



# SUSTAINABLE MINI-GRID

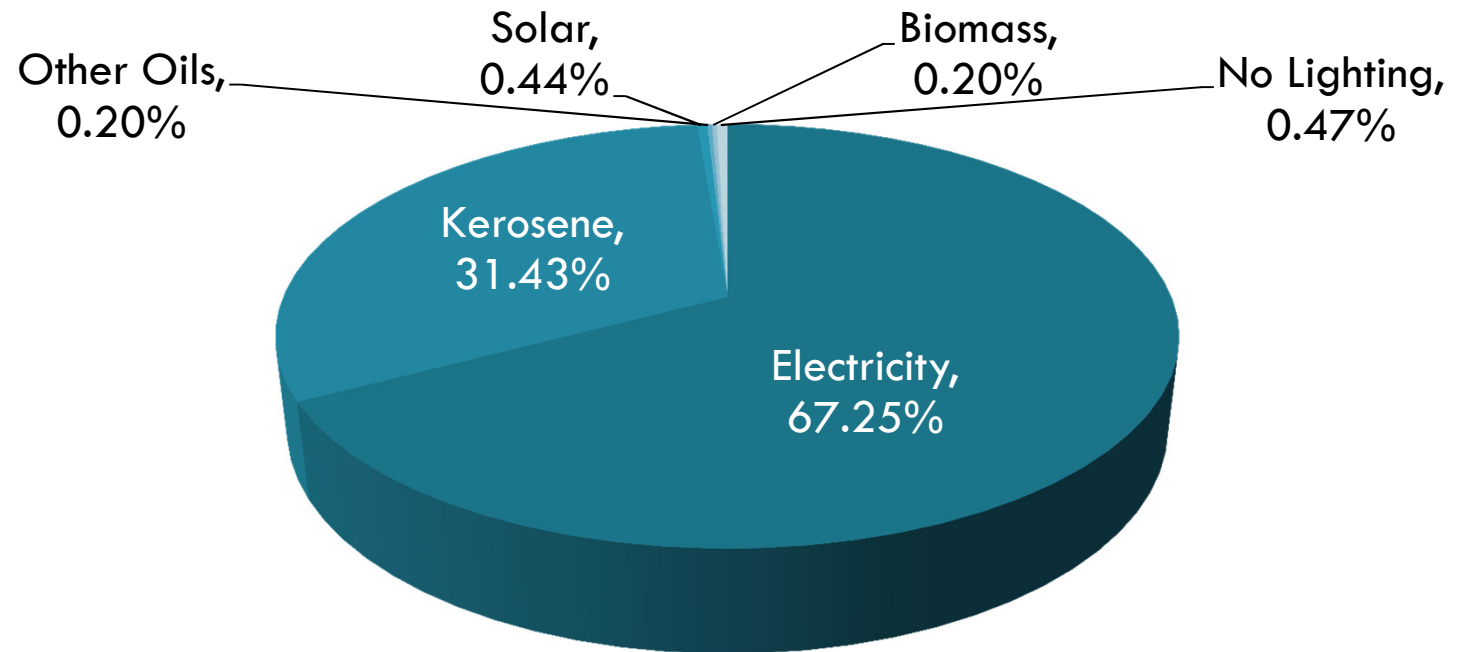


## A MODEL FOR INDIA

27/06/2014

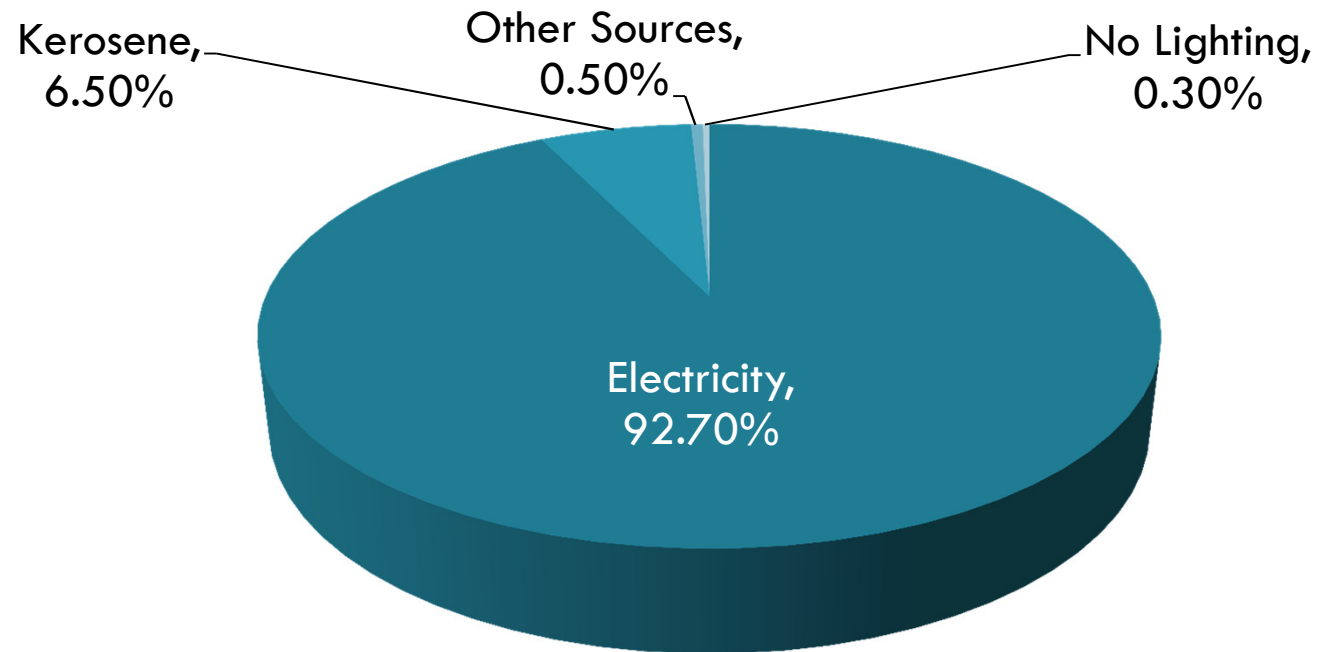
NAYANJYOTI GOSWAMI

# Energy Access - India

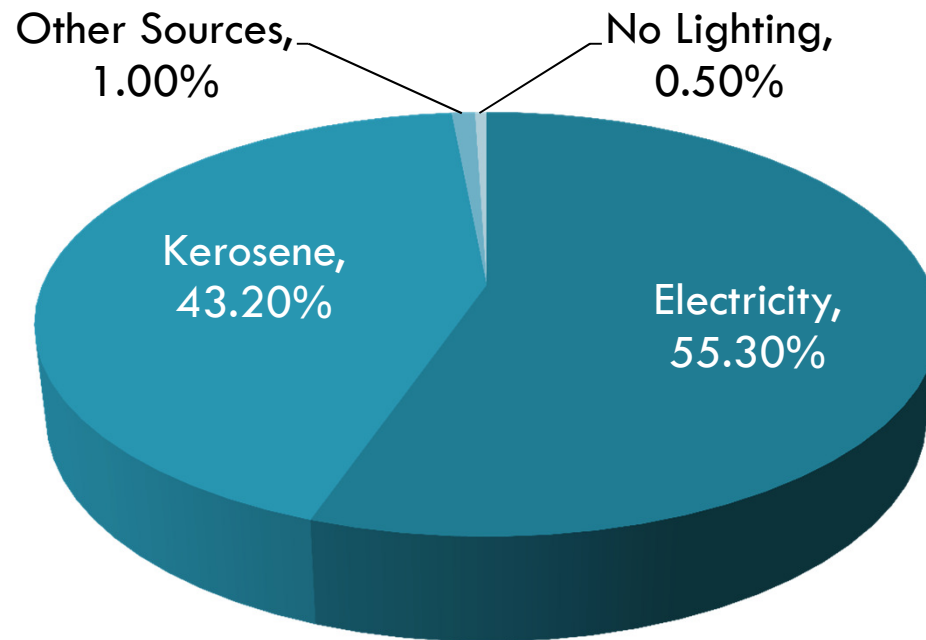




# Energy Access – Urban India



# Energy Access – Rural India





## Six states – pathetic statistics

2011		Total Households		Electricity	Kerosene	Other Sources	No Lighting
Bihar	Rural	16,926,958.0	12,660,007.0	10.4	88.4	1.2	0.1
	Urban	2,013,671.0	1,322,583.0	66.7	32.2	0.8	0.2
	Total	18,940,629.0	13,982,590.0	16.4	82.4	1.1	0.1
West Bengal	Rural	13,717,186.0	11,161,870.0	40.3	57.8	0.6	1.1
	Urban	6,350,113.0	4,554,045.0	85.1	12.7	1.6	0.6
	Total	20,067,299.0	15,715,915.0	54.5	43.5	1.5	0.5
Assam	Rural	5,374,553.0	4,220,173.0	28.4	70.4	1.1	0.2
	Urban	992,742.0	715,185.0	84.1	15.2	0.5	0.3
	Total	6,367,295.0	4,935,358.0	37.0	61.8	1.0	0.2
Odisha	Rural	8,144,012.0	6,782,879.0	35.6	62.8	0.6	1.1
	Urban	1,517,073.0	1,087,248.0	83.1	15.3	0.4	1.2
	Total	9,661,085.0	7,870,127.0	43.0	55.3	0.6	1.1
Jharkhand	Rural	4,685,965.0	3,802,412.0	32.3	66.4	1.2	-
	Urban	1,495,642.0	1,060,178.0	88.0	11.4	0.5	0.1
	Total	6,181,607.0	4,862,590.0	45.8	53.1	1.0	0.1
Uttar Pradesh	Rural	25,475,071.0	20,590,074.0	23.8	75.0	1.1	0.1
	Urban	7,449,195.0	5,170,527.0	81.4	17.2	0.9	0.4
	Total	32,924,266.0	25,760,601.0	36.8	61.9	1.0	0.2



# Why mini-grid make sense?

- ❑ Increasing gap between demand and supply – Rising imports
- ❑ Over dependency on fossil fuel – serious climate change concerns
- ❑ Acute energy poverty in rural India – cause of low HDI index
- ❑ Rapid growth in the power sector will not serve the poor
- ❑ RE potential – opportunity to leapfrog from polluting fossil fuel to clean energy
- ❑ A huge rural market beginning to unfold



## What is Mini-Grid?

- Grid – High voltage backbone system of interconnected transmission lines, substations and generating plants.
- Mini-grid – Smaller version of a grid
- But how small it is?
  - 1.5 kW serving 200 customers?
  - 32 KW serving 400 customers?



# Rural household requirement

Appliance	Load (W)	Quantity (No)	Hours of consumption	Consumption/day (Wh)	Consumption/month (kWh)
CFL lamps	11	2	6	132	3.96
CFL lamps	8	1	6	48	1.44
Ceiling fans/table fan	75	1	12	900	27
Mobile charging	8	1	3	24	0.72
Television	80	1	5	400	12
VCD drive/set-top box	30	1	5	150	4.5
	<b>212</b>	<b>7</b>	<b>37</b>	<b>1654</b>	<b>49.62</b>





# Requirement for 50 households

Appliance	Load (W)	Quantity (No)	Hours of operation	Consumption/day (Wh)	Days /month	Consumption/month (kWh)
Residential needs for 50 households						2481.00
Pump set	3000	1	4	12000	20	240.00
Livelihood (marketplace)	11	20	5	1100	30	33.00
Flour mill	5000	1	2	10000	20	200.00
Street lighting	11	10	10	1100	30	33.00
Community centre/ anganwadi/hospital	500	1	4	2000	30	60.00
<b>Total demand per month</b>						<b><u>3047.00</u></b>
<b>Technical and commercial losses @ 20 per cent</b>						<b><u>761.75</u></b>
<b>Total number of units required to be generated per month</b>						<b><u>3808.75 ≈ 3800.00</u></b>



## Definition of mini-grid

- A set of electricity generators, possibly with energy storage system interconnected to a distribution network that is capable of generating at least 3800 units per month in peak power condition to serve 50 households.
  - Technology neutral
  - A minimum size is defined
  - A minimum service parameter is defined



# Challenges in the definition

- What will happen to the excess power if demand is less?
  - ▣ Interconnected to grid if available
  - ▣ If grid is not available – excess power is wasted
    - Proper assessment of demand & its growth
    - Scheduling of power based on demand
    - Economic activities - productive activities
    - Base loads



# Amendments in policies

- Electricity Act – 2003
  - ▣ Define mini-grid
  - ▣ Direct NEP to formulate policies for DISCOMs to sell and purchase power from mini-grids
  - ▣ Energy equity – equivalent to kerosene replacement cost
  - ▣ Electricity supply code for mini-grids
  - ▣ Institute MVA for monitoring, verification and rating
  - ▣ Follow certain clause of EA part - VI



# Amendments in policies

- National Electricity Policy - 2005
  - ▣ Redefine REDB
  - ▣ Lay down grid interconnectivity with mini-grids
- National Tariff Policy – 2006
  - ▣ RPO must include certain % of power from mini-grids
  - ▣ Mandate SERCs to decide preferential tariff for mini-grids
- Rural Electrification Policy - 2006
  - ▣ Shift the focus from grid extension to mini-grids



## Amendments in schemes

- DDG
  - ▣ Mini-grids in grid connected villages where electricity is less than 12 hours
- JNNSM
  - ▣ Mini-grids in remote villages only through proposed REAP scheme
  - ▣ Off-grid applications like – solar pumps



# Tariff Mechanisms

- Mini-grids in grid connected areas
  - ▣ Feed – in – Tariff from REC directly.
    - Sources – RGGVY, Kerosene subsidy
  - ▣ Tariff from served customers
- Mini-grids in remote areas
  - ▣ Generation based incentives from MNRE directly.
    - Sources – NCEF Fund, Green Climate Fund
  - ▣ Tariff from served customers



# Capital Expenditure

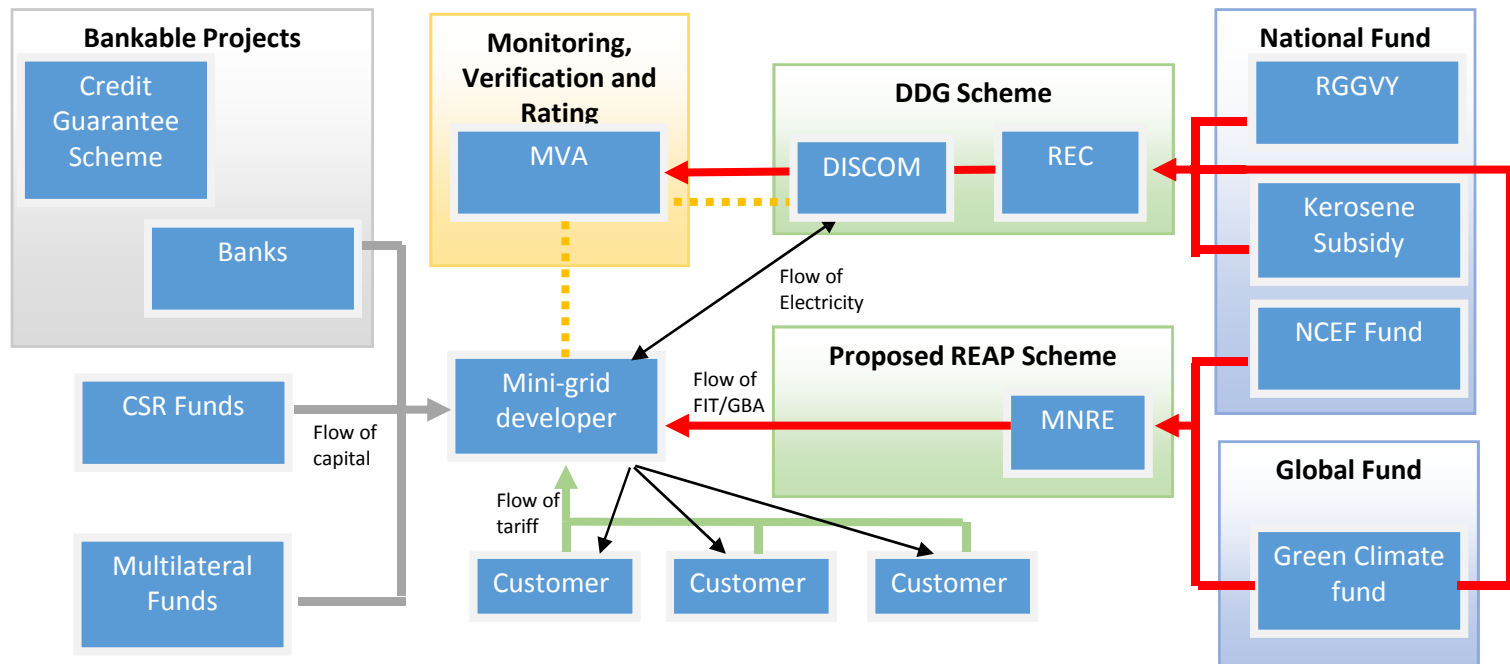
- Debt Finance
  - ▣ Bank with soft loans – backed by credit guarantee from government for bankable projects
  - ▣ CSR Funds / Multilateral funds for non bankable projects
- Equity Finance
  - ▣ Mini-grid developer



# Renewable Energy



# The Model



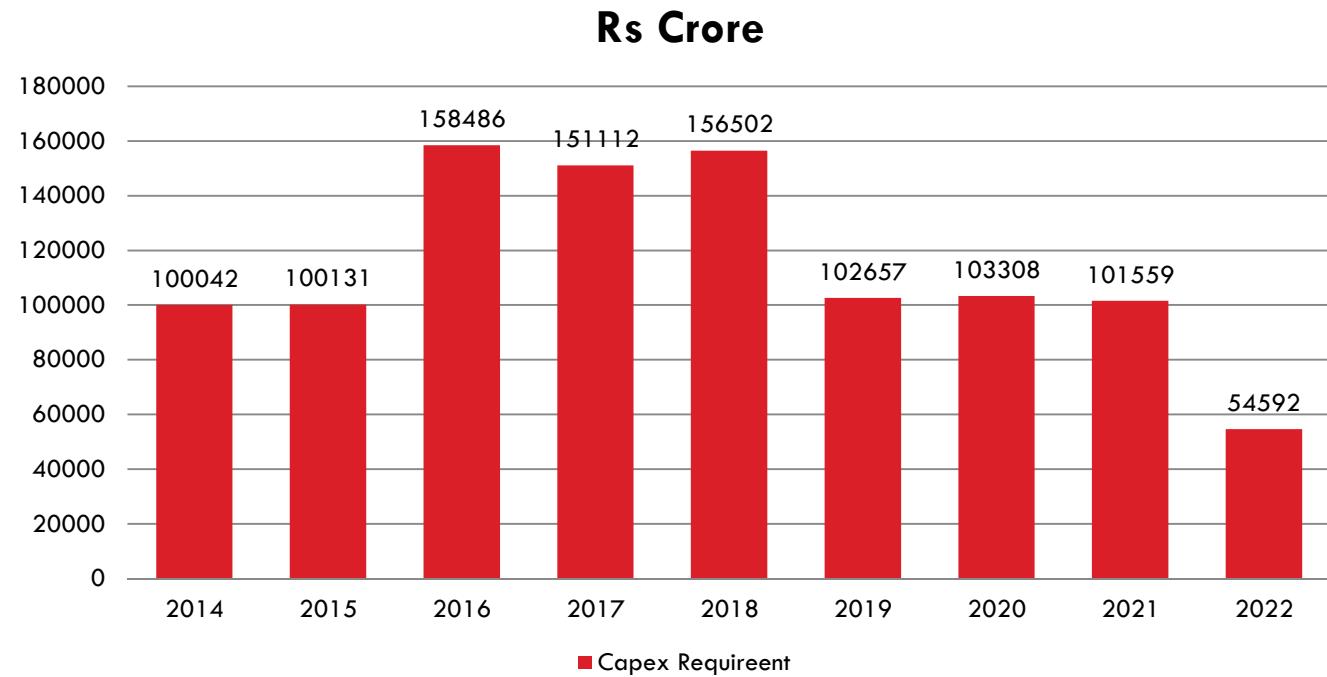


## Features of the model

- ❑ Source and flow of funds defined
- ❑ Bankable and non bankable projects dealt separately
- ❑ MVA for monitoring, verification and rating
- ❑ Global fund for FIT / GBI
- ❑ Cluster approach
- ❑ Grid interconnectivity if grid is available
- ❑ Energy equity

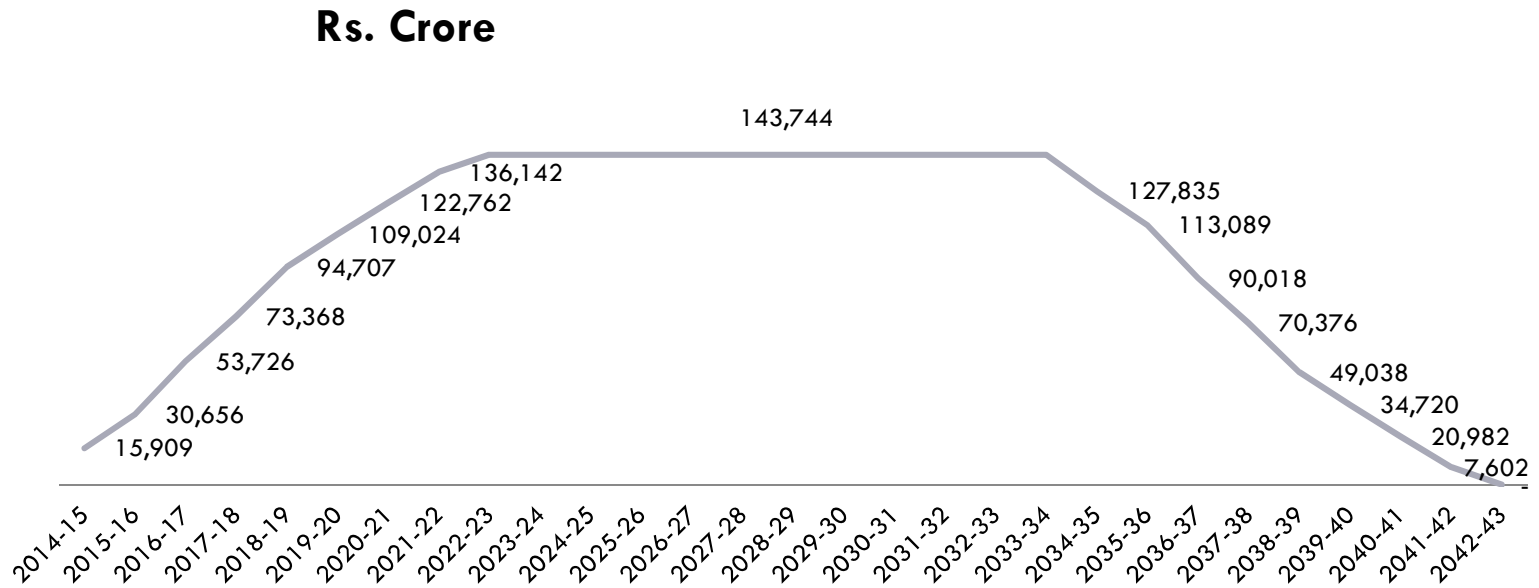


# Cap-ex requirement - India





# FIT/GBI requirement - India





# Selection of mini-grid developer

- ❑ Bidding
- ❑ Bid preparation
- ❑ Financial eligibility
- ❑ Distribution of electricity – adhere to provisions
- ❑ O&M and capacity building