Energy-Efficient Solar Systems Applications for Productive End Uses

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Rural Electrification Applications

Historically, the primary means of providing power have been through grid extension and diesel generators.

– **Grid Extension**: Very high initial cost, poor cost recovery, time intensive (generation, transmission, distribution) and usually must be subsidized. Most often used.

– **Diesel Generators**: Inexpensive installation but expensive to operate, environmental damage/pollution, and subject to volatile fuel costs and availability.
Simple Direct Drive PV System
Simple DC PV System with Battery Storage
AC PV System with Inverter
Inverter

Converts Direct Current (DC) to Alternating Current (AC)
Utility-Connected (Line-Tie) PV System
Design Procedure

Collect information:
- Estimate or measure load
- Get best solar resource (weather) data

Inverter capacity (kW)
Photovoltaic capacity (kW_{rated} or m^2)
Battery capacity (kWh)
PV Design Tools

DOE Building Energy Software Tools Directory:
  – Energy Simulation Tools
    http://www.eren.doe.gov/buildings/tools_directory

UCLA Schools of Arts and Architecture:
  – Energy Tools Design Directory
    http://energy.design.tools@ucla.edu

PV Watts from NREL
http://www.nrel.gov/rredc/pvwatts/
Small Scale Individual DC Systems

Example Applications
Solar Home Systems

Brazil

India

China

Ghana
Public Area Lighting

Brazil

South Africa

Ghana
Schools

Lights
Computers
VCRs
Distance Learning
Adult Education

Brazil

South Africa
Health Clinics

Ghana

India

Peru
Water Pumping
Water Purification

Bangladesh

Mexico

Nigeria

Philippines
Rural Telecomm

Brazil
Microenterprise Development

India

Ghana

China
Afghanistan Solar Enterprise Development

Carpet weaving is a traditional Afghan industry.

Currently, many carpets are finished outside of the country because it is too cold in the winter to accomplish drying.

We are investigating solar energy for the rug drying application.
Carpet Completion

Rug washing and finishing requires hot, dry conditions
Solar Energy may be useful for Rug Drying; Two Possible Concepts are Shown:

1) Heated Room Drying
- Losses to Building
- Poor Surface Convection
- Wall Mass / Insulation?

2) Cabinet (Tent) Drying
- Horizontal or Vertical Flow Across Carpet Surfaces (including flow between folded carpet)
- Wall Mass / Insulation?
Summary of Solar Applications

Solar Electricity applications may be small, DC systems or large, AC grid-connected systems. There are many opportunities in Afghanistan to apply solar systems.

Solar PV can be used for any application that run on electricity, but systems not connected to the grid will require battery storage or backup power.

Thermal solar energy may be used to heat water, or to heat air for applications such as crop drying and, possibly, carpet drying. This application is a research project at NREL in collaboration with International TradeWorks.
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