Tutorial - 2 **Energy Access**

EN653/PS611 Energy Policy Analysis **January 2019**

The data sheet enclosed provides the details of 'a hypothetical un-electrified village in India. The village has 100 households with different income/expenditures (based on their Kerosene consumption). The village has some shops, flour mills, a school, a pump set for irrigation and a mobile tower. It is proposed to provide electricity access to the village. The options being considered are:

i) Solar Home Systems

ii) Solar PV- Battery Micro grid

iii) Biomass Gasifier- Engine Micro grid

iv) Diesel Engine Micro grid

v) Grid extension

a) Compute the present energy used for lighting and motive power in the village. Determine the annual carbon dioxide emissions and the annual cost incurred by the village.

b) Compute the viability of solar home systems for the three different income classes. Would you recommend a subsidy on solar home systems? What would be a viable leasing model for Solar home systems?

c) Size, select and compare options ii) to v) for the village. Compute the tariffs without subsidy. Compare different policy interventions from the different stakeholder perspectives. Add/ modify the data sheet , as required (Include your sources)

HHs			
SN	Parameter Description	Units	Values
1	Total number of HHs in the village	Number	100
2	Number of HHs – High kerosene consumption	Number	20
3	Number of HHs –Moderate kerosene consumption	Number	40
4	Number of HHs – Lowkerosene consumption	Number	40
5	Kerosene consumption – High (HI)	Ltrs/month	8.5
6	Kerosene consumption – Moderate HHs	Ltrs/month	5.5
7	Kerosene consumption – Low HHs	Ltrs/month	3

Demand Survey			
Description	**Capacity (Watts)**	**Number of HHs Willing**	**Willingness to Pay (Rs/Month)**
Package - 1	30	30	40
Package - 2	50	30	80
Package - 3	100	20	150

Microenterprise - Shops			
SN	Parameter Description	Units	Values
1	Number of shops using Diesel generator set	Number	2
2	DG Capacity	kVA	7.5
3	Average fuel consumption of DG set being used in the shop	Ltrs/hr	1.3
4	Average hours of diesel generator usage - shops (2 hrs in Morning and 2 hrs in evening)	Hrs/day	4
5	Average days per month for shop operation	days/month	20
Micro-enterprise - 3 phase load			
SN	Parameter Description	Units	Values
1	Total number of flour mills in the village	Number	2
2	Capacity of diesel engine being used in flour mill	hp	10
3	Average diesel consumption of the flour mill	Ltrs/hr	3.5
4	Average hours of diesel engine operation in Flour mill	hrs/day	3
5	Number of day per month	days/month	22
Institutional load			
SN	Parameter Description	Units	Values
1	Total Number of Institution present in the village	Number	1
2	Capacity of DG set being used for electricity supply in Institution	kVA	7.5
3	Average fuel consumption of DG set being used in Institution	Ltrs/hr	2.95
4	Average hours of diesel generator usage – Institution	Hrs/day	7.5
5	Average days of operation per month – Institution	days/month	22

Microenterprise - Irrigation load			
SN	Parameter Description	Units	Values
1	Total area under irrigation	Acres	50
2	Capacity of diesel engine being used in flour mill	hp	10
3	Fuel consumption for diesel pump being used for irrigation	Ltrs/hr	2.5
6	hous of operation diesel pump	hrs/year	1325
Micro-enterprise - 3 phase load (mobile Tower)			
SN	Parameter Description	Units	Values
1	Total number of Mobile tower	Number	1
2	Total Load	kW	3
3	DG capacity	hp	10
4	Average diesel consumption of the flour mill	Ltrs/hr	3.5
5	Number of day per month	days/month	30

Capex		
Cost of Civil Work	RS	10000
Cost of Gasifier System	(Rs./kW)	63712
Cost of Gas Engine	(Rs./kW)	32274
Cost of battery bank	(Rs./kWh)	6500
Cost of converter	(Rs./kW)	16000
Cost of charge controller	(Rs./kWh)	350
Cost of Solar Panel	(Rs./kW)	35000
Cost of BoS	(Rs./kW)	20000
Cost of Diesel Generator	(Rs./kW)	15000
Cost of distribution network	(Rs./km)	125000

Parameter	Unit	Value
Gasifier Life	Years	10
Engine Life	Years	20
Battery Life	Years	5
Charge Controller Life	Years	10
Invertor Life	Years	10
Panel Life	Years	25
Civil Work Life	Years	35
Discount Rate	%	10%
DG Set Life	Years	10

O&M Biomass		
Salary of trained manpower	Rs/ Month	7000
Salary of untrained manpower	Rs/ Month	3500
Per kg Fuel Cost	Rs/kg	2.5
Days of operation - Biomass Gasifier System	Days/Year	330
Biomass Gasifier O&M Cost	Rs/kWh	2.5
Solar PV	Rs/kWh	0.5
Days of operation - Solar System	Days/Year	300
Battery Charging and Discharging Efficiency	%	85

Other Charges		
One time connection Fee – Category 1	Rs	400
One time connection Fee – Category 2	Rs	350
One time connection Fee – Category 3	Rs	200