Off-grid Rural Area Electrification by Solar-Diesel Hybrid Mini-grid in Bangladesh : Design Considerations

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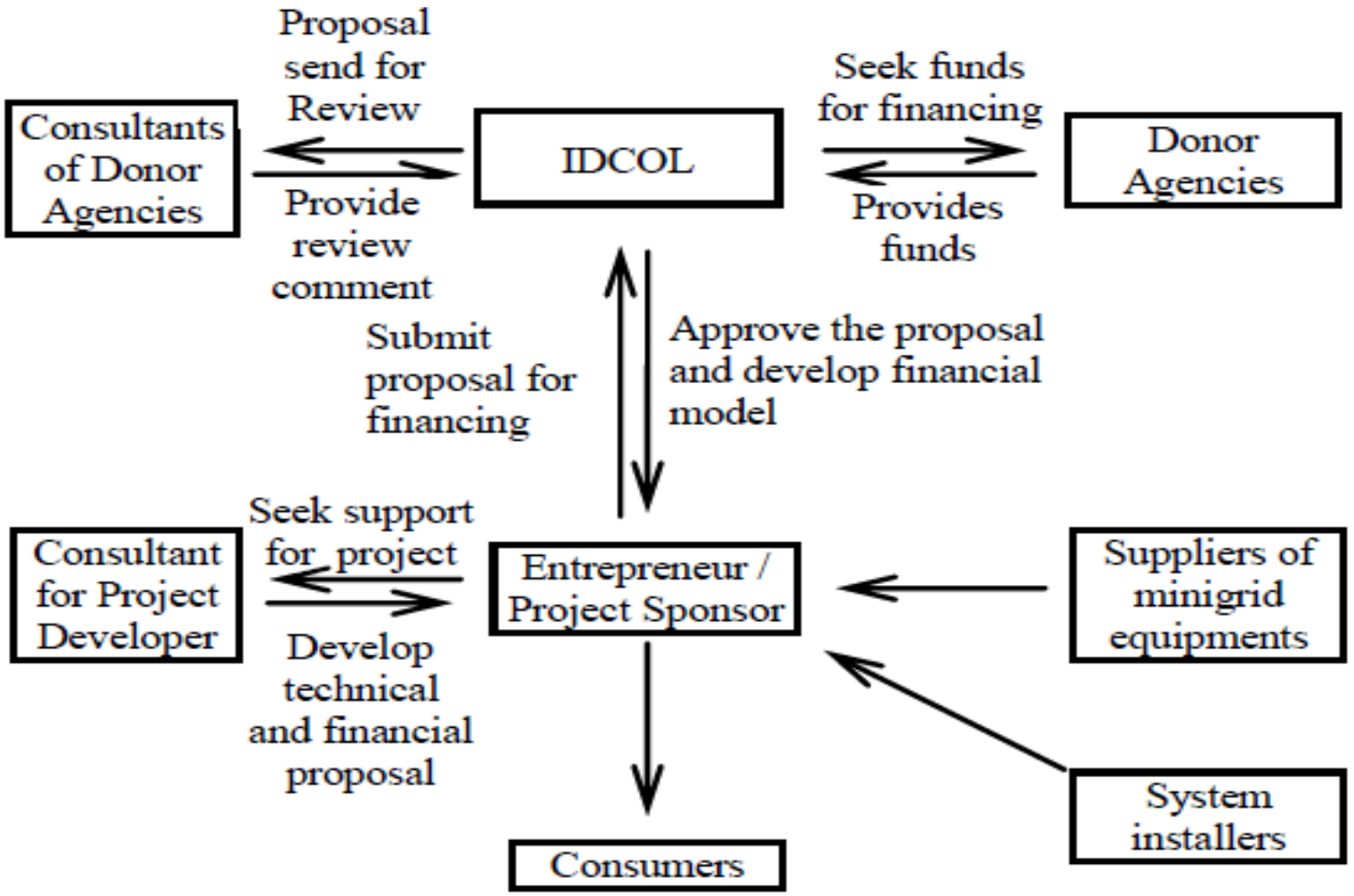
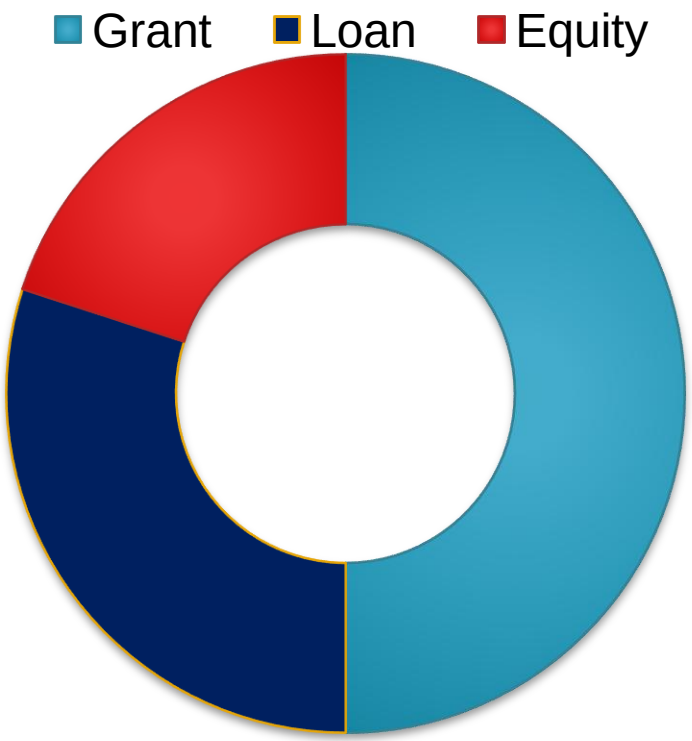
Functional Structure of IDCOL Solar-Diesel Hybrid Minigrid



Financial Scheme of IDCOL Minigrid Project



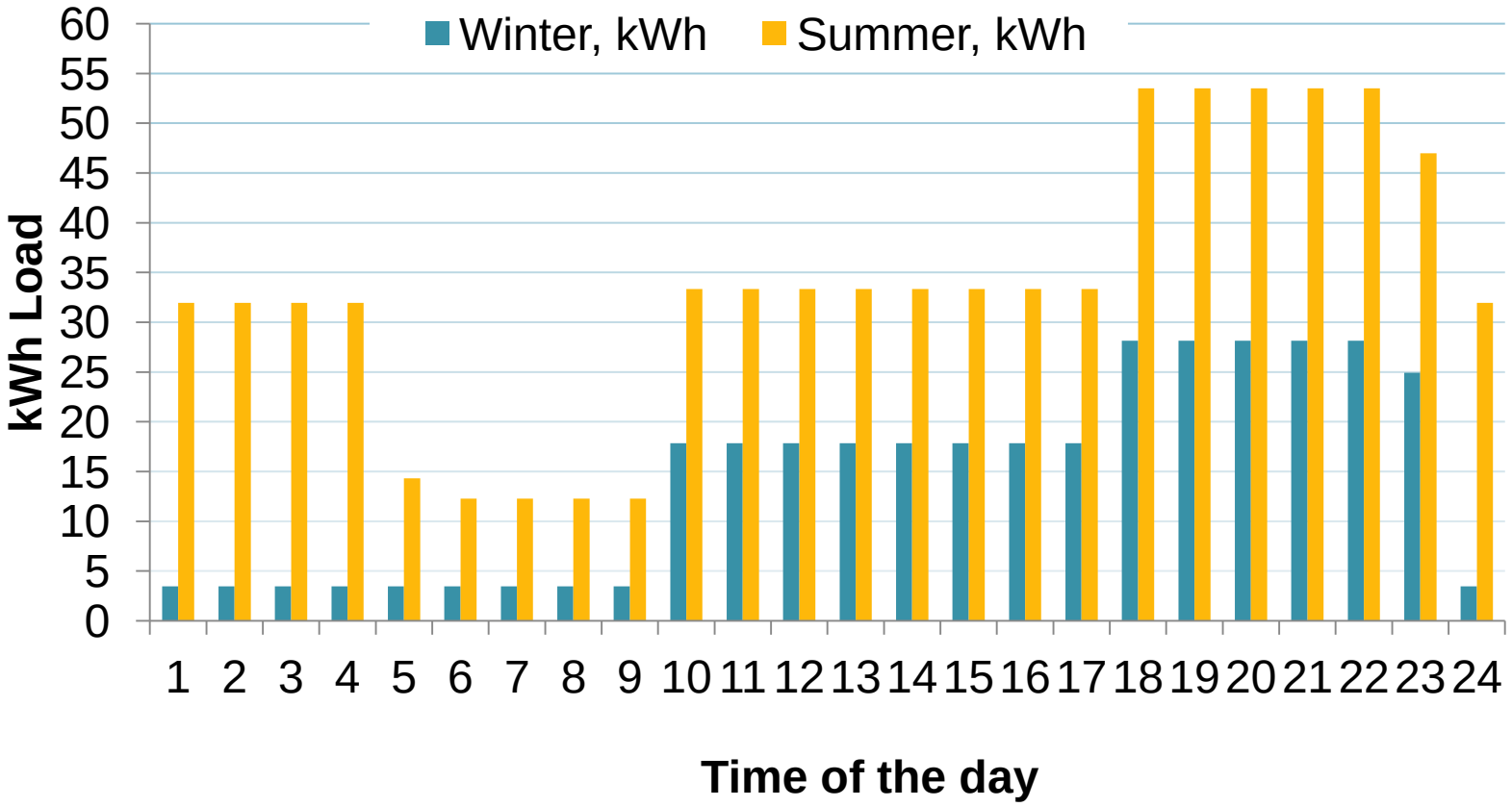
Project Donors:
KfW, WB, ADB and JICA

Loan Scheme:
Interest rate: 6%
Tenure: 10 years
Principal grace: 2 years
Payment frequency: 3 months
Payment type: Annuity

Mini-Grid Design Steps

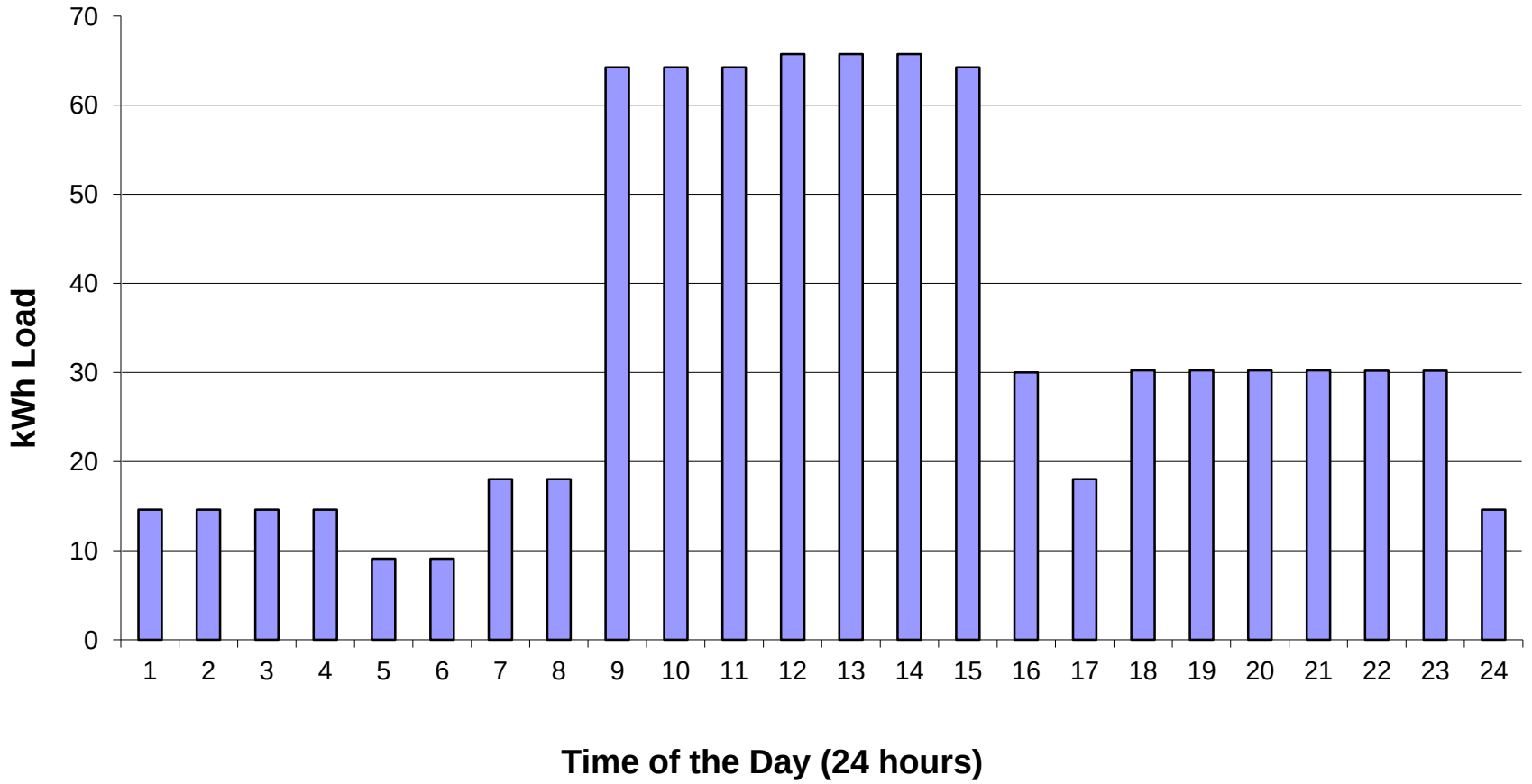
1. Site Survey for Feasibility Study
2. Demand Assessment (Load duration curve)
3. Technical Design
4. Financial Analysis
5. Preparing Bankable Document
6. Installation Supervision and Commissioning

Typical Rural (Household and Shops) Load Duration Curve



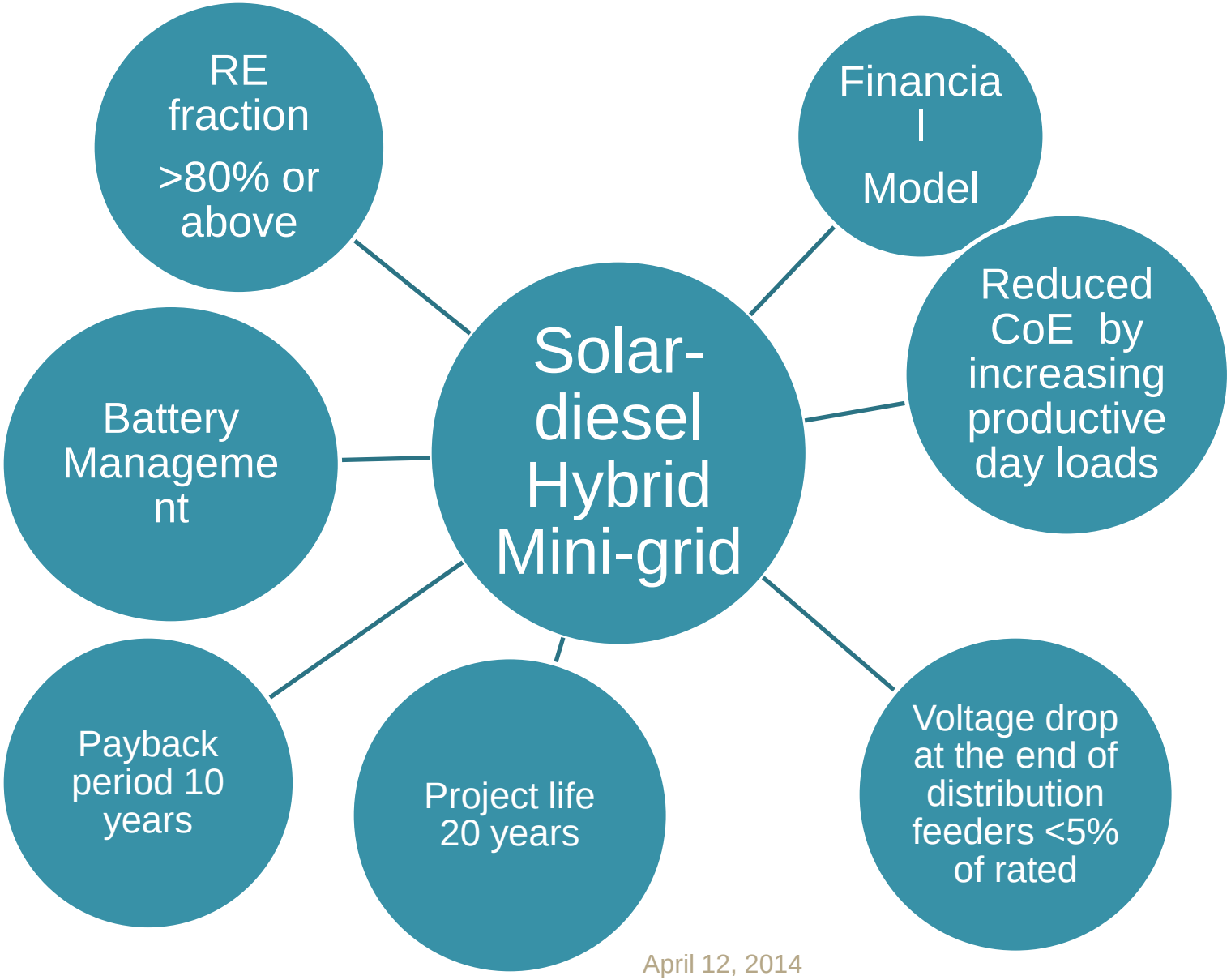
For 800 house holds and a village market having 200 shops

Typical Rural Load Duration Curve With Productive Day Loads

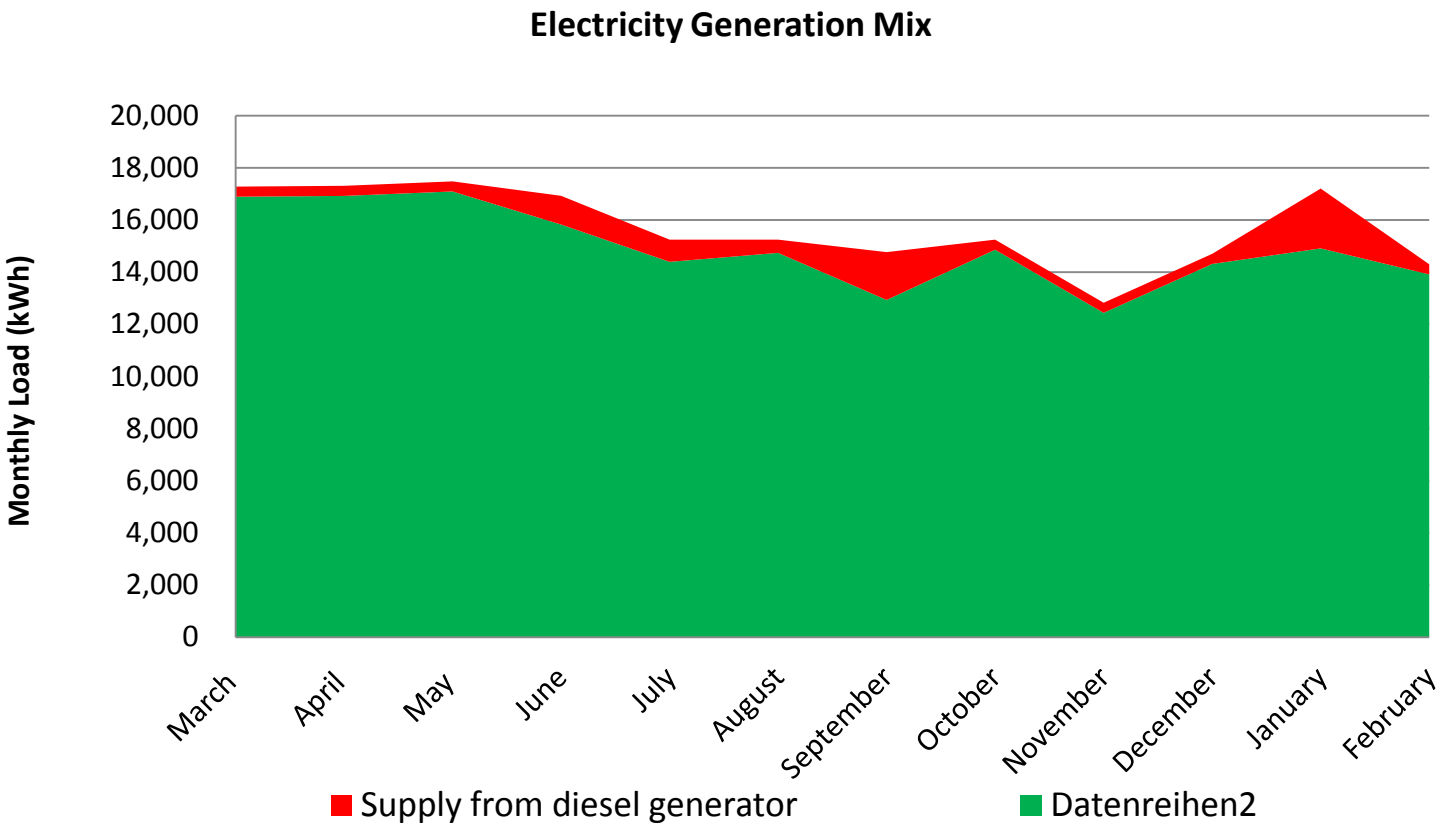


For 500 households, a village market having 150 shops and industrial loads (Workshop, Saw mills and ice making industry)

Design Consideration



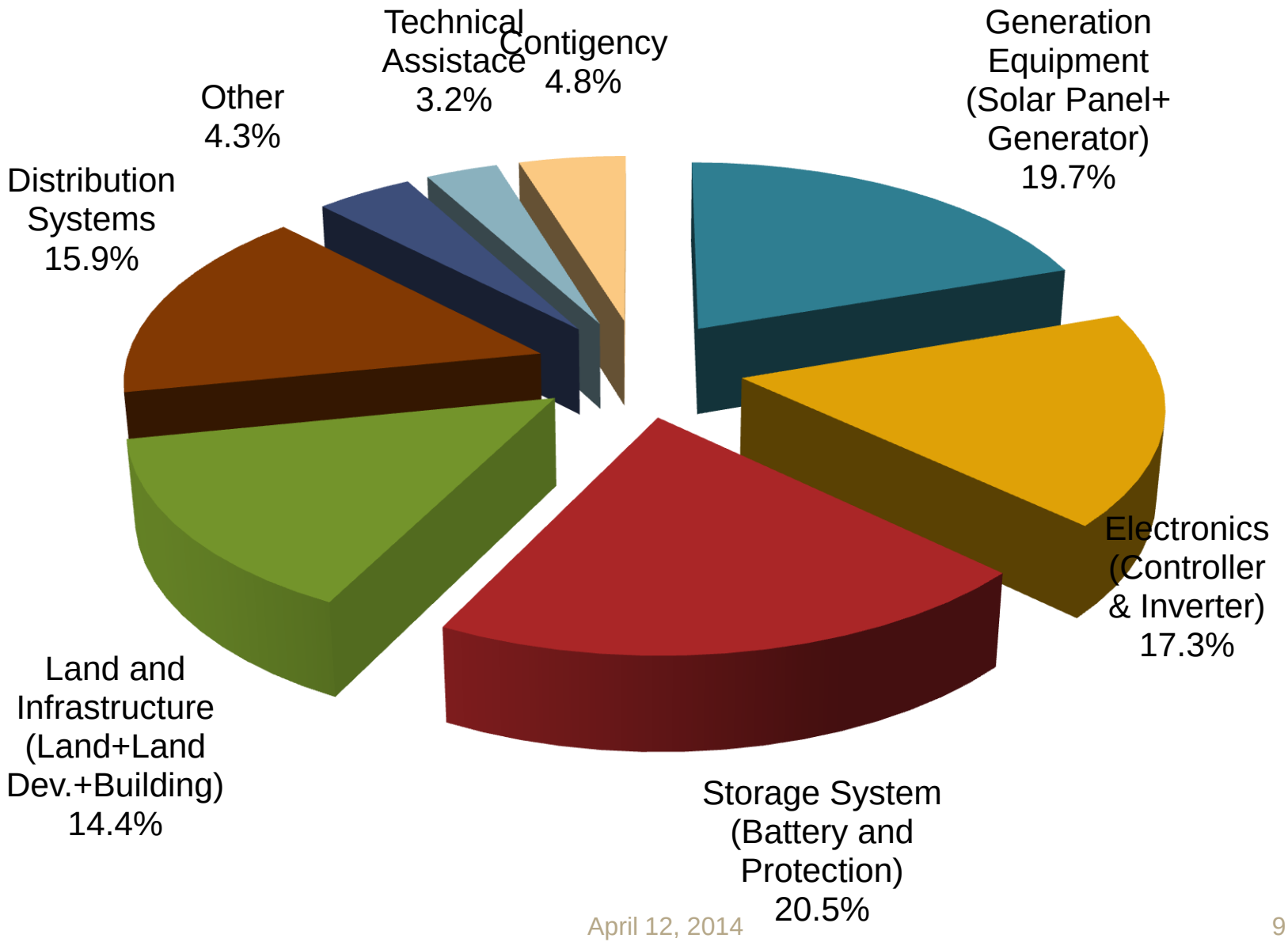
Energy Mix for Rural mini-grid



Energy share curve of a 200kWp Solar-Diesel Hybrid Mini-grid

Renewable Fraction > 90%

Project cost breakup



Cost Reduction Potential

- Increase of daytime load (does not require battery storage)
  - Solar irrigation
  - Cottage industries (Sewing or weaving machine etc.)
  - Husking mills
  - Sawmills
  - Lathe machine
  - Welding machines
  - Grinding machines (spice)
  - Photocopier machine
  - Computer training centres
  - Poultry firms
  - Cold storages
  - Ice making industry (for fish preservation in island areas)
  - Offices /Schools/Madrasas etc.

Storage system

Most difficult part of designing an off grid solar system for rural electrification is the storage system managements.

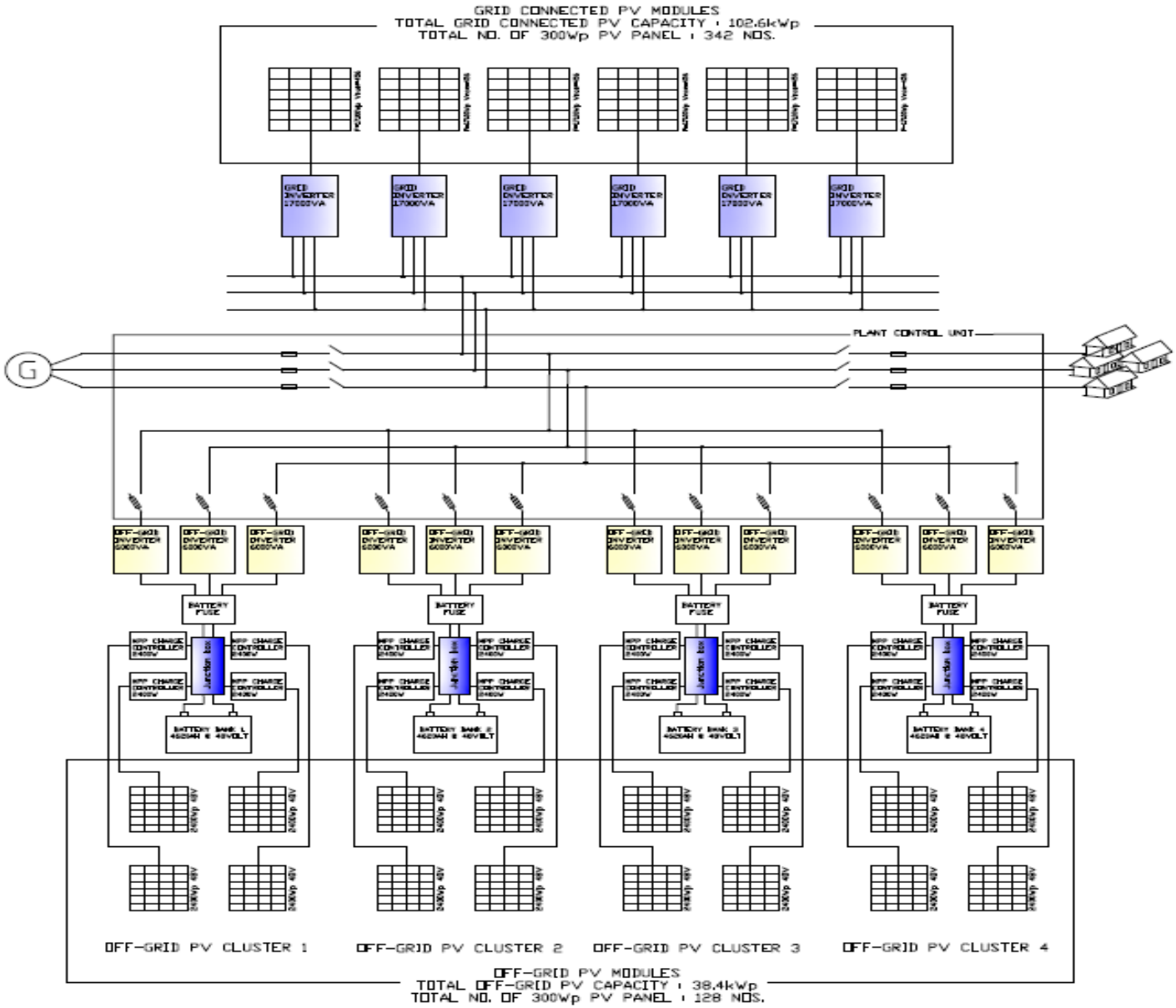
Bottle necks:

1. Limitation of charging and discharging currents limits the design flexibility.
2. Limitation of DoD of battery operation increases the size of battery bank
3. Higher ambient temperature reduces the designed battery life

Advantages of adding a diesel generator is included in mini-grid to

1. Increase the reliability of power
2. Reduce the storage requirement
3. Avoid autonomy requirements
4. Reduce project cost (reduced battery size reduces the

Single line diagram of PV –diesel minigrid



Consumer type (Household) and approximate monthly bill

Package type	Load	Quantity	Power /unit	Approximate monthly bill in USD
Package-1 (Small Households 550)	LED light	4	7	5.75
	Ceiling Fan	2	25	
Package-2 (Medium Households 205)	LED light	5	7	8.75
	Ceiling Fan	2	25	
	TV	1	50	
	DVD	1	20	
Package-3 (Well off households 85)	LED light	5	7	18.85
	Ceiling fan	3	25	
	TV	1	50	
	Refrigerator*	1	100	
	CD/ DVD	1	20	
Package-4 shops	LED light	3	7	2.6
	Ceiling Fan	1	25	
Package-5 shops	LED light	3	7	12.75
	Ceiling Fan	2	25	
	TV	1	50	
	Refrigerator*	1	100	
Package-6 School	LED light	20	7	23.07
	Ceiling Fan	10	25	

Considering IDCOL model tariff varies from USD 0.35 – 0.45 depending upon the size and load pattern of the minigrids

Thank you