefully consider the ecological function orientation of the area the project is located, and may, in coordination with the government of the host country and community, prioritise such measures as on-site and off-site (e.g., conservation of animal and plant resources that deserve protection near the project location, to reduce adverse impacts on the local biodiversity).

For ecological impacts caused by investment activities, enterprises are encouraged to carry out ecological restoration in accordance with the requirements of the laws and regulations of the host country or common practices in the industry.

Article 16. Enterprises are encouraged to implement clean production, promote recycling, reduce pollution at source, improve resource use efficiency, and reduce the generation and emission of pollutants in the course of production and service/product use.

Article 17. Enterprises are encouraged to implement green procurement and give preference to environmentally friendly products. Enterprises should apply for relevant environmental management system certification and environmental label certification for products in light of the laws and regulations of the host country.

Article 18. Enterprises are encouraged to post their environmental information on a regular basis, and publish their plans on implementation of laws and regulations on environmental protection, including measures taken and environmental performance achieved.

Article 19. Enterprises are encouraged to strengthen their contacts and communications with the government and regulatory authorities in charge of environmental protection in the host country, and actively seek their opinions and suggestions on environmental protection issues.

Article 20. Enterprises should establish the manner of communication and the dialogue mechanism pertaining to their environmental and social responsibilities, take initiatives to strengthen their contacts and communications with communities and relevant social groups, and

seek their opinions and suggestions with respect to the environmental impacts of their construction projects and operation activities through forums and hearings according to the requirements of the laws and regulations of the host country.

Article 21. Enterprises should actively participate in and support local public benefit activities for environmental protection, publicise the concept of environmental protection, and build a good image for themselves in this regard.

Article 22. Enterprises are encouraged to conduct research on and learn from the principles, standards, and practices relevant to environmental protection and adopted by international organisations and multilateral financial institutions.