End-Use Load Monitoring of a Community Microgrid in Rural East Malaysia: Challenges Faced During a Period of Rapid Development

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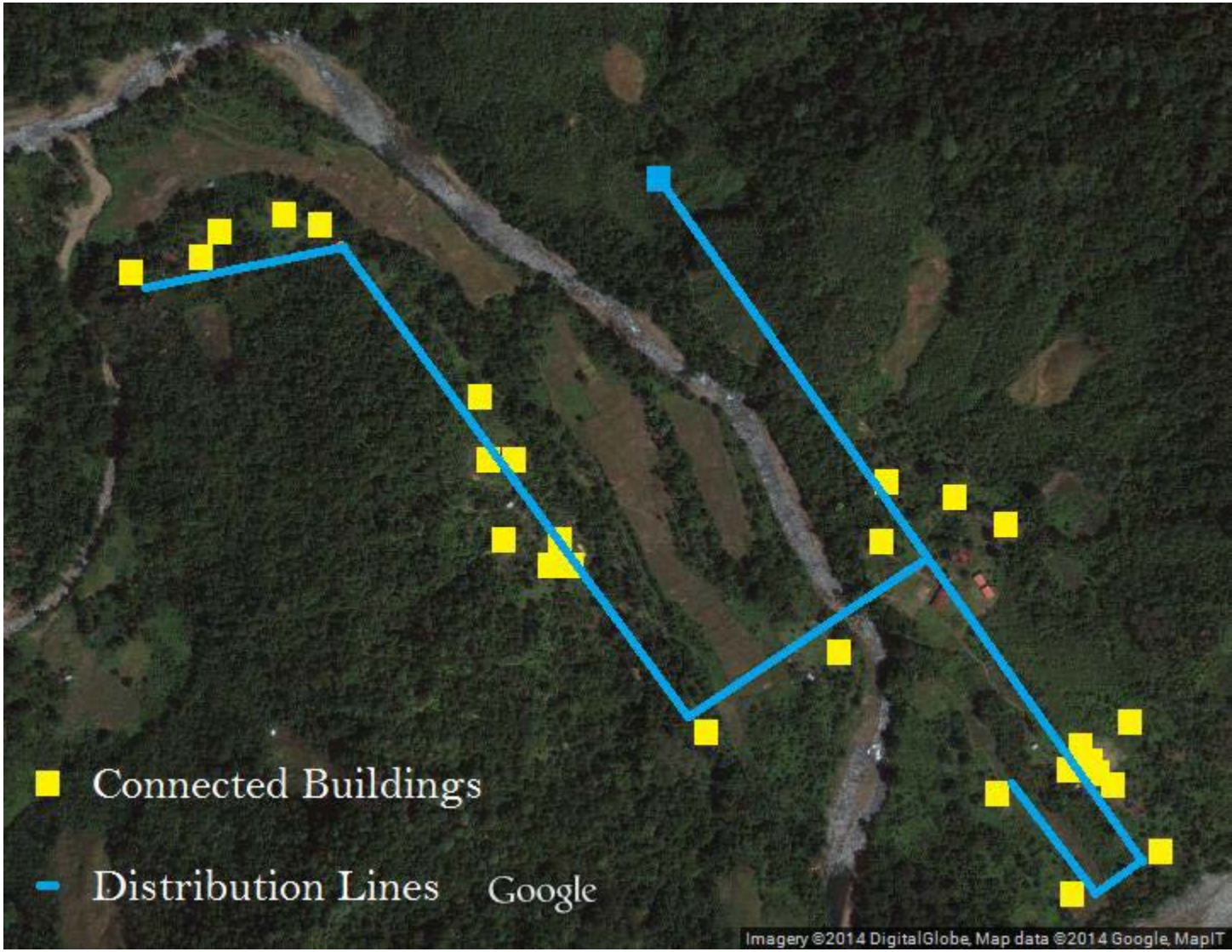
Context

- Village is located in a hilly region with significant water resources
- Population is approximately 200 people
- Consists mainly of traditional subsistence farmers
- Microgrid powered by a 12.8kW microhydro system was installed in 2009 by a community-based organization. The system is currently connected to 28 buildings

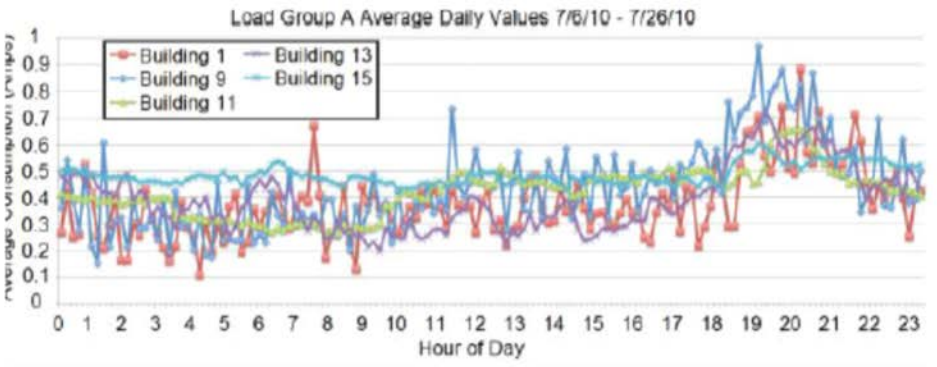


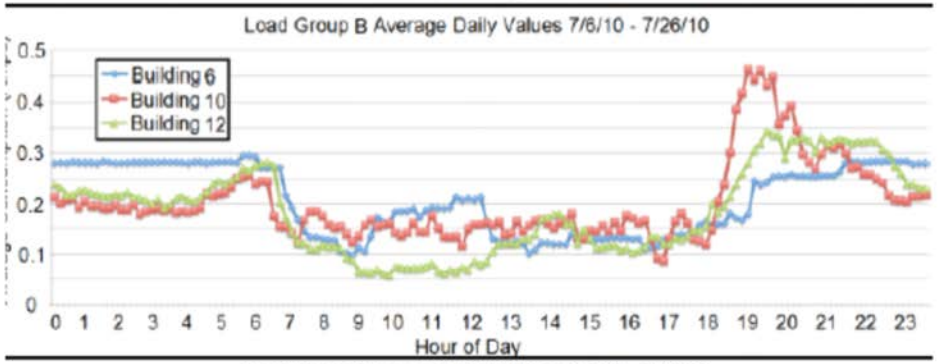
Relationship to the Community

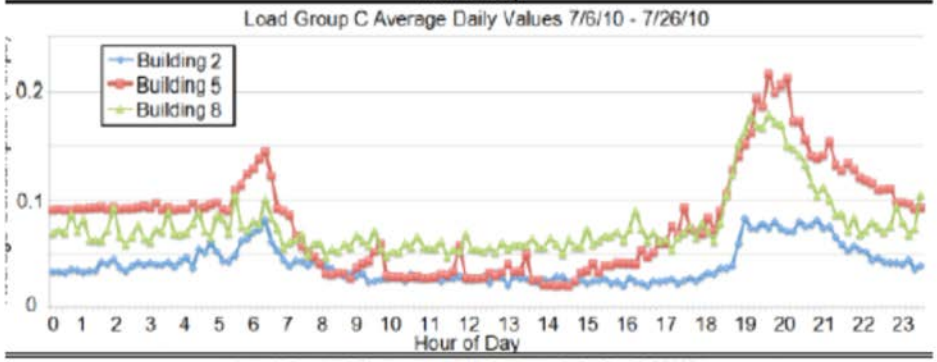
- Since 2010 Masdar Institute has built a relationship with both the community and community based organization
- Masdar has sent groups of students from the Energy and Poverty Solutions (EAPS) class to work on such topics such as water and resource management, village economy, governance and the electricity system

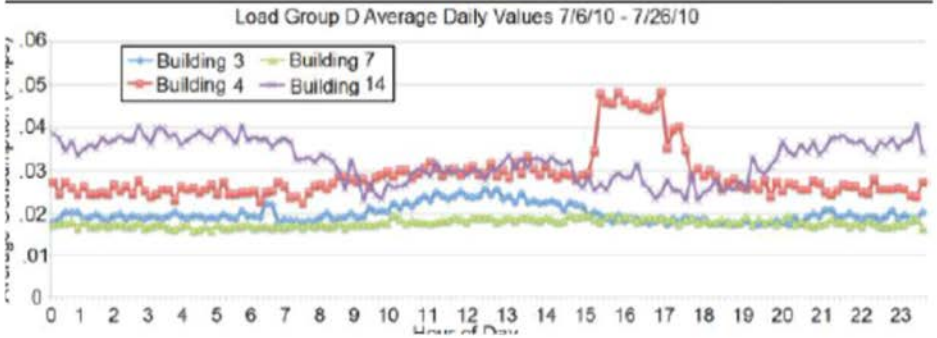
Physical System (Not Static)

- The Microhydro system has been historically unreliable
- The solar PV system for the telecenter has also been unreliable
- Diesel fuel and lead acid batteries were historically difficult to bring into the village
- The recent (2013) road extension has made diesel fuel and generators much more economical as well as small solar PV systems to charge 12V batteries









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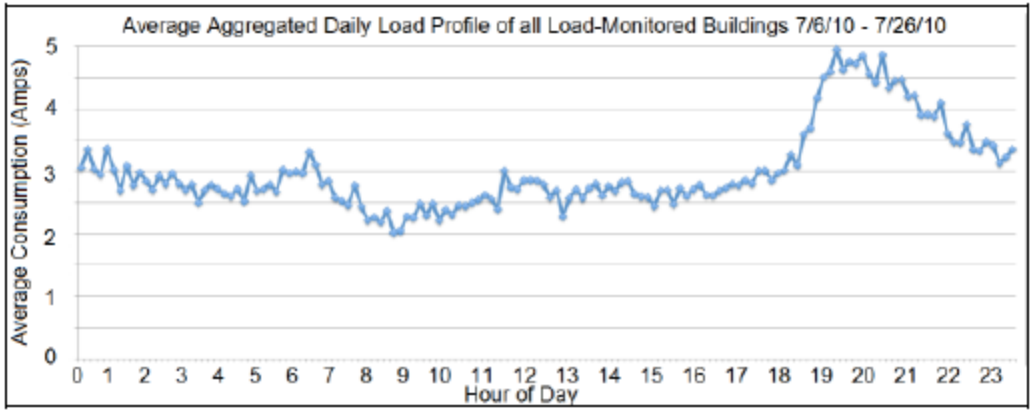
Load Use Behavior in 2010

- Based on the results obtained from data loggers installed on each connected building and the qualitative survey data determining the types of appliances/ devices utilized, four distinct load groups were established
- Each load group had a distinct profile, with peaks noticed in the morning and at night and a duty cycle characteristic of refrigerators for one of the load groups.
- Combined together this gives an average daily load profile for the system



Planning, Assessment and Implementation

- Microhydro system had issues from the start:
  - Difficulty in knowing how fast villagers would add devices
  - Funding limits during construction limited buffer time and increased outtages
- Created frustration in the community as the system was perceived as being inferior
- Due to lack of a better system, the committee determined usage fees to be charged based on the size of the fuses/breakers in each household
- This led to a feeling of unfairness and some individuals refusing to pay

#	Start Date/Time	End Date/Time	Down Time
1	7/12/10 19:20	7/13/10 6:10	10 hours 50 minutes
2	7/13/10 23:30	7/14/10 6:30	7 hours
3	7/19/10 17:00	7/23/10 20:40	4 days 3 hours 40 minutes
4	8/26/10 20:30	8/26/10 22:00	1 hour 30 minutes
5	8/27/10 17:30	8/27/10 19:40	2 hours 10 minutes
6	8/28/10 7:00	8/28/10 15:10	8 hours 10 minutes
7	8/29/10 7:50	8/29/10 12:50	5 hours
8	8/29/10 18:40	8/30/10 6:40	12 hours
9	8/30/10 13:40	8/30/10 15:30	1 hour 50 minutes
10	8/31/10 4:30	9/3/10 17:10	3 days 12 hours 40 minutes
11	9/11/10 8:10	9/11/10 14:30	6 hours 20 minutes
12	9/22/10 20:10	9/22/10 21:10	1 hour
13	9/23/10 22:40	9/24/10 19:30	20 hours 50 minutes
14	9/28/10 20:50	9/29/10 10:40	11 hours 50 minutes
15	10/2/10 8:50	10/2/10 12:10	3 hours 20 minutes
16	10/15/10 18:50	10/15/10 20:00	1 hour 10 minutes
Total Down Time			11 days 13 hours 20 minutes

Summary and Discussion

- Data suggests a progression exists from load group D to A. How fast this progression occurs is often based on financial resources available
- Due to the poor quality of the data obtained in 2013, it is difficult to make a comparison between now and 2010; This is likely due to the system constantly which make end-use load monitoring challenging.
- The lack of trust in the microhydro makes payment compliance a problem and has empowered many villagers to find a way to meet their electricity needs themselves.

Future Work

- End-use load monitoring given various electricity sources
- How the aggregate and individual load profiles change over time
- Investigating the interplay between reliability and usage trends
- Progression from load group D to A and applicability for regional analysis

Thank You

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