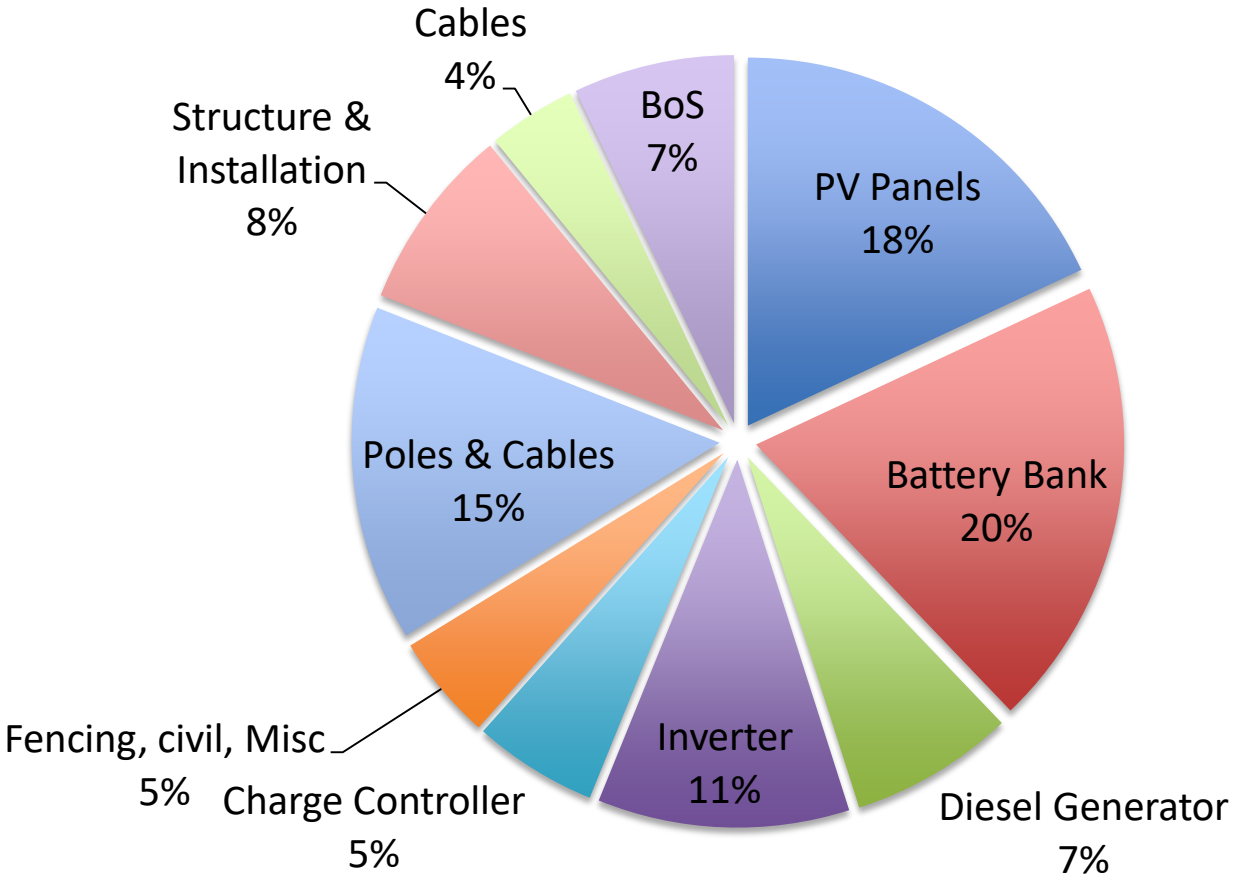
Cost reduction in the value chain of solar mini grid installation in Nigeria.

Hasna Khan

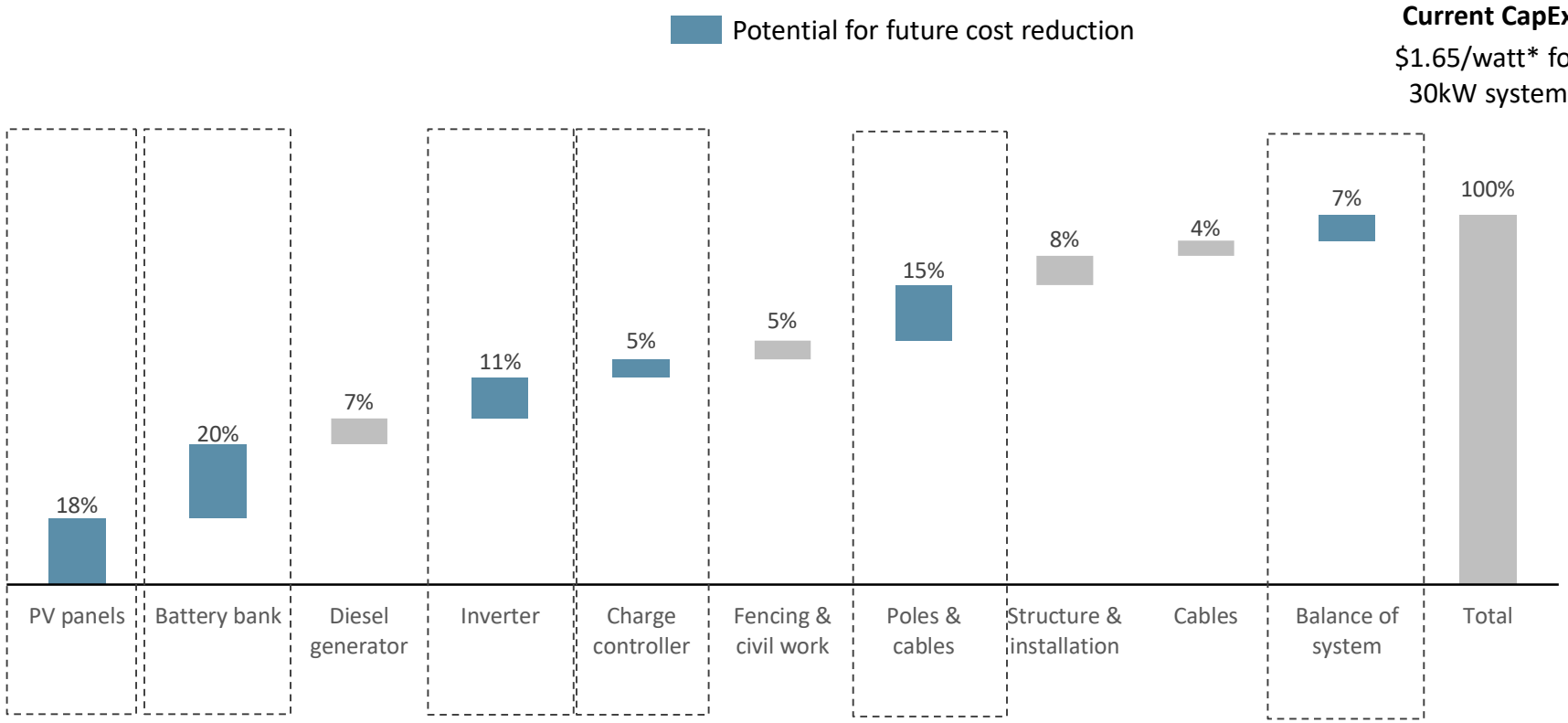
PSL-USA

Capex distribution of Small Solar mini grid (30kW) in India 'Utility in a Box'



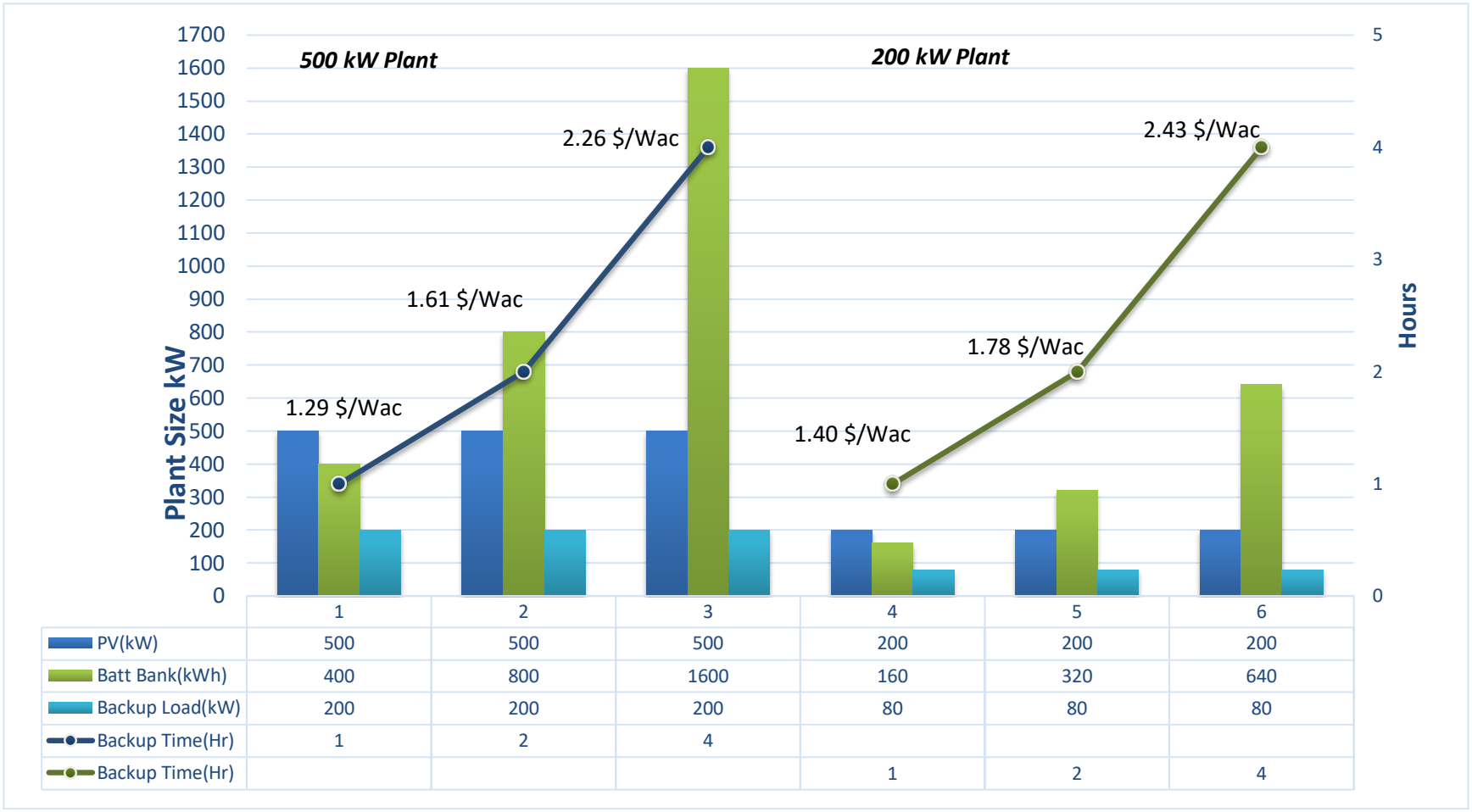
CapEx of Solar Mini Grids (30kW) in India

- opportunities for further cost reductions



Impact of storage on Capex unit cost of Solar Power Plant

(200kW and 500kW)



	1	2	3	4	5	6
PV(kW)	500	500	500	200	200	200
Batt Bank(kWh)	400	800	1600	160	320	640
Backup Load(kW)	200	200	200	80	80	80
Backup Time(Hr)	1	2	4			
Backup Time(Hr)				1	2	4

Costs: CapEx

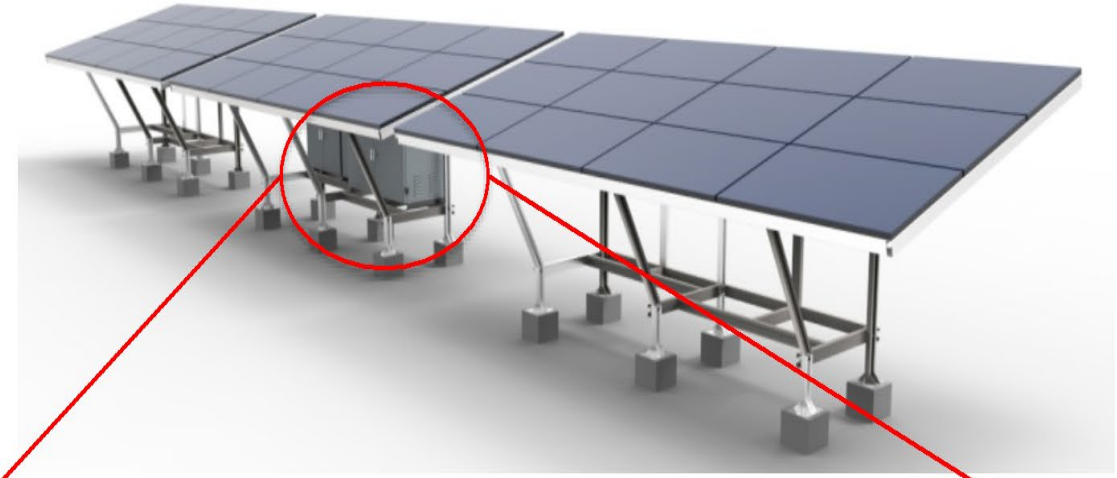
Solar mini-grid in India (30kWp)

The ”Utility-in-a-box” (UiB)

- Pre-assembled, easy to install system (<2 week per site for the power plant) which significantly reduces need for civil work and eliminates the control room
- Highly modular: Sub-systems of 10, 20 and 30 kWp, to build systems in the 10-90kWp range to meet the consumption needs of each community, and scale up with demand growth over time
- Designed and engineered for harsh outdoor conditions
- Flexibly designed battery box to house different sizes and makes

The smart-meter

- Controls load, time-of-use and payments for individual users (prepay & post-pay)
- Designed for off-grid applications; can be modified for grid connectivity
- Shared architecture: up to 6 meters/ users per box
- Comprehensive system-wide usage data available locally and centrally
- Integrated payment of appliances for on-bill financing & Mobile Payments
- Customers can track consumption via smartphone or in-house display unit



(UiB) in India

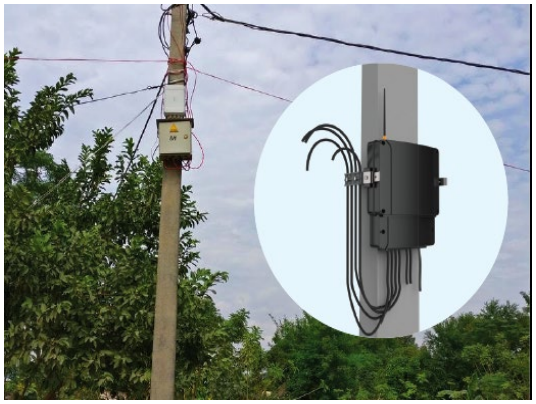
Storage Battery Unit (SBU)

Power Management Unit (PMU)

Monitoring & Control Unit

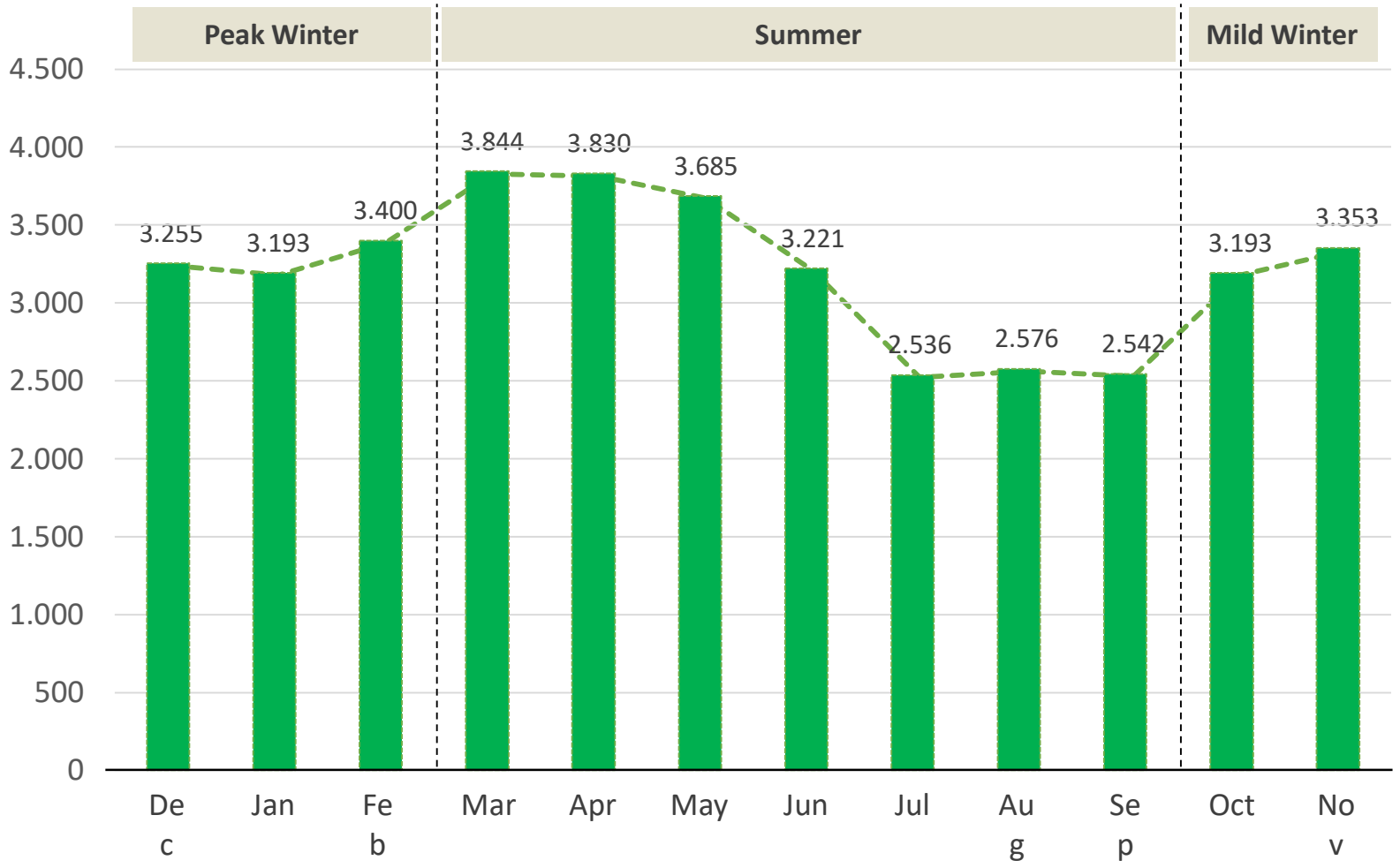
Controller Unit

UiB and smart-meter: In the field



A typical 30 kW plant can produce, on average over the year, 3,200 kWh per month, or about 105 kWh per day

Max. solar output; units (kWh) per month



Source: Data from SPI plant in Bihar, December 2017 through November 2018

30 kWp Solar UiB Plant (Bihar, India)

The UiB Design eliminates the need of a Control Room, thus reducing the need for major civil work at site.

Modular Control Panels along with Battery Box

The capacity of the plant can be increased as required by adding pre-assembled control and battery boxes.

All Control Panels are design engineered to withstand heat, dust and water

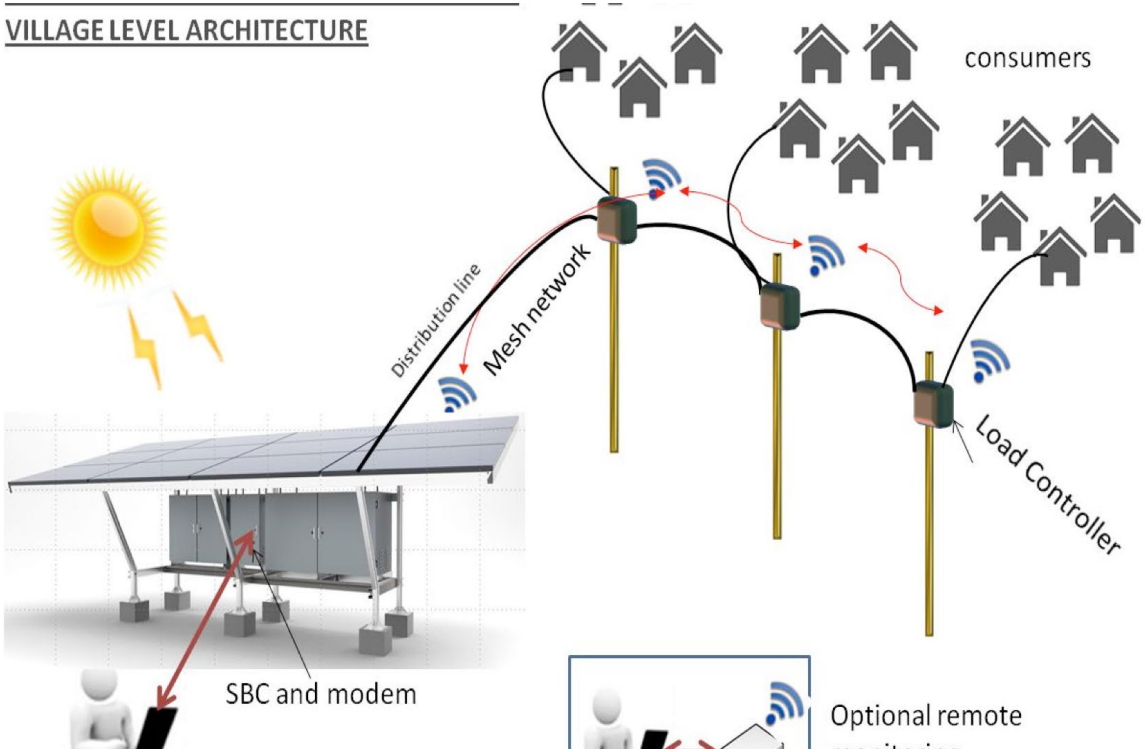
All Panels are designed IP54 and placed under the panels.

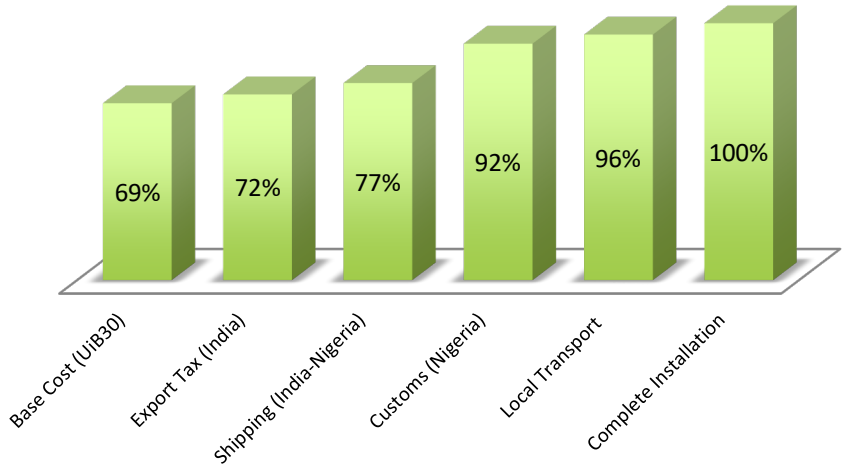
Scalable Model – Additional Panels can be added to increase capacity.

Both the AC Power and Stored Power can be increased as the demand in the rural area increases.

Smart meters with distribution line using RF Mesh Network

pre-pay and post-pay;
remote monitoring and load management;
Including a new feature **on-bill financing** of appliances





Cost in the Value Chain of Solar Mini grids for Nigeria

	Cost(USD)	*USD/Wdc*	*USD/Wac*
Base Cost (enhanced UiB30)	**78,000**	**2.50**	**$3.82**
Export Tax (India)	3,900	5%	
Shipping (India-Nigeria)	5,000		
Customs (Nigeria)	17,380	20%	
Landed Cost	**104,280**	**3.34**	**5.11**
Local Transport	4,000		
Installation	5,000		
Total cost	113,280	3.63	5.55
Price of installed mini grid (USD)	**124,800**	**4.00**	**6.12**

Adding commercial loads to household and PUA

Daily units consumed, kWh