Large Scale Solar Hybrid Roll-out for Shared Towers

GSMA Conference on
Green Power for Mobile, Cairo

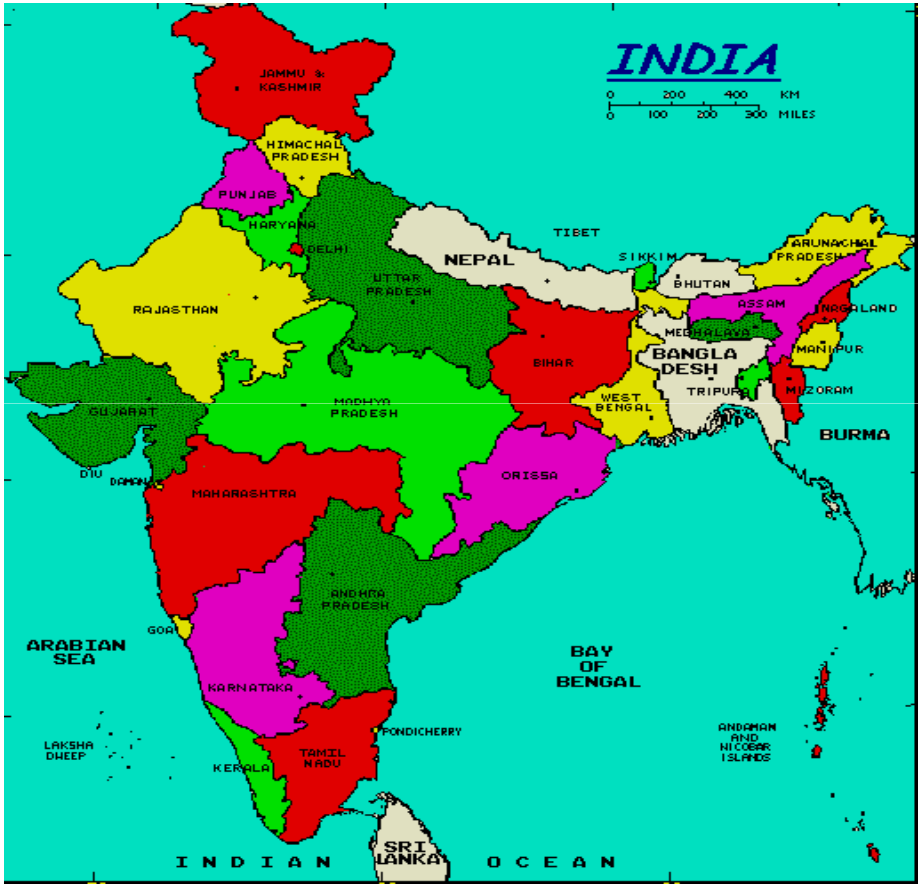
Sairam Prasad
CTO, Bharti Infratel
March 23, 2010

Presentation Flow

- Indian Telecom Overview
- Electricity Scenario in India
- Snapshot of Telecom Towers in India
- About Bharti Infratel
- New Energy Initiatives at Bharti Infratel (P7 Program)
- Solar DG Hybrid Project for shared sites
  - Drivers & Enablers
  - Key Objective
  - Scope
  - Challenges
  - Technology
  - Key Performance Parameters
  - Highlights
- Discussion

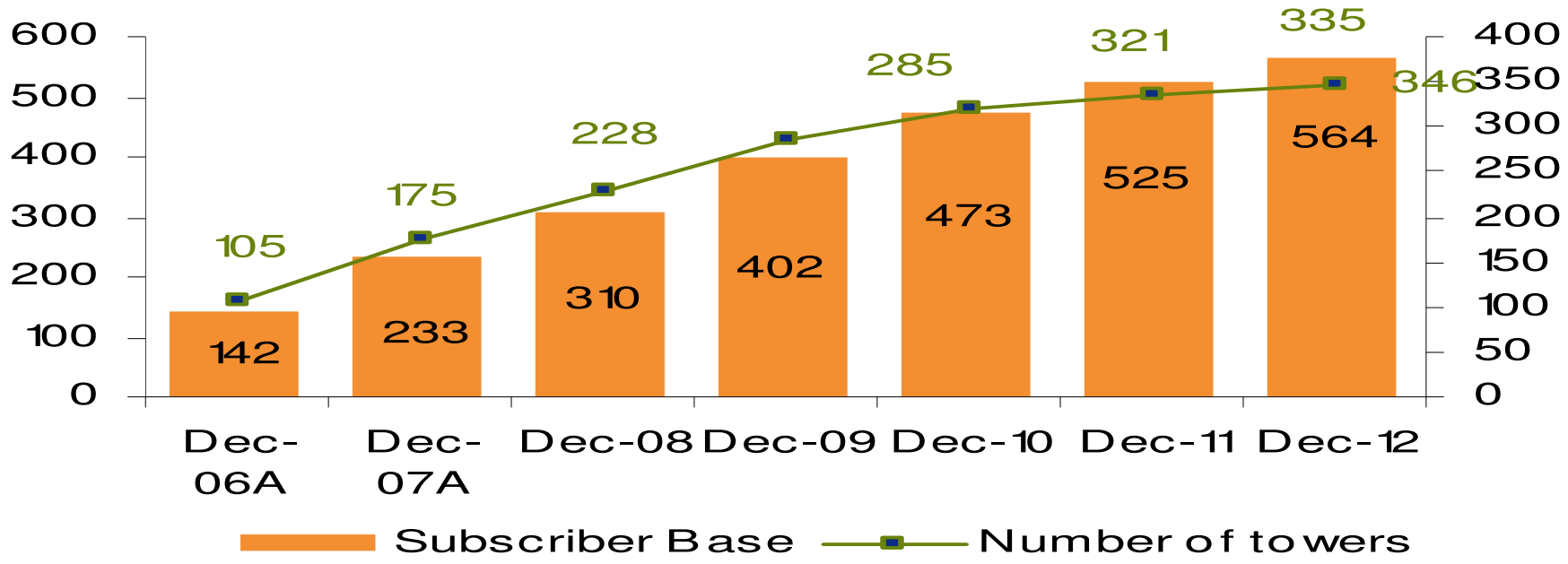
Indian Telecom Overview

- More than 1 Billion population
- 2nd largest telecom subscribers base in world at 525 mn
- Tele-density at 49.71%
- Projected tele-density at 64.69% by 2012
- More than 10 mobile operators with 259000 towers across various circles
- Both CDMA & GSM technologies in use with GSM being widely used
- Lowest Mobile Tariff in world & low ARPU with high MOU.



Low ARPU, high MOU & high Energy costs driving operators & tower company to look for energy cost reduction initiatives in a big way.

Telecom Tower Growth in India

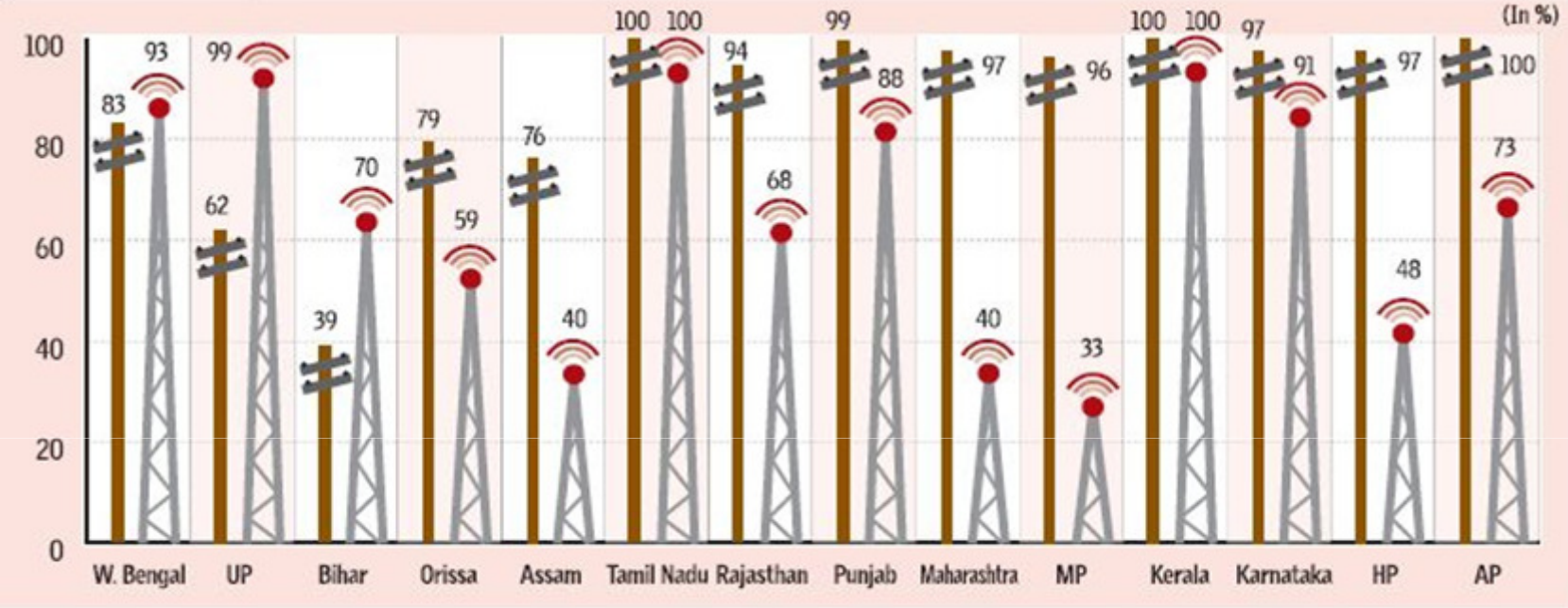


- Average power demand – 3 to 5 KW
- Total energy demand is about 1.5% of India's energy bill
- Grid power availability – 50%
- Second highest Diesel consumption after Railways

About 2 billion liters of diesel is consumed by telecom towers every year

Electrification Scenario in India

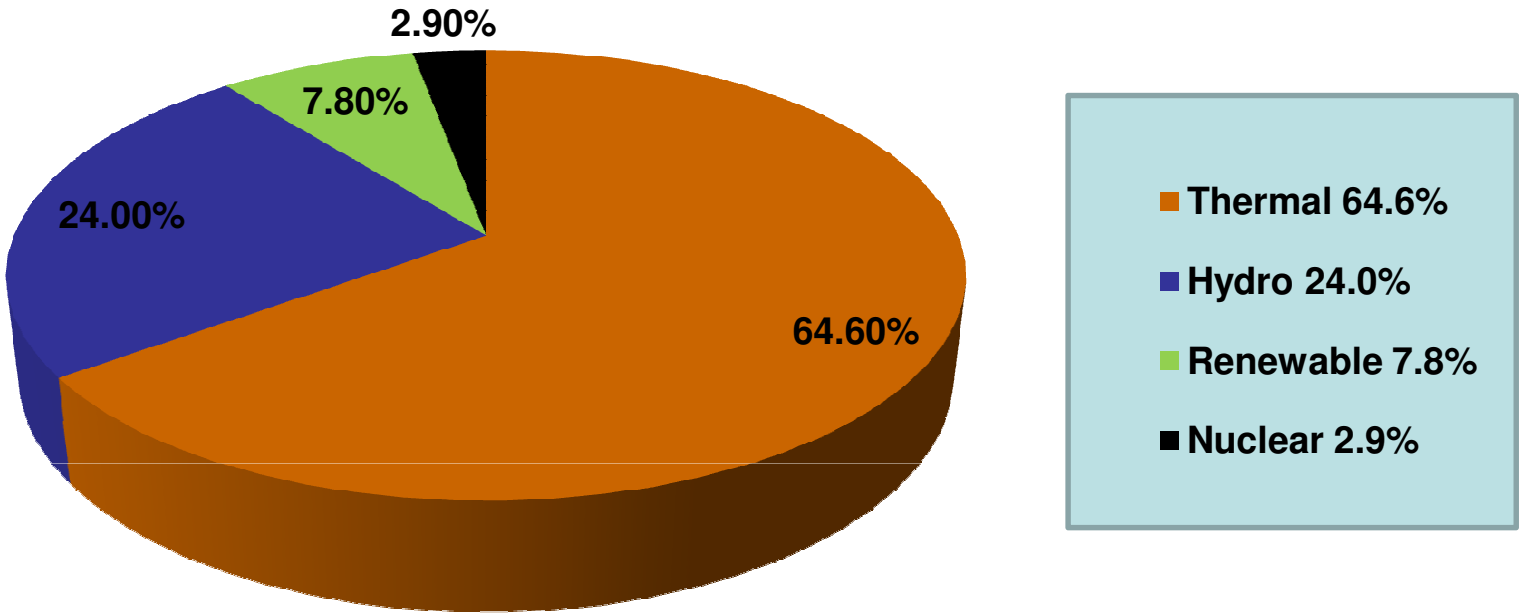
Electrification Vs Telecom Coverage (% of Villages)



- **West Bengal, Bihar and Uttar Pradesh, Mobile penetration is higher than electrification.**
- ***Although 83% villages have been electrified, the frequent and long interruptions in electricity supply put a large number of these villages at par with non-electrified ones".**

*Source: Ministry of Power, Govt. of India

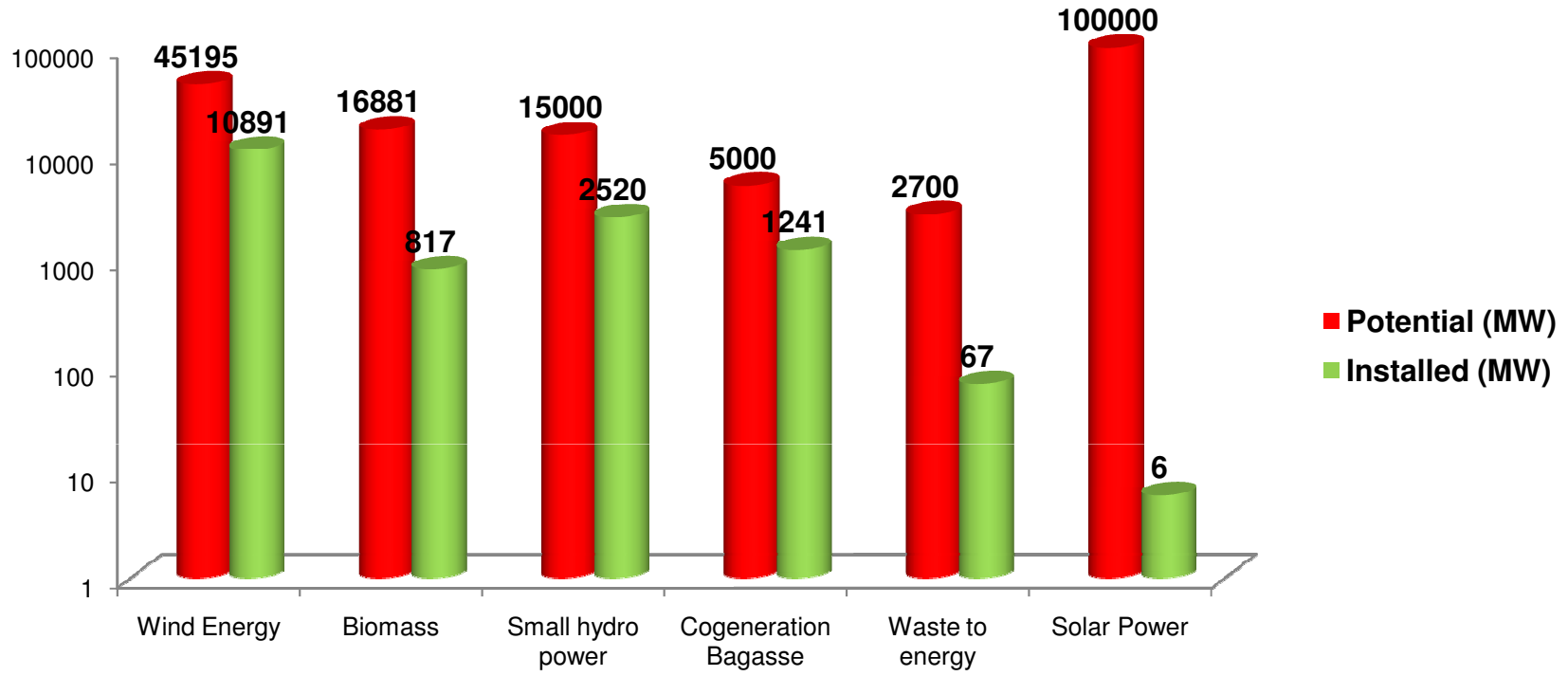
Energy Status in India



Renewable Energy utilized is 7.8% of total installed capacity in India

Source : CERC India

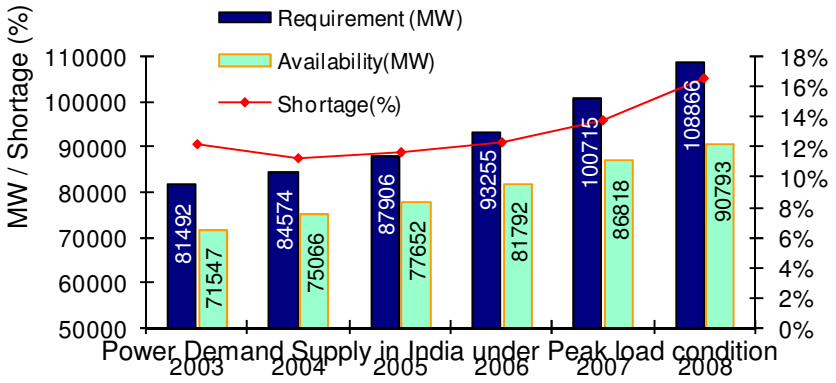
Renewable Energy Scenario



- **Solar power potential contributes to >50% of the total RE potential in India**
- **Support from MNRE ,govt of India for subsidizing solar power telecom towers is under consideration**

Source : CERC India

High diesel consumption is due to widespread power shortages in India

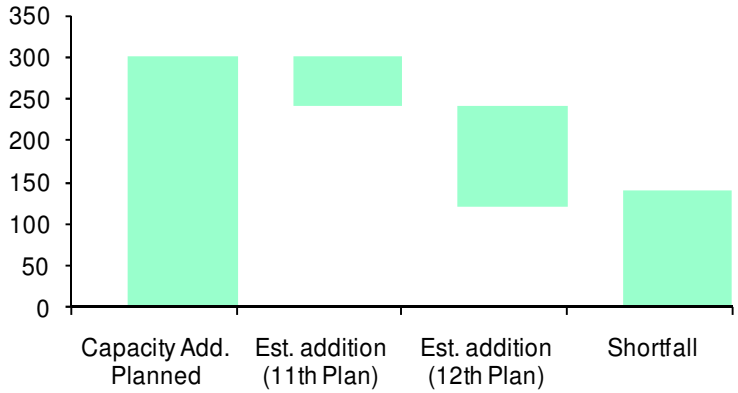


Power Demand Supply in India under Peak load condition

- Peak power shortage on an increasing trend from 12% in 2003 to **17% in 2008**

- **Capacity shortfall of 95-140GW by 2017**

Power Scenario in India by 2017



This situation is further exacerbated with telecom network expansion into rural areas

Sources: Planning Commission, McKinsey&Co. – Powering India: The road to 2017

About Bharti Infratel

Towering The Telecom Boom

- One of the world's largest telecom passive infrastructure service providers, that deploys, owns and manages telecom towers and communication structures for all wireless operators
- A big first-mover advantage in India, also having a strong differentiator of having presence and providing services in some of the toughest terrains
- Provides best-in-class services and compelling capital investment saving opportunities to wireless operators
- A Strong telecom heritage, coupled with deep industry understanding and capabilities, people and processes



Portfolio & Footprint

- Operations in 18 states / 11 telecom circles
- 30K+ towers, 42K tenancies and growing
- 42 % stake in worlds largest tower company -- Industowers
- Ready to use infrastructure (plug & play)
- Lowest cost of ownership (Rentals + Opex)
- World class processes & people ~ 800+
- In-house O&M strength of 3,500
- Decentralized ops in circle & zonal offices
- World's 2nd largest Tower Company



Key Customers

Awarded **"Innovative Infrastructure Company of the year-2010"**

Awarded **"Telecom Infrastructure Company of the year-2009"**

(Essar Steel Infrastructure Excellence Awards)

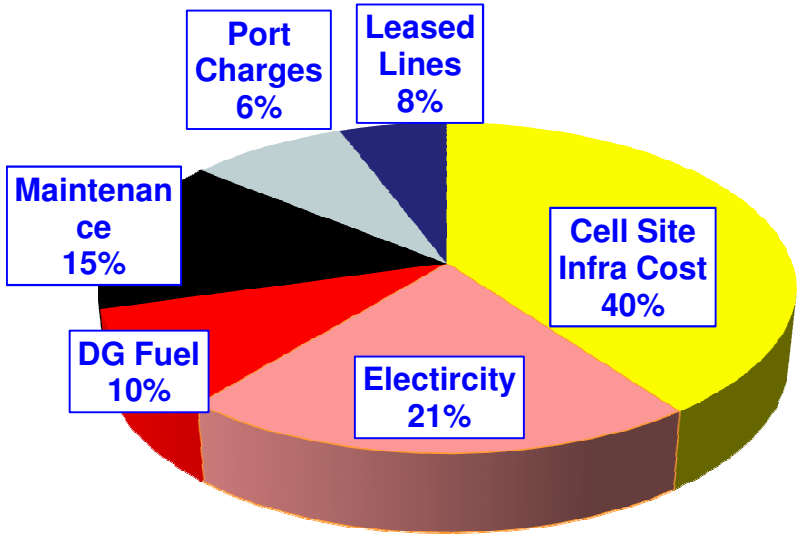
Our Vision

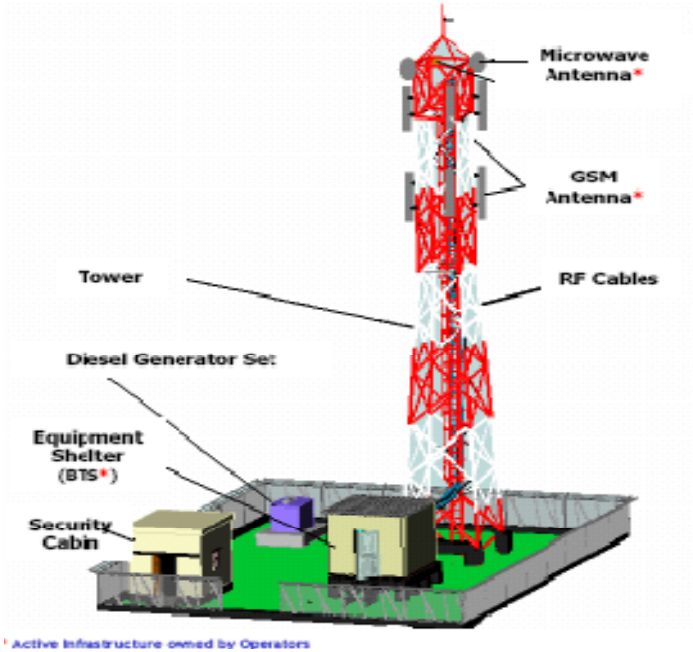
To be the best and most innovative
Passive communications
Infrastructure provider globally

Known for

- Highest uptime
- Speed and quality of deployment
- **Cost and energy efficiencies**
- **Environmental friendliness**

Typical Network OPEX Cost



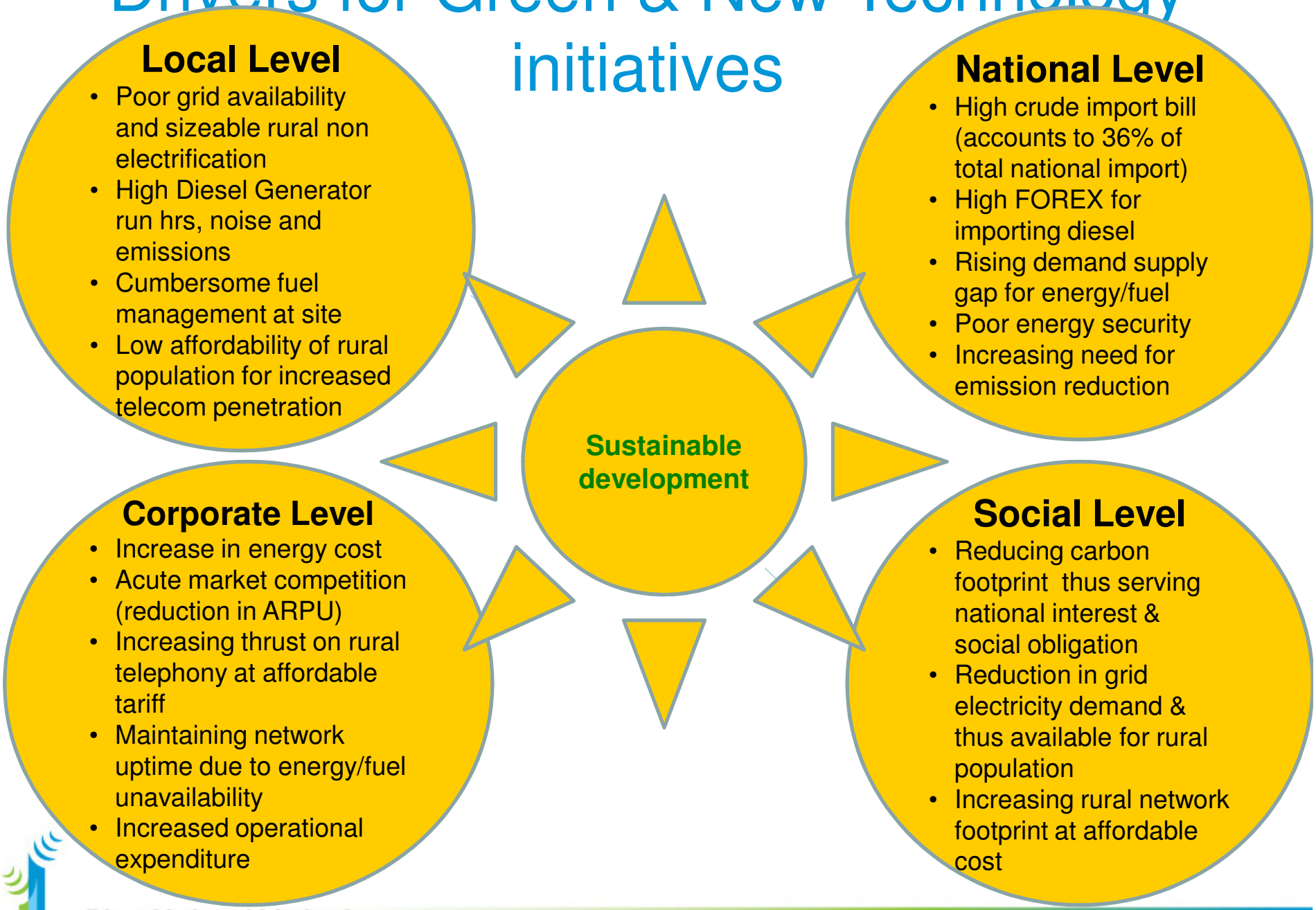


- On avg., each tower runs Diesel Generator for 12 hrs
  - 22 liters per day
  - 8000 liters a year
  - CERs generated 20 per year per tower
- For 250,000 existing towers in India, it is 5M CERs

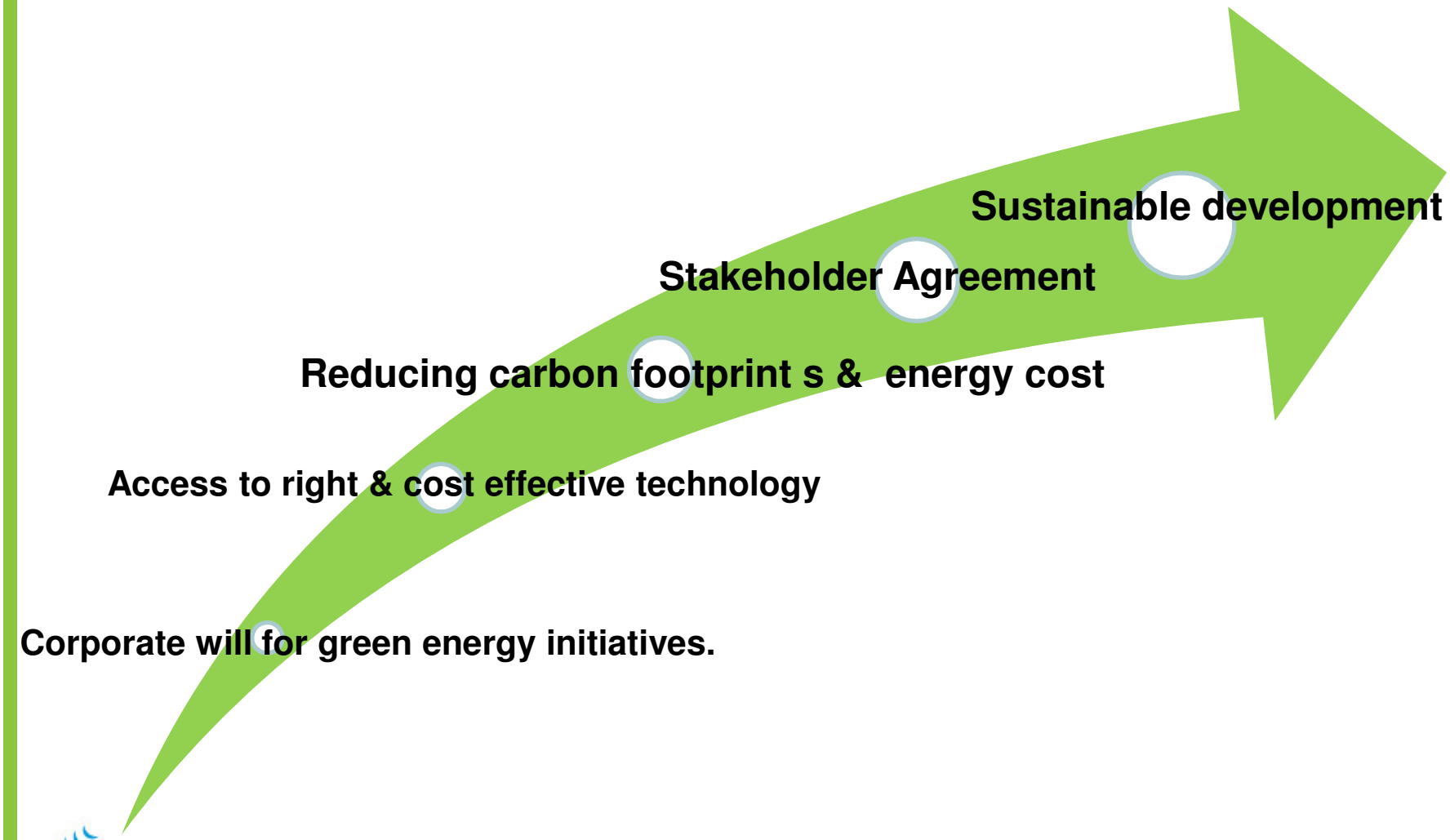
- Shelter houses the AC, Battery Rack and Base transceiver station (BTS)
- Microwave antennas are used for tower to tower communication
- Electrical works costs consists of cost of Servo stabilizer, DC power plant, Connection, Installation & Cabling charges

Electricity and Diesel bills are major expenses and must be brought down from the present high of 31% of the opertors overall network expenditure

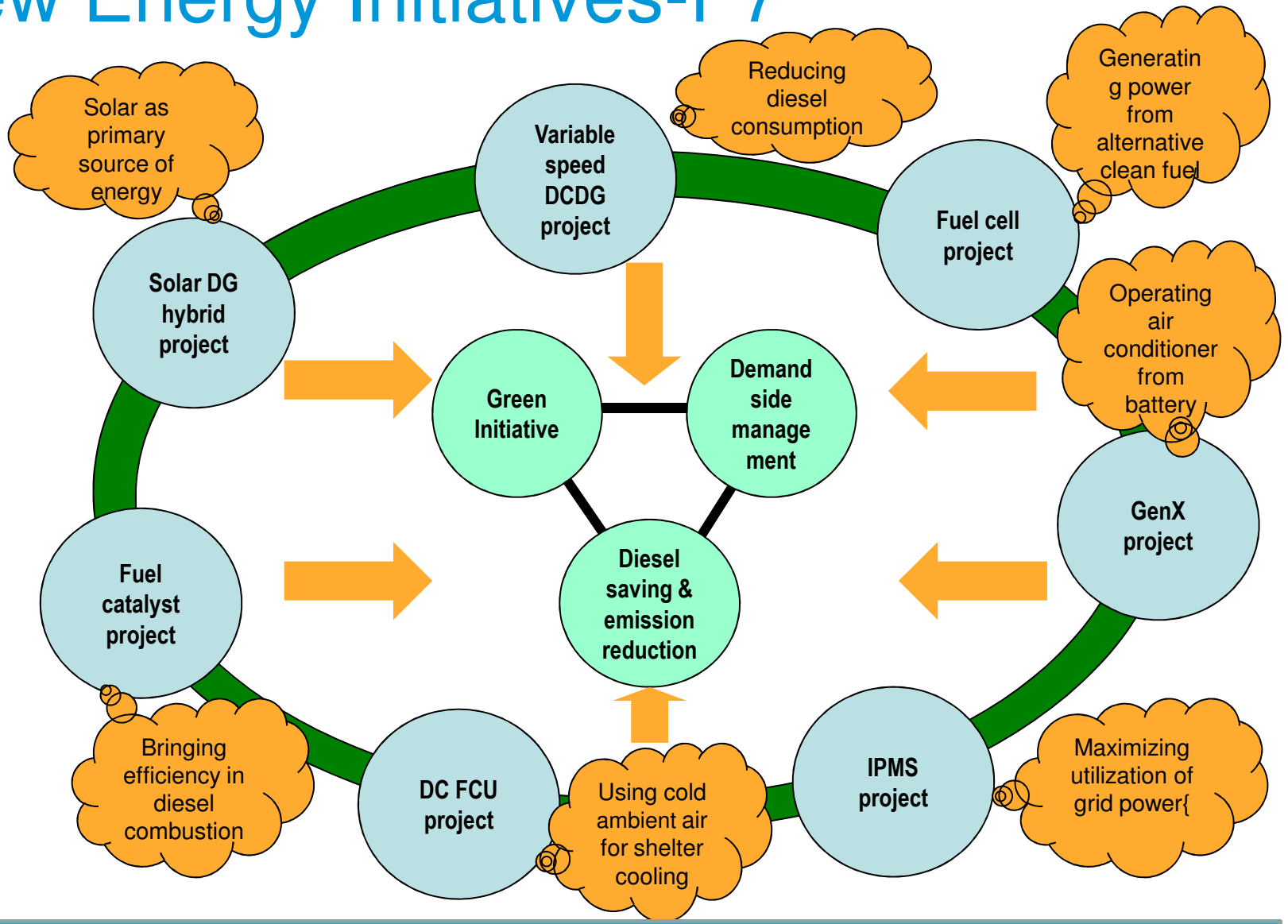
Drivers for Green & New Technology initiatives



Enabler for Green & New Energy Initiatives



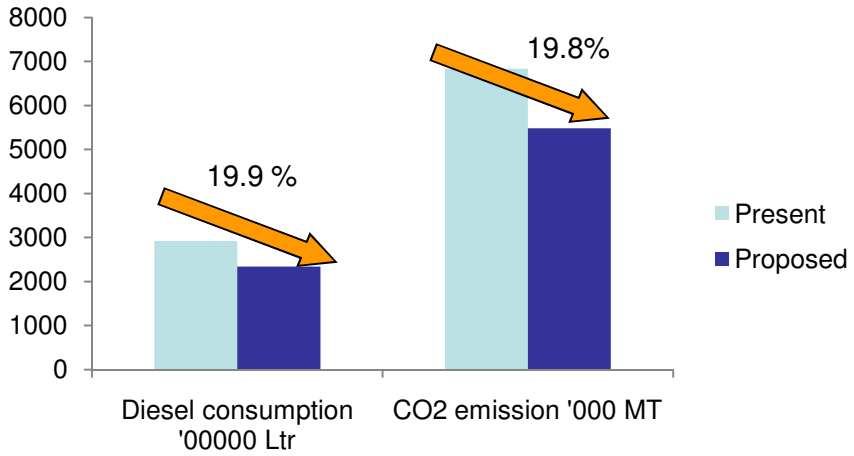
New Energy Initiatives-P7



Seven New Energy Initiatives covering 23,800 sites targeting 17% energy cost reduction

P7 Initiative Snapshot

Estimated fuel and CO_2 saving						
Project	**Planned Nos.**	**Estd Diesel saving, Mn ltr**	**Estd cost saving, R Mn USD**	**Estd CO_2 saving, MT**	**Trial status**	**Pilot status**
Solar DG Hybrid	2000	21.45	16.3	36356	✓	☑
DCDG	2000	10.18	7.7	50960	✓	Planned
IPMS	4658	4.2	3.2	11382	✓	☑
Fuel catalyst	4836	3.31	2.5	8970	✓	Planned
DC FCU	6318	7.57	5.7	20514	✓	Planned
GenX	3534	4.88	3.7	13224	✓	Planned
Fuel Cell	500	6.58	4.9	12582	✓	Planned



Key benefits

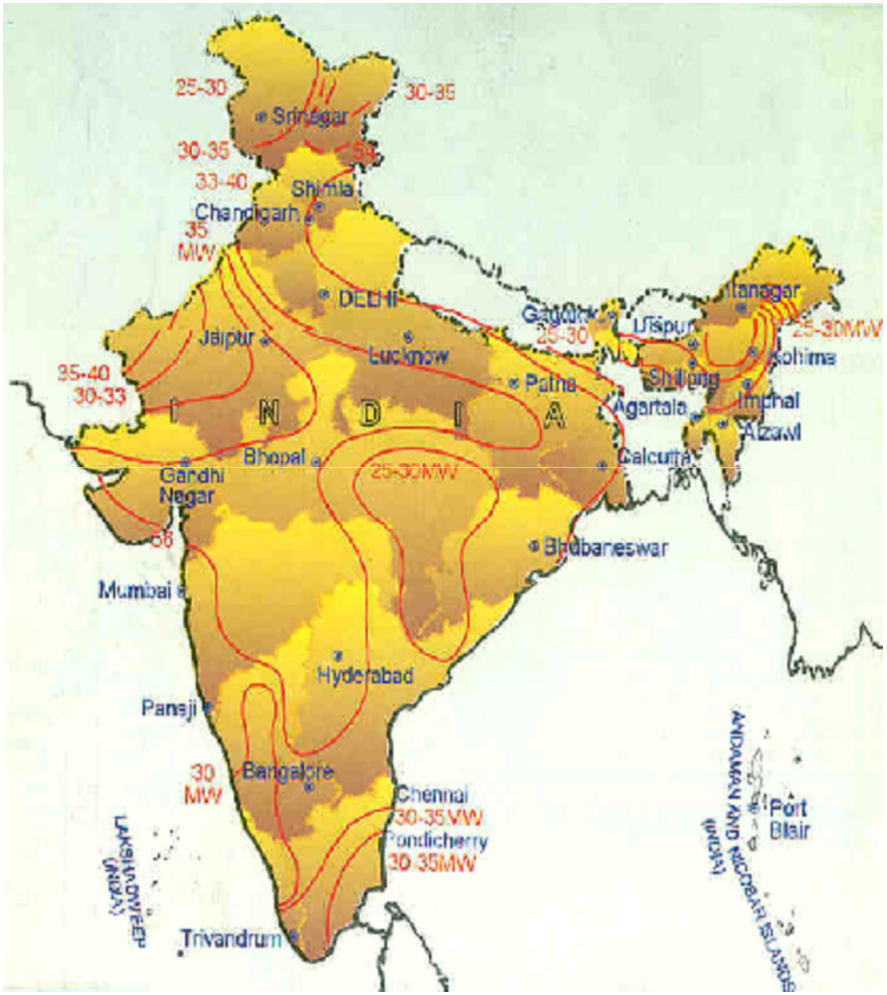
- Estimated saving of 40 million USD per annum for the company
- 58.17 million liters of diesel saving per annum for the company and for the nation
- Reduction in 1.54 million MT of CO_2 emission per annum
- Estimated saving of 45 million USD as FOREX for the nation
- Enabling rural penetration at affordable tariff

Key Objective of Solar Project

To bring out Cost, Energy Efficiency and provide Environment Friendliness using Green Energy Initiatives

Solar Advantages

- **No Fuel Required**
- **Sun available aplenty**
- **Fixed Costs**
- **Cost-effective**
- **Environmentally Friendly**
- **Long Life**
- **Modular**
- **Hybrid**



Project scope

To convert 2000 cell sites across 5 circles having more than 19 hours of DGRH per day to solar hybrid solution by Sep 2010.

Site Selection criteria

- **Non EB/Poor EB**
- **Outdoor BTS**
- **Ground based Towers**

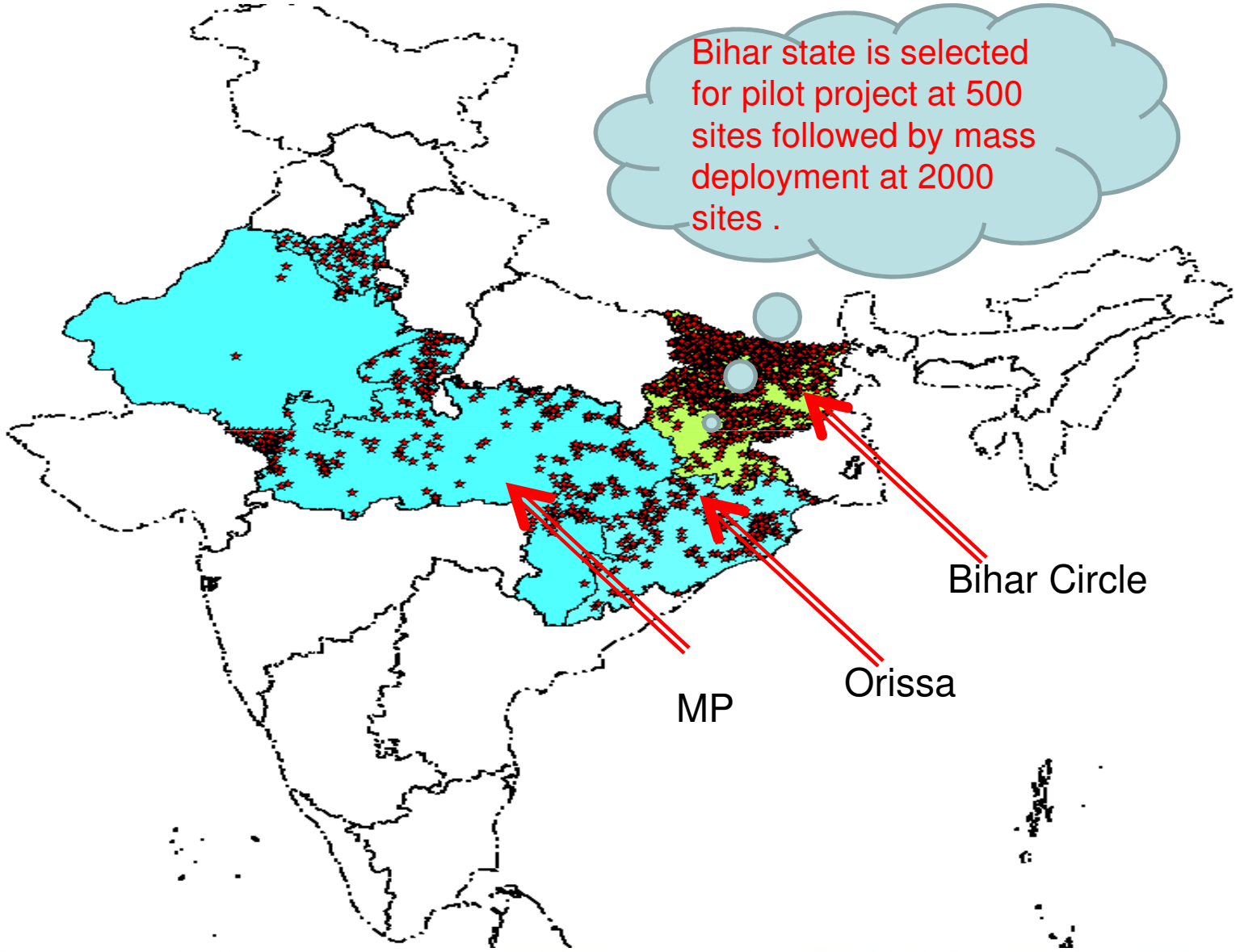
Key Challenges

- **Varying site configuration & conditions.**
- **Availability of Sites with south facing**
- **Space availability to accommodate 10 sq meter per kW of solar panel**
- **Remote monitoring of key parameters**
- **Theft & pilferage**

Above challenges have been overcome by

- **Categorizing sites to 8 DC load slabs**
- **Pre installation surveys for all qualified sites**
- **Use of both SMS & GPRS based SIMs for transmitting site info to remote server.**
- **Local people involved in Operation, Maintenance & security of sites**

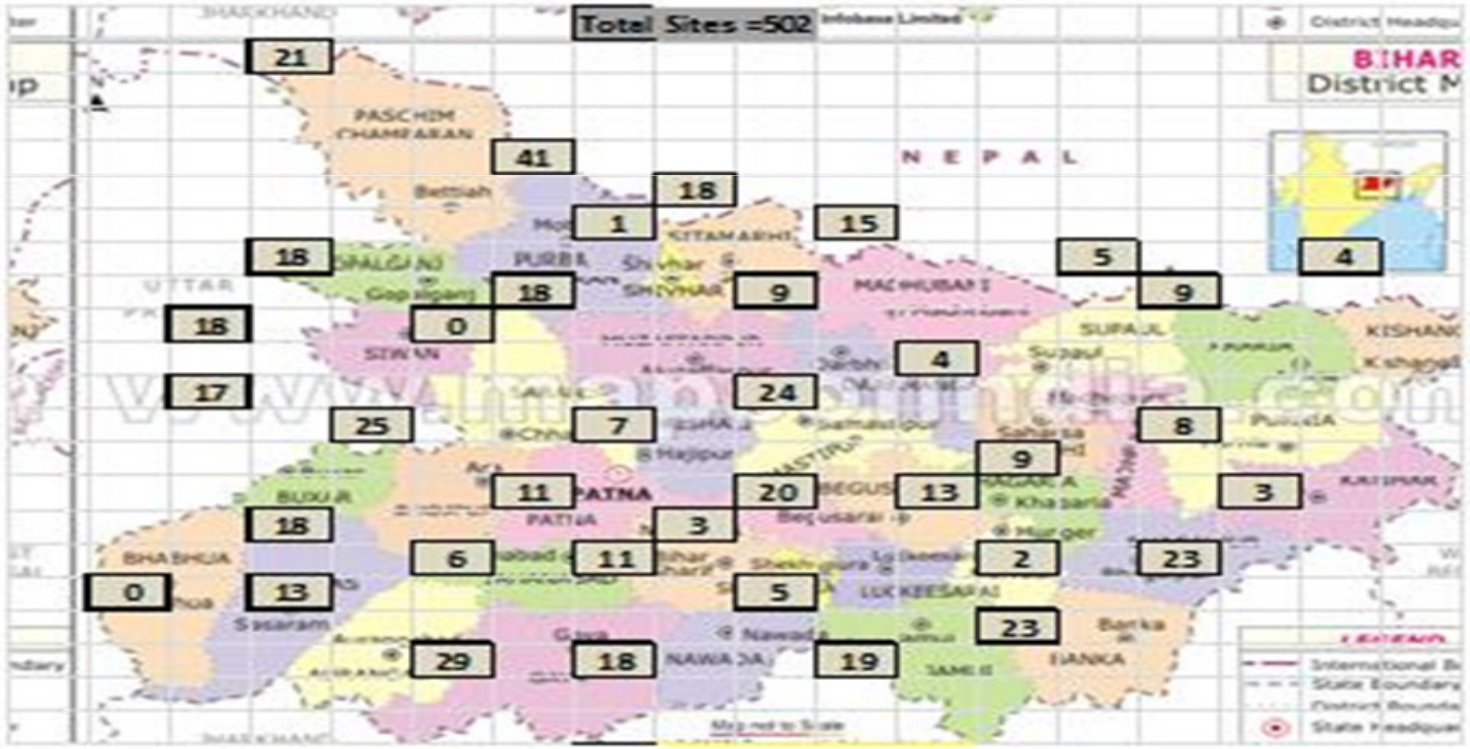
Planned Deployment



Project Plan

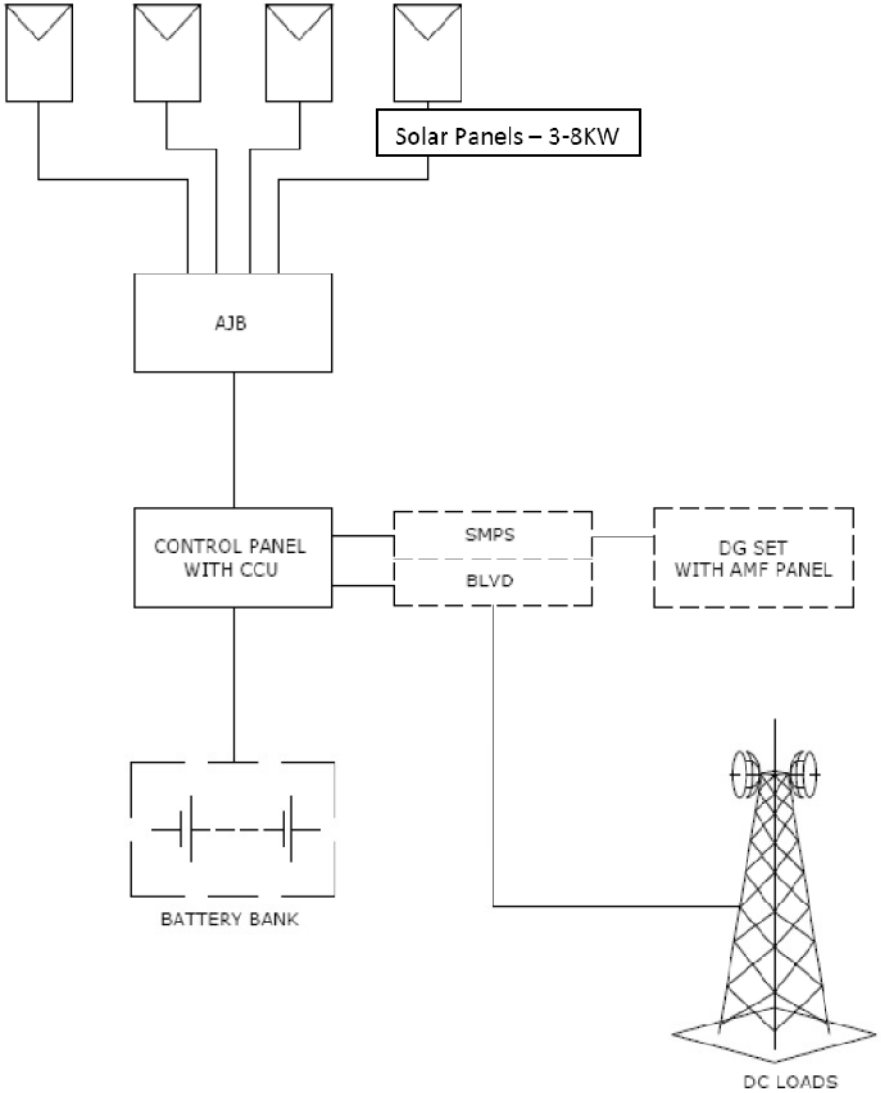
Completed	In progress	Planned further
300 sites	200 sites April 2010	2000 sites SEP 2010

Spread of Sites



Solar DG Hybrid System Over View

- **Solar Panels:**
  - 3-8 KWp
  - Mono & Multi-crystalline silicon.
- **VRLA Batteries (600 Ah-1200 Ah) :**
  - Prolonging battery backup
  - New Battery instead existing ones
- **Hybrid Solar Controller (HSC) :**
  - Sophisticated controller for runhour optimization
  - Communication with centralized Data Management Center.
- **Data Management Center (DMC):**
  - 2-way communication with sites
  - Data reporting.
  - Escalation Alarms



Hybrid Solar Controller

- Robust control :Self-sufficient memory and operation
- Data storage : I/O Communication & Display
- Report energy usage and operational parameters
- Generate, monitor and resolve all alarms.
- Maximum Power Point Tracking charge controller for efficient usage of solar energy.



HSC intelligently uses Solar, Battery & DG energy to minimize DGRH

Solar DG Hybrid Solution



Solar Panels

Charge controller





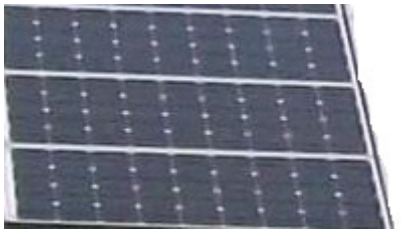
Battery bank

Diesel Generator



Solar Panels

- Application :
  - Off-grid solutions
  - Grid-connected photovoltaic systems
- High-Quality Components :
  - Cells embedded in EVA (ethylene vinyl acetate)
  - water proof foil on the back side
  - High strength frame.
- Warranties :
  - 10 years on 90% of the minimum output.
  - 25 years on 80% of the minimum output.
- Cells :
  - Polycrystalline/Monocrystalline
- Efficiency :
  - Reduced internal resistance with more connectors between cells .



Monocrystalline



Polycrystalline

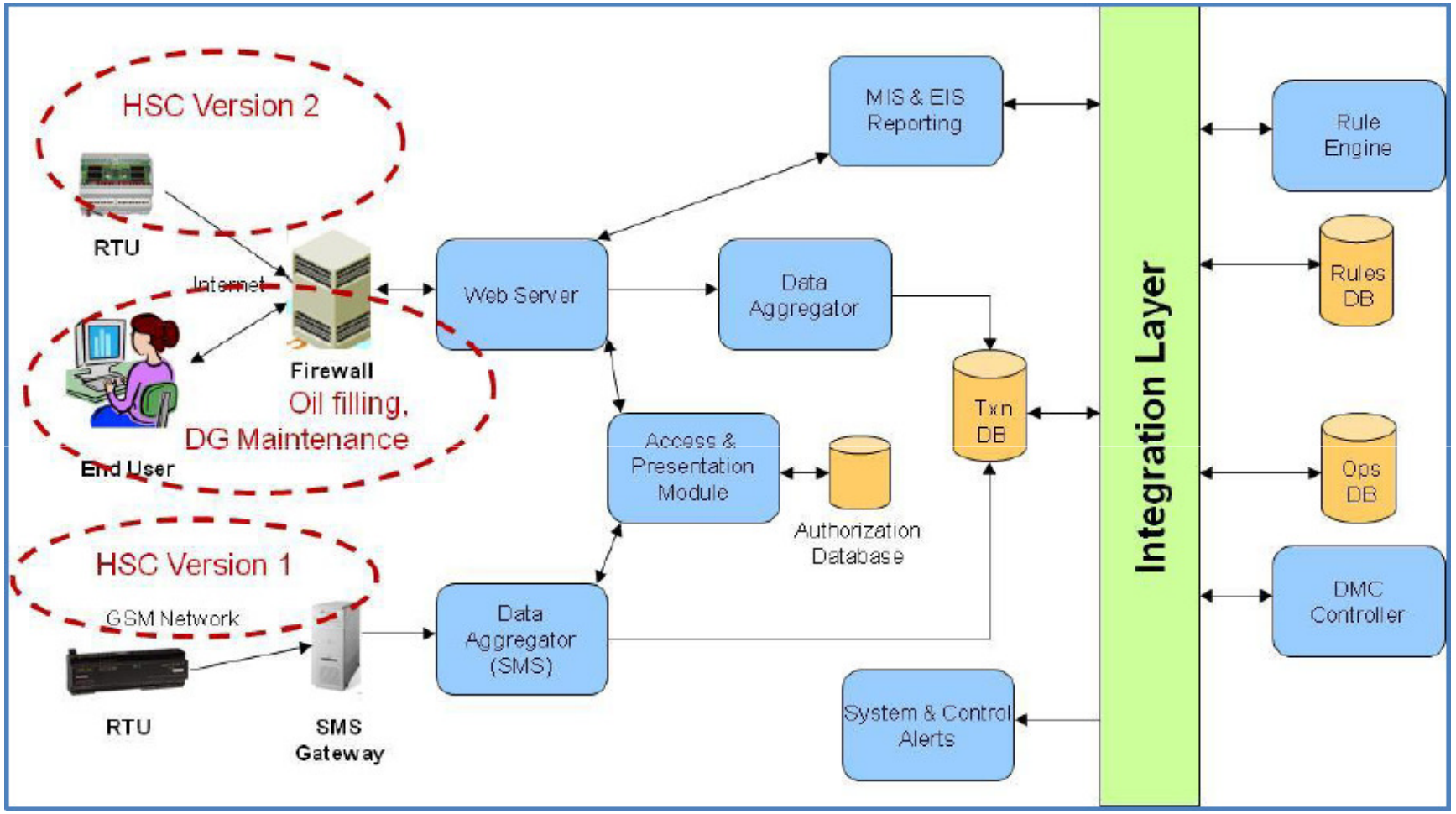
Internal connectors of cells modified to increase efficiency during low solar intensity.

Battery Bank



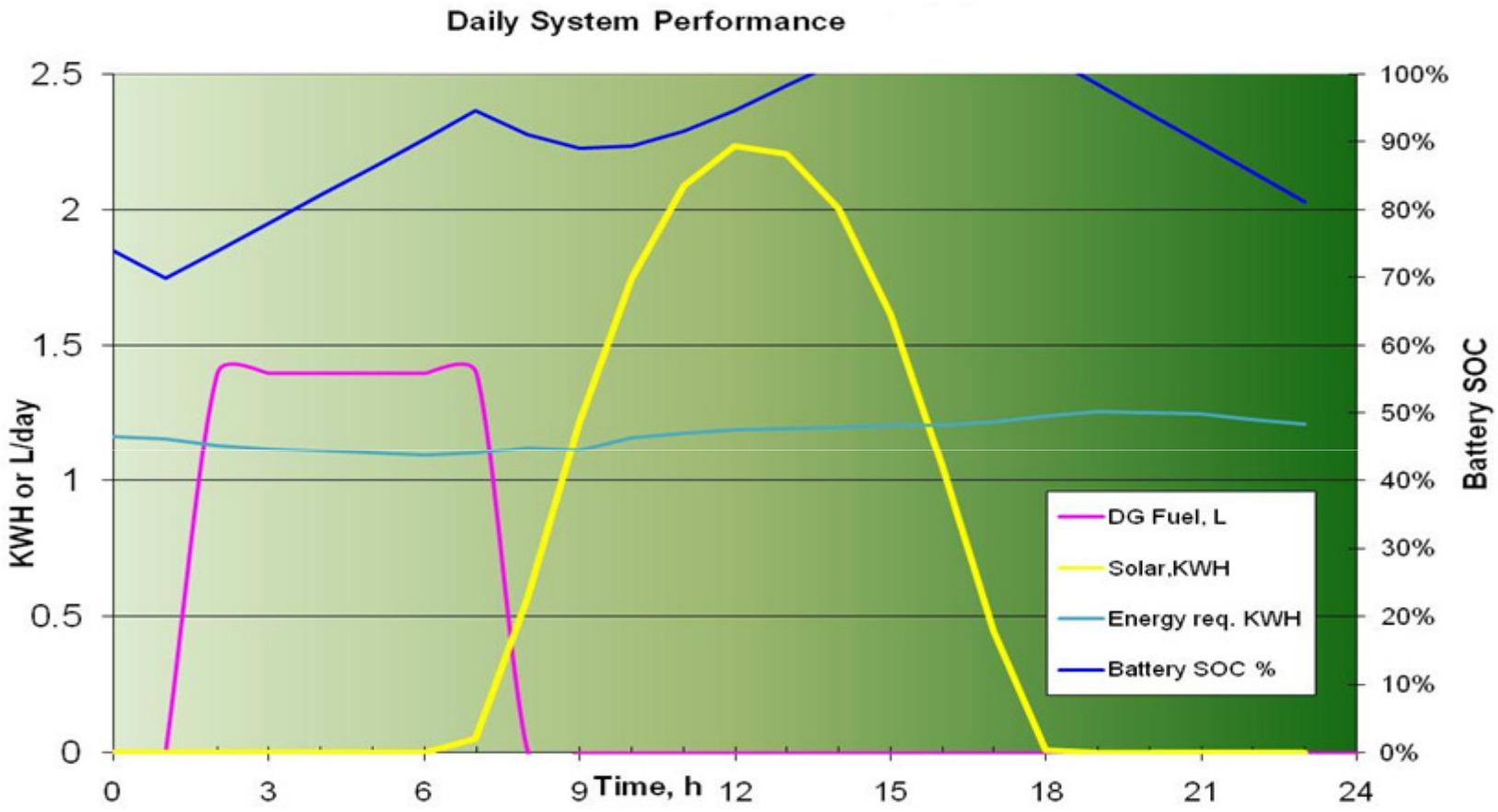
- VRLA batteries with modified plate design to operate at high Depth of Discharge
- Inter cell space provided to accommodate expansion during high temperature operation

Data Management Center



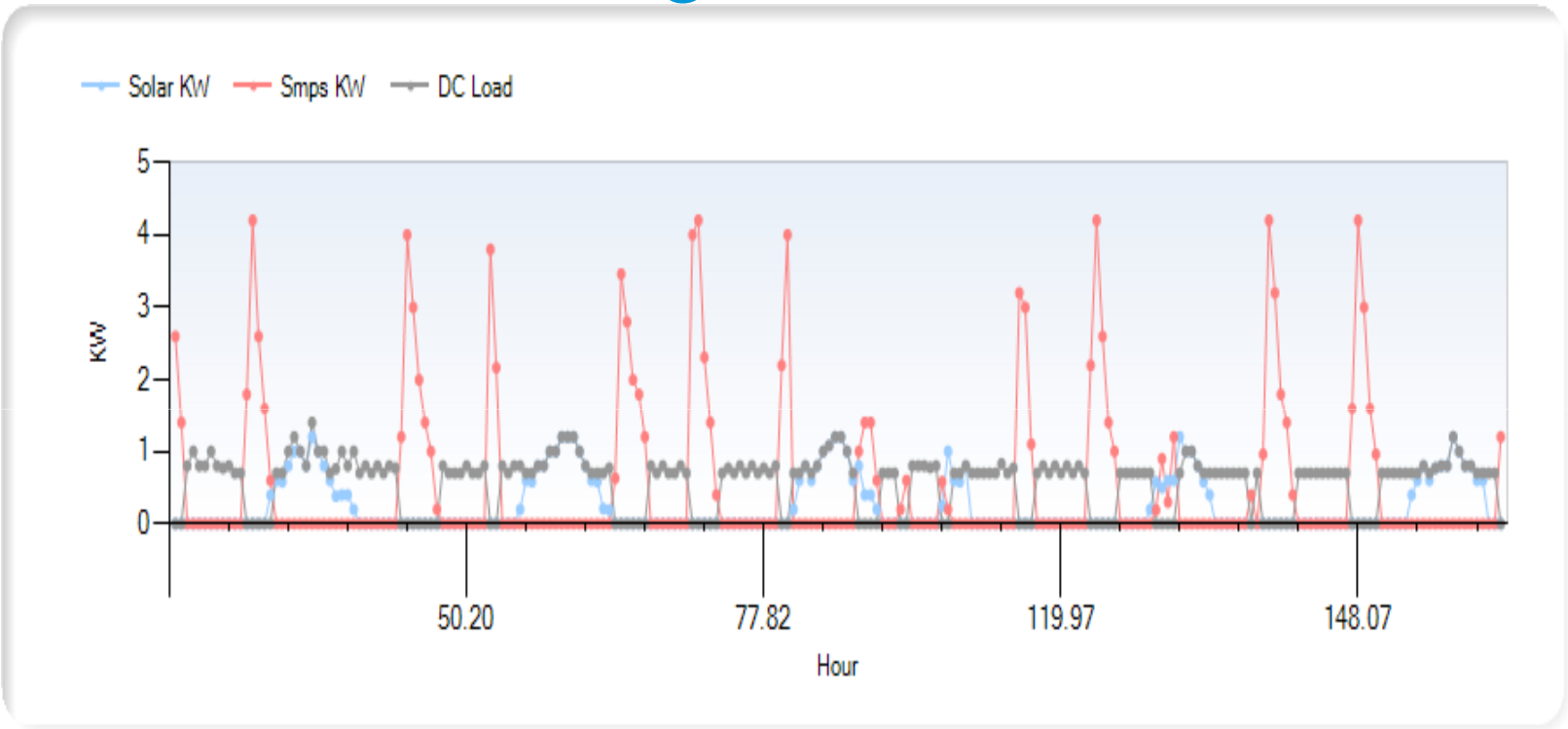
Automatic NOC solution using GPRS & GSM modem at site to collect key parameters for remote monitoring & control

Solar DG hybrid Battery usage profile



Using solar DG hybrid DGRH is reduced from 22 hrs to <8 hrs per day

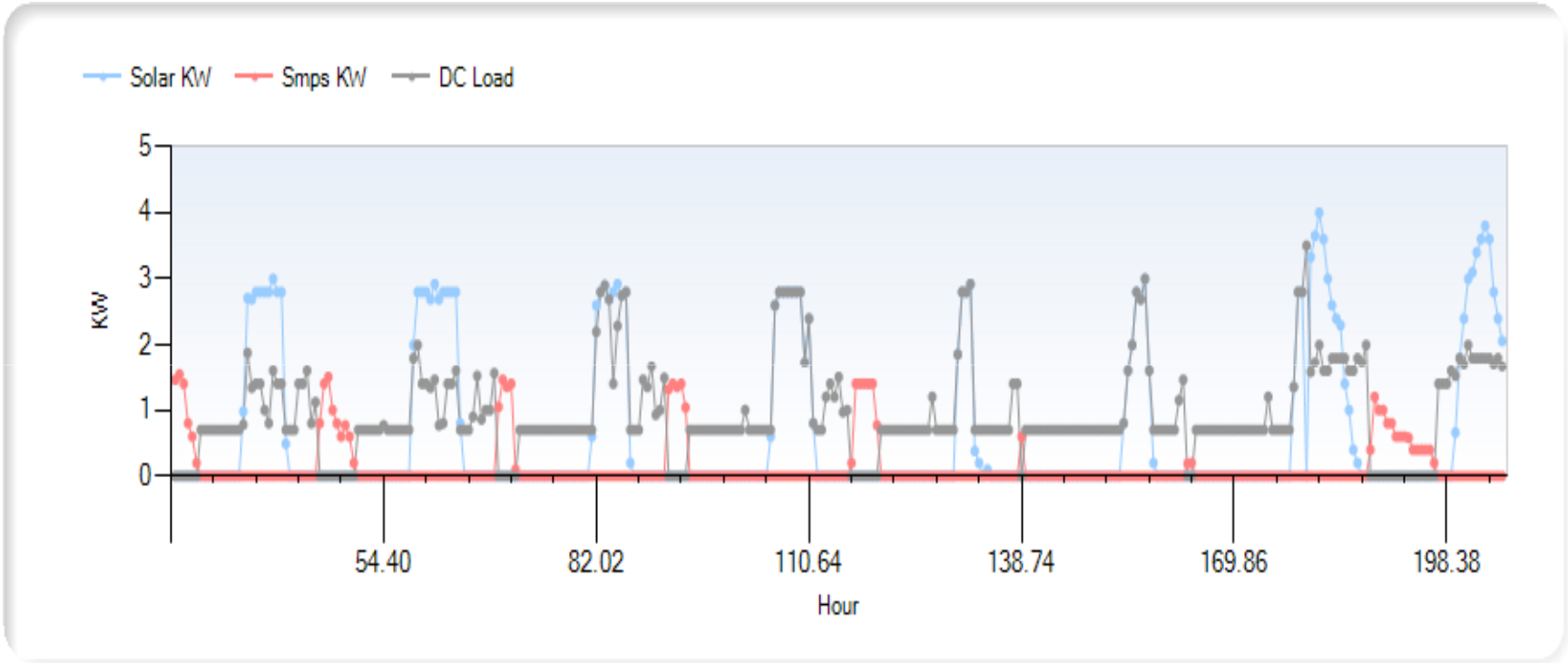
Site performance for 1 BTS site Monitored through NOC



DC load – 1.0 KW
Solar – 3 KWp
Battery – 600 AH
Avg DGRH – 4 hours

Site – BHPAB01

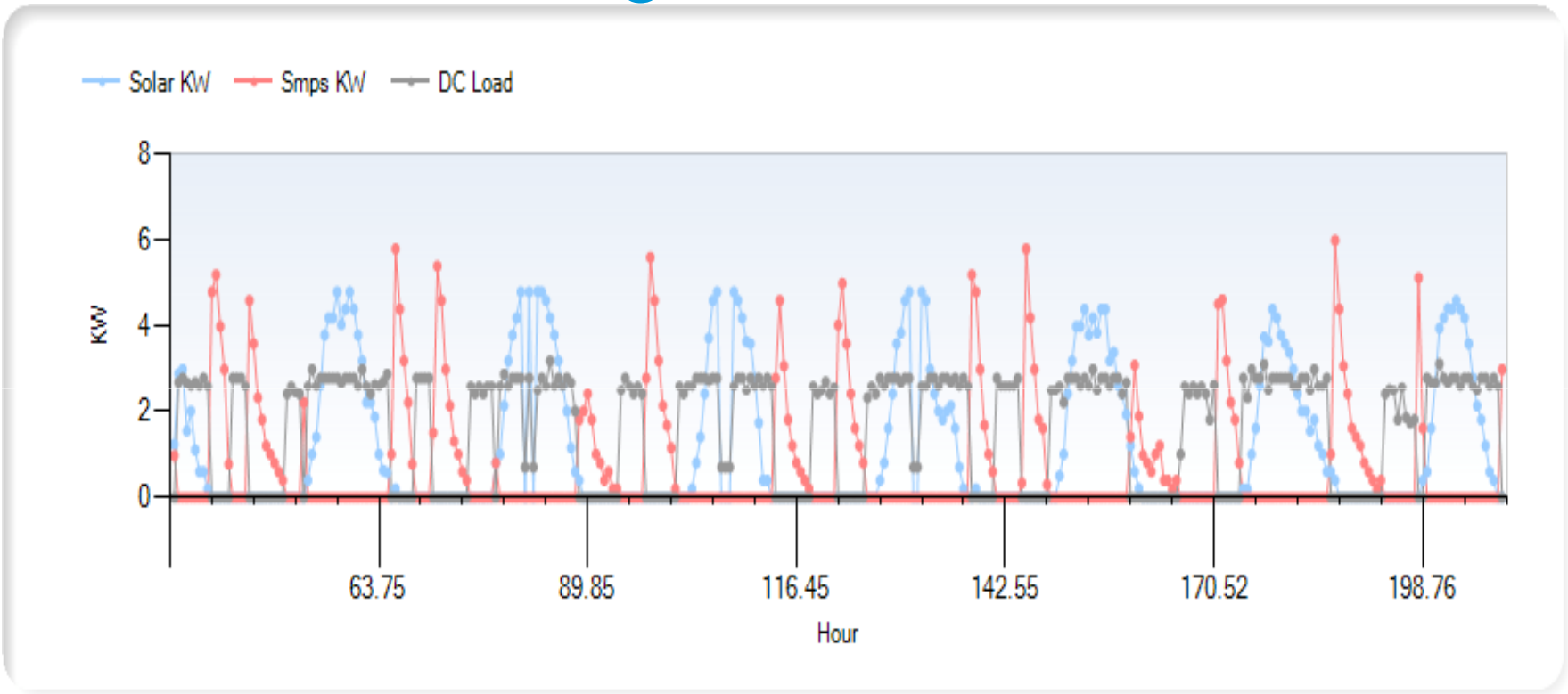
Site performance for 2 BTS site Monitored through NOC



DC load – 3.0
KWSolar – 5 KWp
Battery – 1200 AH
Avg DGRH – 5 hours

Site – BHBEL02

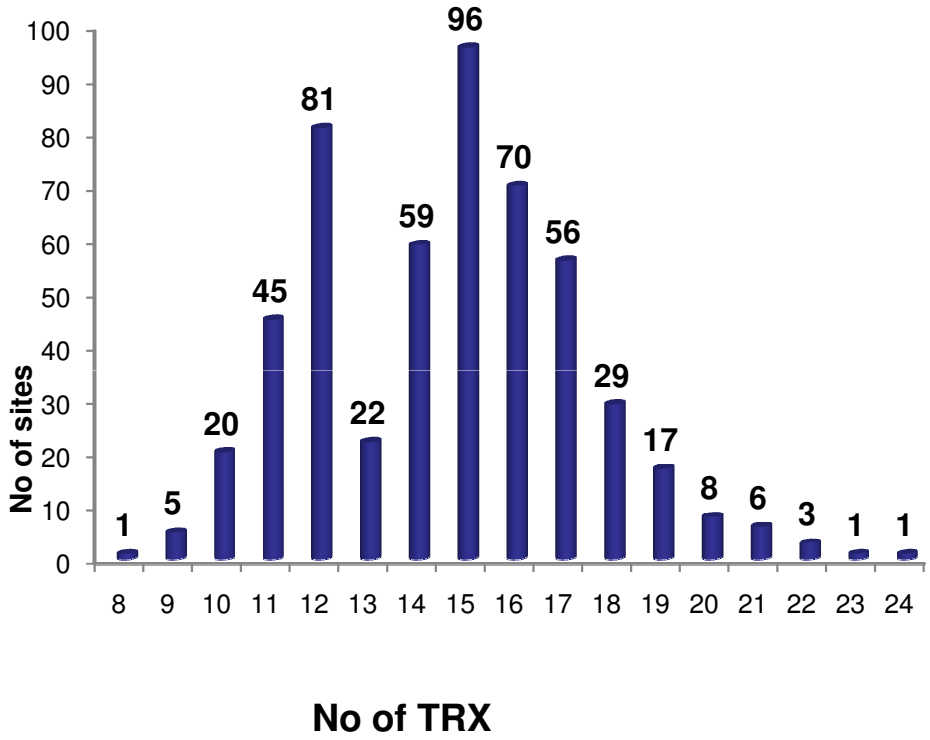
Site performance for 3 BTS site Monitored through NOC

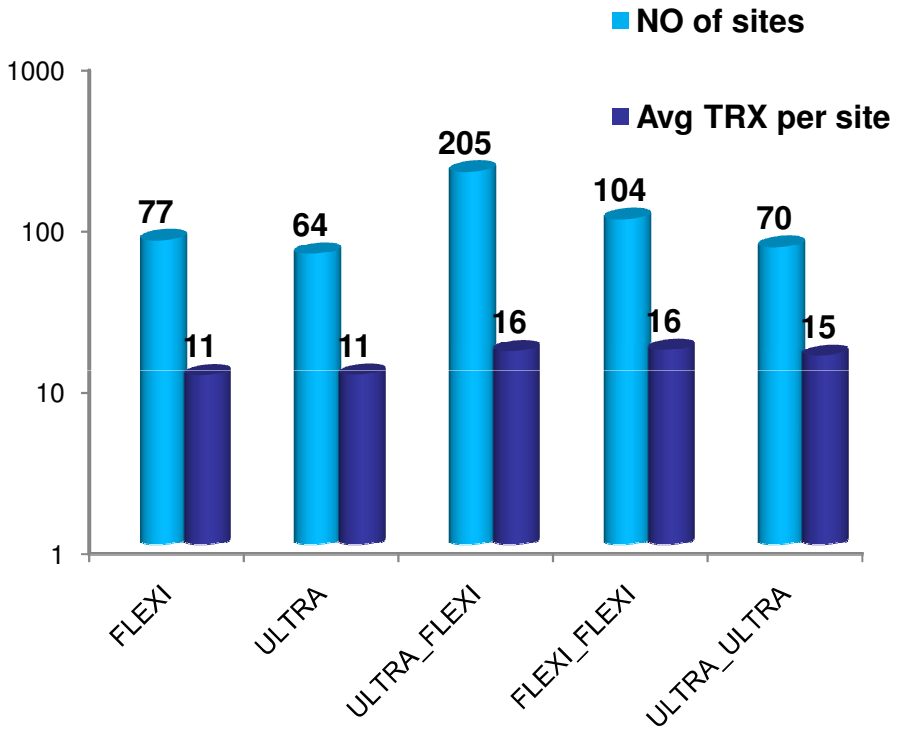


DC Load – 3 KW
Solar – 7 KWp
Battery – 1200 AH
Avg DGRH – 7 Hours/day

Site – BHBAH07

TRX & BTS distribution in pilot sites

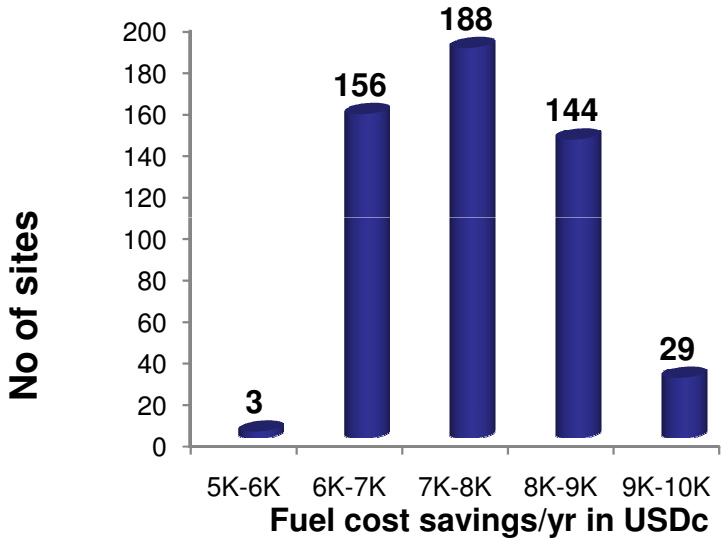




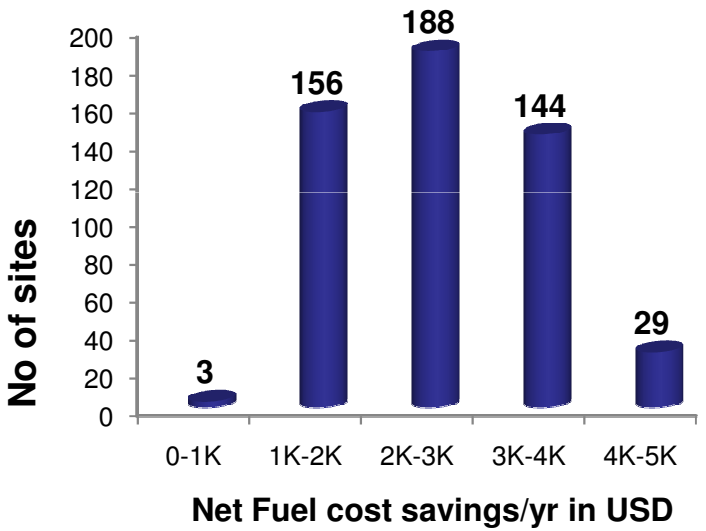
Wide range of TRX configuration & type of BTS at sites

Saving distribution of Pilot sites

Fuel cost Saving distribution



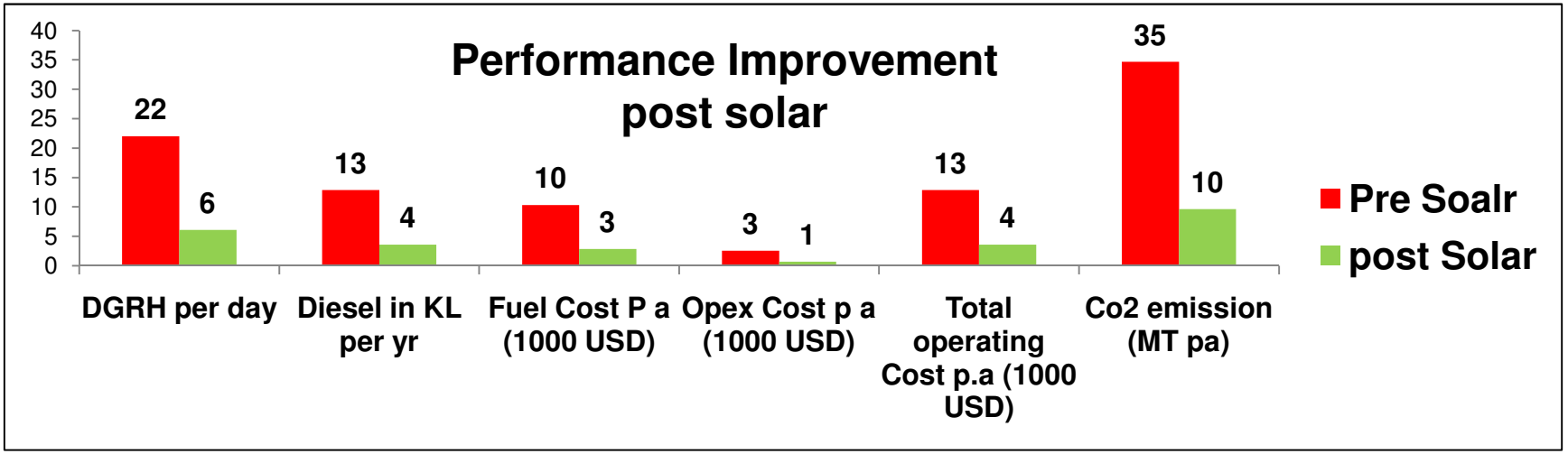
Net fuel saving distribution after capex recovery



In addition to above savings there is an Opex saving of appox 1600 USD / yr on account of lower DGRH

1 BTS site key Parameters

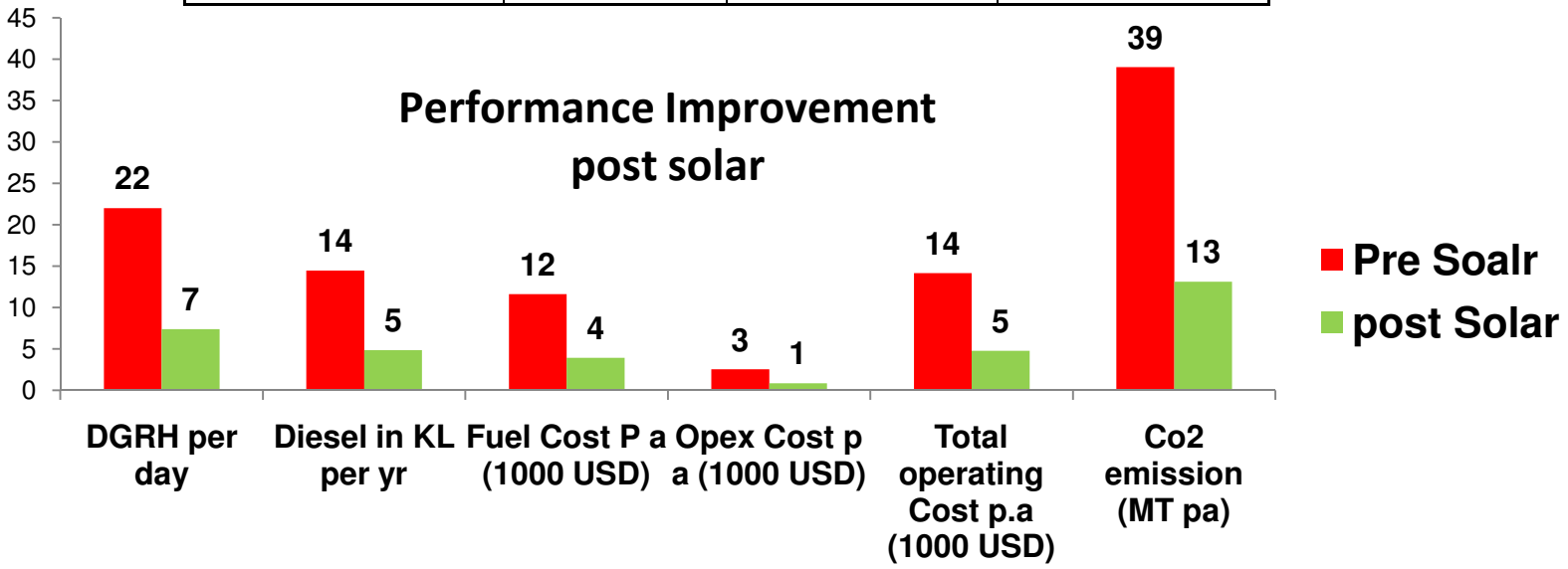
	Max	Min	Avg
No of TRX	12	8	11.2
DC load (kW)	1.4	0.64	1.2
Post Solar DGRH	8	5	6.1



Sites vary widely on DC load & TRX configuration for 134 sites of pilot project

2 BTS Site Key parameters

	Max	Min	Avg
No of TRX	24	10	15.7
DC load (kW)	2.66	1.04	1.68
Post Solar DGRH	8	5	7.4



Sites vary widely on DC load & TRX configuration for 134 sites of pilot project

Highlights - Solar DG Hybrid Project





- Site energy cost reduction by utilizing green energy.
- Average DGRH reduction from 22 hrs to <8 hrs per day for non-electrified sites.
- Potential to reduce
  - Site energy cost by 25 %, amounting to 16.3 mn USD gross saving & 6 mn net savings after capex recovery
  - 36356 MT of CO_2 per year
  - 66% opex cost reduction in DG Maintenance expenses.
- Accommodate up to 4 outdoor BTS.
- Model is framed as per site DC load to maximize energy saving.
- Suitable for outdoor BTS, GBT sites, no/poor grid availability sites.
- Network uptime for solar hybrid powered sites has improved to 99.95%.

Discussions

Thank You



Bharti Infratel Limited
www.bharti-infratel.com