Lessons learnt from Solar PV pumping in India

A presentation by

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AT

PVSDCPW Workshop
June 28, 2007, Bangkok, Thailand

Presentation structure

- About IT Power India
- Power Scenario in India
- Renewable Energy Development
- Solar Energy Programmes
- Solar PV Water Pumping Programme
- Issues & Barriers
- Lessons Learnt
- Summary
- Way Forward
IT Power India Pvt. Ltd.
Sustainable Energy and Environment Management

ITPI
Social responsibility, environmental commitment and sound business practice

- Focus on RE and Environment Management
- Operations from 1997
- Over 120 projects (2005) in 23 countries
- Head Office: Pondicherry
- Regional Offices: New Delhi and Pune
The Team

- Multi-disciplinary, multi-national in-house team;
- Strong pool of highly experienced Indian and overseas experts as associates;
- Technical expertise from IT Power Ltd. UK

ITPI Expertise

- Renewable Energy Advisory services
  - Solar Photovoltaics
  - Micro-Hydro
  - Solar Thermal
  - Wind Energy
  - Bio-energy
  - Waste to Energy
- Climate Change
- RE Fund management
- RE for Health
- Management Info. Systems
- Training & Capacity Building
India -- At a glance

Population - 1080 Million
Growth of Population - 1.93% p.a.
Share of Urban Population - 28%
GDP - US$ 3319 Billion
GDP Growth - 8.9% Industrial Growth - 7.2%
Service Sector Growth - 8%
Inflation Rate - 4.56%
Prime Lending Rate - 13%-13.5%

Energy Sector Overview

- Per capita energy consumption: 610 units/yr
- Normal & Peak power shortage: 7 and 11%
- High projected economic growth requires growth in energy supply
- Limited Fossil fuel (Coal/Oil/Gas) reserves
- 6th largest Greenhouse gas emitter in the World
- Disparity between energy consumption pattern in Urban and Rural segments
India Energy Scenario as on 28.02.2007

Category of Energy Mix - Share in Percentage
(Total Installed Capacity - 1,26,839 MW)

- Thermal: 66.45%
- Hydro: 25.85%
- Nuclear: 2.26%
- Renewable: 4.95%

Status of Electrification in India

- 84% villages & 43.5% rural homes connected to grid
- About 95,498 census villages remain to be electrified (as per CEA data of 31.3.2003)
- About 77 million households use kerosene for lighting
- 126,800 MW power generating capacity. Demand for power increasing @ 9% per annum
Institution Building

1981: Constitution of Commission for Additional Sources of Energy (CASE) in Department of science & Technology
1982: Constitution of Department of Non-conventional Energy Sources (DNES) in Ministry of Energy
1987: Incorporation of Indian Renewable Development Agency Limited (IREDA)
1992: The DNES converted into full fledged Ministry of Non-Conventional Energy Sources
Institution Building: outcome

- Promotion through
  - R & D
  - Demonstration Projects
  - Programmes supported by Government subsidies
- Overcoming financing barrier through
  - The catalytic role of IREDA
  - Innovative financing mechanism
  - Success stories for commercial Banks to follow

Fiscal Financial and Promotional Initiatives

- Nil or concessional import duty
- Excise duty and sales tax exemption
- Accelerated depreciation
- Soft loans
- Capital and Interest subsidy
- Tax holiday on power generation projects
- Guidelines to states for RE power purchase
- States advised to modify building bye-laws to promote solar water heating
Legal Initiatives

- The Electricity Act 2003 with an objective towards competition, protection of consumers interests & power for all areas
- State Electricity Regulatory Commissions
- Renewable Energy Policy underway

Electricity Act 2003 on Renewable Energy

- Stand alone RE systems from rural area
- Open access
- Cogeneration from renewables
- Generation delicensed
- Minimum percentage from renewables
- T & D in rural areas delicensed
### RE Potential and achievement

<table>
<thead>
<tr>
<th>Sources/Systems</th>
<th>Estimated Potential</th>
<th>Cumulative Achievements (31.1.2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-interactive renewable power</td>
<td>84,776 MWe</td>
<td>9372.95 MW</td>
</tr>
<tr>
<td>Distributed renewable power</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar Power</td>
<td>2.92 MW</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Installed</td>
<td></td>
<td>9497.05 MW</td>
</tr>
</tbody>
</table>

### India’s Position in RE Development

- Largest decentralized Solar Energy Programme
- Second largest Biogas and Improve Stove Programme
- Fourth largest Wind Power Programme
- Substantial Manufacturing Base - Variety of RETs
SOLAR ENERGY PROGRAMME

Solar Energy in India

- Solar Radiation over India 5000 trillion KWH/year 300 sunny days in a year
- Average daily solar energy incident over India 5.5 KWH/Sq.m
- MNRE implementing SPV programme for the last decades
- Indian SPV Programme is world’s largest programme
MNRE Programme in SPV

- **Aim:** Cost reduction, large scale deployment
- **Programme components:** R & D, Demo and Utilization, Testing & Standardization, Promotion
- **Systems covered:** Home lighting and Street lighting systems, Stand alone PV power plants, SPV water pumping systems
- **MNRE programmes are implemented through IREDA**

Decentralized Energy Systems

<table>
<thead>
<tr>
<th>Sources/Systems (As on 31.1.07)</th>
<th>Estimated Potential</th>
<th>Cumulative Achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV programme</td>
<td>20 m sq.km</td>
<td></td>
</tr>
<tr>
<td>Street lighting</td>
<td></td>
<td>54659 nos.</td>
</tr>
<tr>
<td>Home lighting</td>
<td></td>
<td>301603 nos</td>
</tr>
<tr>
<td>Lantern</td>
<td></td>
<td>463058 nos.</td>
</tr>
<tr>
<td>Power Plants</td>
<td></td>
<td>1859.80 kWp</td>
</tr>
<tr>
<td>Solar Thermal Programme</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Heating</td>
<td>1.66 million sq.m collector area</td>
<td></td>
</tr>
<tr>
<td>Cookers</td>
<td></td>
<td>0.6 million</td>
</tr>
<tr>
<td>SPV pumps</td>
<td></td>
<td>7068 nos.</td>
</tr>
</tbody>
</table>
SOLAR PV WATER PUMPING PROGRAM

Scenario in 1993-94

- SPV pumping systems technically proven
- Considered suitable for replacing Diesel pumps in un electrified locations
- Motivation for use erratic and uncertain power
- High initial cost was found to be a barrier
- Technology up gradation and volume production could bring down cost in 3 to 4 years
- To facilitate a programme for deploying 50000 SPV pumping systems over 5 years conceived by the MNRE
SPV Pumping Programme

Objectives

- Commercialization
- Strengthen production base
- Technology up gradation
- System cost reduction
- Facilitate marketing infrastructure

Demo Project 1993-94

- 1000 SPV pumps through IREDA to facilitate development of marketing infrastructure
- obtain market feedback
- decide extent of future Govt. intervention
- workout institutional back up requirement for marketing, installation, maintenance and service
Demo Programme Financing Structure

- **MNES**: Provides FA and Interest subsidy for user loan
- **IREDA**: Provides FA received from MNES & user loan from its own resources
- **INTERMEDIARIES**: Procure pumping systems for installation at user’s sites and reimbursement from IREDA
- **END USERS**: Receives the pump for installation at his site at concessional price
- **MANUFACTURERS / SUPPLIER**: Supplies & maintains the system

Impact of Demo Programme

- Subsidy may have to be eliminated and instead higher accelerated depreciation may be better
- Lesser documentation and streamlined procedures
- Should be more attractive to intermediaries
- High cost is a barrier
- Economies of volume for manufacturer required
- More market orientation
- Better standardization and quality control
- Establish infrastructure for after sales service
- Permit multiple use for the system
SPV Pumping Programme - Salient Features

- Eligible uses/users/specs as per MNRE guidelines
- Site identification by SNAs/Manufacturers as per MNRE guidelines
- Manufacturers empanelment by IREDA
- Subsidy and soft loan through IREDA
- Promotion campaign by MNRE & IREDA
- Soft loan to manufacturers through IREDA
- Implementation through IREDA & SNAs
- Testing & Certification by Solar Energy Centre/MNRE approved regional test centers
- Training programmes by manufacturers/IREDA/MNRE

Subsidy - At a glance

<table>
<thead>
<tr>
<th>Year</th>
<th>Subsidy For Panel Rs./ Wp</th>
<th>Maximum Subsidy for system</th>
<th>Soft loan for unsubsidized system cost thru IREDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993-94</td>
<td>170</td>
<td>70% of system cost</td>
<td>5% p.a , 10 yr repayment, 1 yr moratorium</td>
</tr>
<tr>
<td>2001-02</td>
<td>110</td>
<td>=Rs.0.25 million or 90% of system cost</td>
<td>5% p.a</td>
</tr>
<tr>
<td>2002-03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003-04</td>
<td>75</td>
<td>=Rs.0.2 million</td>
<td>5% p.a</td>
</tr>
<tr>
<td>2004-05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005-06</td>
<td>30</td>
<td>=Rs.50,000</td>
<td>5% p.a</td>
</tr>
<tr>
<td>Present</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Punjab Energy Development Agency (PEDA) - Model

- First phase 500 SPV pump systems successfully installed in 2000-01
- System size 1800 W, 2hp DC motor pump
- Found adequate to irrigate 5 - 8 acres
- Block identification by PEDA
- Selection process to choose applicants based on land holding, water table
- Direct supply to farmers holding 5 acres minimum

PEDA-Model

- Detailed site survey and site selection by supplier
- Site allocation in clusters to facilitate service and maintenance
- Requirement 5 years maintenance contract by suppliers and open at least one service center in the State of Punjab
- The programme was successfully implemented with repetition of another 500 Nos.
PEDA-Model

- Pumps used also with drip irrigation & sprinkler
- Following PEDA’s success, Haryana, Uttar Pradesh, Rajasthan and Tripura etc. took up projects in their states.
- Uttar Pradesh has taken up for drinking water supply through solar pumps.

PEDA Model

- State Subsidy towards lease cost of the system (Rs.50,000)
- Reduced lease cost + AMC charges for 5 yrs
- Supply & maintenance
- Target allocation
- System cost (Rs.0.45 million)
- Enduser list
- CFA @ Rs. 135/- per Wp
Solar PV Water Pumping System installed under PEDA

CAPACITY: 1800 Wp, 2 H.P.

SPV Pump usage in India

- Drinking water use 35%
- Agriculture use 65%
SPV Pump Distribution in India

Programme Highlights

- 900watt system was found in adequate for most of the crops. 1800 watt system with 2 hp DC motor was found adequate
- 9 vendors empanelled
- Subsidy scaled down from Rs170/Wp to Rs 30/Wp in 12 years. Soft loan to users/manufacturers continued
- 29 states covered .Total 7068 systems (31.1.07)
- Agriculture related 65%, Drinking Water 35%
- Efficiency Improvement in solar cells 10% to 16% and pumps 30% to 45/50% achieved
- Programme from 2004-05 onwards applicable only for community drinking water projects
**Issues & Barriers faced**

- General expectation—regular electricity will be available in near future
- Lack of service network. Remote locations too expensive for service by manufacturers
- Large variation in product cost and quality
- Inadequate network for market promotion
- Lack of awareness among and interest in lending institutions and micro credit facility
- O&M for 10 years too expensive

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**Issues & Barriers faced**

- Lack of awareness and interest in Financial Institutions and availability of micro credit
- Repayment obligation to financial institution is difficult to meet
- O&M for 10 years too expensive
- Theft problem—particularly in lease finance cases
- Lack of interest in system protection when not owned
- Fear of misuse of the system lighting/TV—too irresistible
Lessons learnt

- Commercialization is necessary for sustainable growth. However, commercialization is difficult without government assistance. Subsidies and concessions may have to continue till price reduction of SPV Systems.

- Government programme may have to be more user friendly for creation of additional demand. The cost of infrastructure development for conventional energy may be given as subsidy/concession for SPV Systems.

Lessons learnt

- Affordable financing accessible to rural consumers is essential for selling PV products in rural areas.

- Delivering rural PV services needs a partnership between key actors like rural financial institutions, product/service suppliers, consumer groups etc.

- Cost effectiveness, high reliability & quality assurance is necessary through extensive R&D and technology development.
Lessons Learnt

- Training of farmers / users is essential
- Aggressive marketing for awareness creation is a must. Full scale marketing and service network to be established
- Strong policies for development of SPV Pumping Program required perhaps by removing free conventional power and subsidy

Current Status of SPV Market

- SPV Industry growth rate 25% annually primarily due to growth in export - Germany.
- Shortage of silicon wafers
- Silicon wafer price & system cost increase
- Gradual reduction in subsidy to Rs 30/Wp
- However soft loan facility continues
- Programme restricted to Community Drinking water projects
New Initiatives of the MNRE

- Set up Task force to study
- Task force recommendation
- Bulk procurement of silicon wafers
- Expansion of manufacturing facility for wafers
- R & D for lesser usage of Silicon material
- Examine setting up 2000 TPA poly-silicon plant
- Prepare Road Map for PV technology development

New Initiatives of the MNRE

- Follow up action initiated on Task Force recommendations
- A Group of Experts constituted by the MNRE in 2005 to prepare SPV Road Map
FUTURE SCOPE

- Large village electrification programme through renewable offers ample scope for growth
- Large scale plants are expected to come up soon to realize economy of scale in manufacture and consequent reduction in SPV system cost
- With strong industrial base, successful commercialization of technologies such as wind, SPV, ST, SHP, Biogas and improved biomass stoves, India is in a position to offer “state-of-the art” technology to other developing countries and is poised for a leading role in the global market towards sustainable development

Summary

- The SPV pumping programme of India is the world’s largest solar pv based pumping programme
- Private sector has been motivated to exploit the market potential
- IREDA earned Water Globe Award in 2002
- Over 7000 SPV pumping systems installed
- Demonstrated capability to replace Diesel pumps
- Sustainability depends on system cost coming down
Way Forward

- Incentivise usage/power saving in lieu of subsidy
- Technology up gradation and large scale volume production for Silicon/wafers through foreign direct investment
- Encourage Esco model through incentives
- Permit multiple use of system
- Facilitate micro-financing through rural banks/NGOs and financial intermediaries
- Facilitate focus on quality and standardized training – institution accreditation/networking
- Locate low cost finance. Working capital at low interest
- Tax holiday for solar industry
- Explore support through CDM revenue

THANK YOU