

Off-grid Systems – Introduction

- 1.2 billion people in the world live without access to electricity
- Further 1.7 billion are exposed to a highly unreliable systems
- Off-grid systems currently provide electricity to around 40 million people around the world
- By 2030 around 700 million people will be served by off-grid systems

What's Next?

- Most off-grid system are limited in terms of their scalability
- Once the Human Development Index (HDI) after providing access to electricity grows, off-grid systems often fail to meet the demand
- Bottom-up electrification at the lowest (SHSs) level could significantly improve reliability of power supply for customers willing to add more electrical appliances
- Large diversity in demand between prosumers (power producers and consumes) makes a bottom-up electrification a viable option which could bring a lot of benefits
- Improvement in reliability of supply could be achieved by providing LVDC between existing customers. No need to add extra generation or storage to the system.
- Interconnecting microgrids could diversify generation as well as demand profiles. As a result, Average System Peak Demand after interconnection could be shaved reducing loads experienced by existing batteries

Currently Available Off-Grid Solutions

- Microgrids – Systems with a capability to generate and often store electricity. They are connected to a low voltage distribution infrastructure supplying customers in the village
- Solar Home Systems (SHS) – off-grid technology comprised of a single PV unit connected to the battery via a charge controller. SHS typically give access to Tier 1 and Tier 2 appliances - lightening systems, phone charges, radios and small TVs.
- Solar Kiosks – System with a PV generation capability. It is not connected to any distribution system. Gives a chance to charge batteries for the customers living in the village.

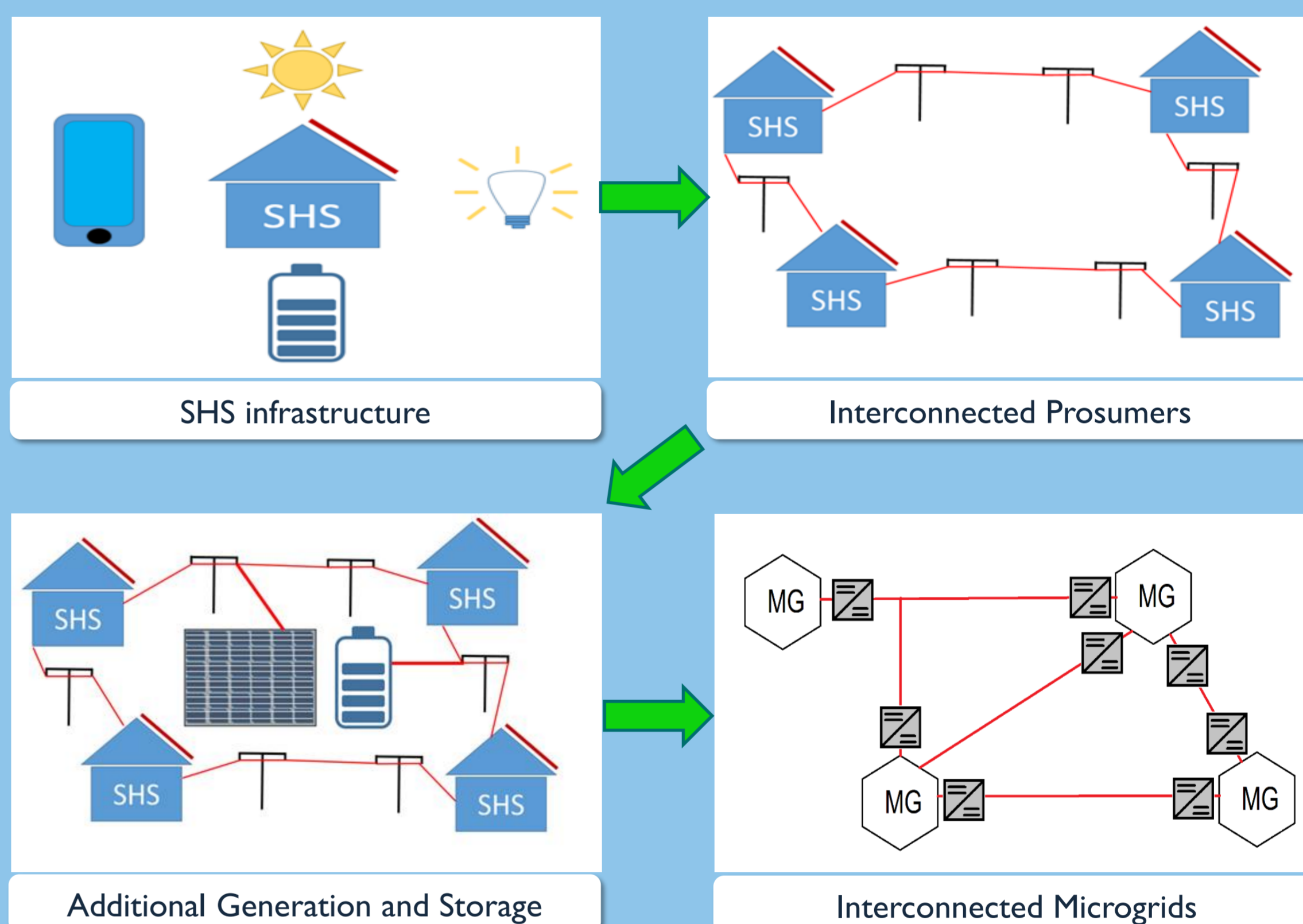


Figure 1. Bottom-Up Electrification Step-by-Step

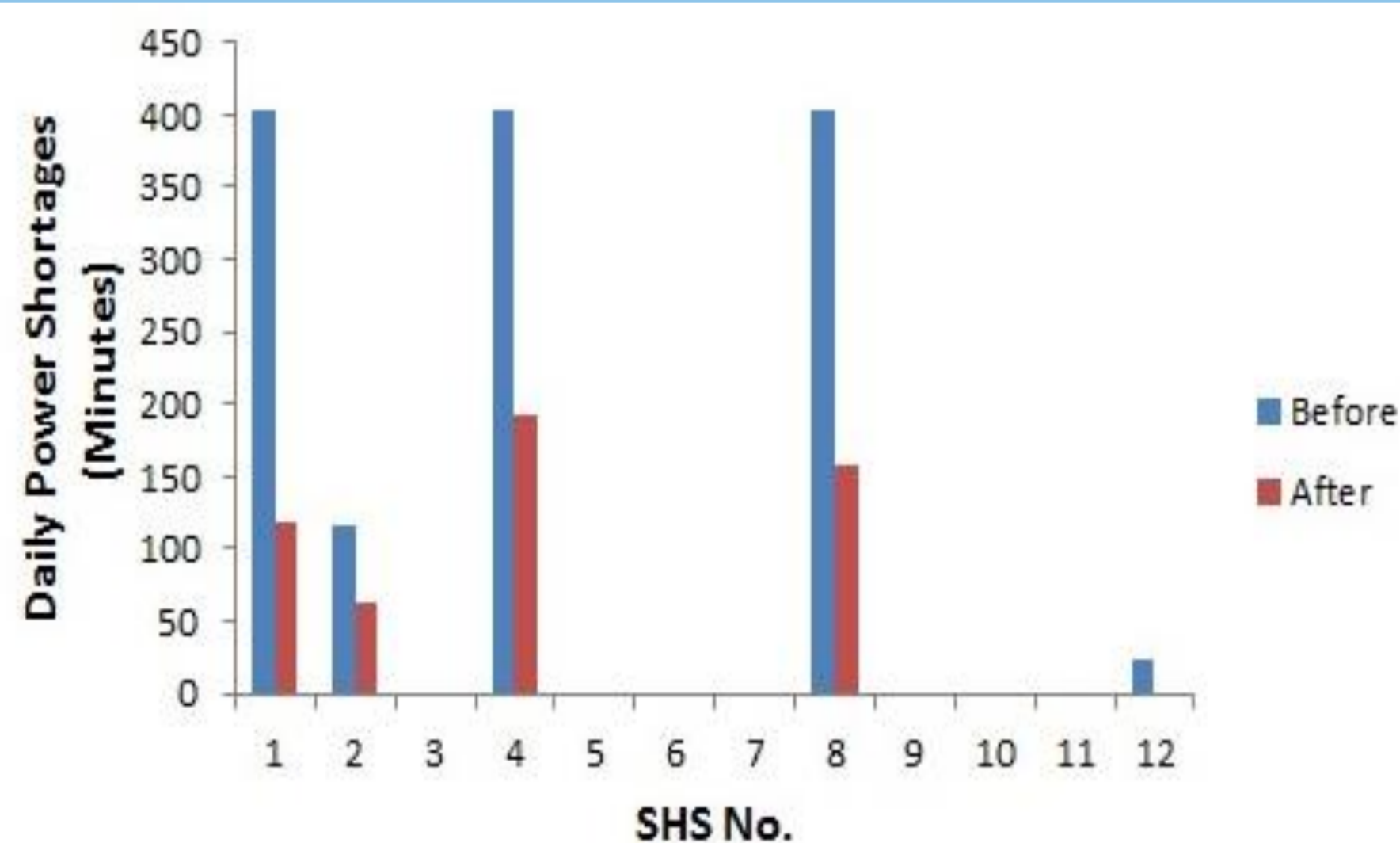


Figure 2. Estimated time without Power Supply for a Village in Bangladesh with 12 SHSs before and after interconnection

Proposed Solution

- De-centralised System with a distributed power control
- DC system providing Optimal Power Flows between in mesh power networks
- Battery State of Charge Optimisation Techniques used to Export/Import power
- Capability to connect Consumers (power consumers without generation or storage capability) to the microgrid

Challenges Faced

- No standards for DC microgrids
- Providing stability of a system with a parallel operation of buck and boost converters
- By-Passing existing infrastructure of the SHS or microgrid
- Damping oscillations due to Constant Power Load (CPL)