Off-Grid Renewable Energy Systems:

Technologies, Advantages, Challenges

Ankur Scientific, Baroda, India

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Agenda

- ✓ Problem Statement
- ✓ Current Solution and its issues
- ✓ Renewable Energy Solutions available
- ✓ Analysis of each option
- ✓ About Biomass Gasification
  - ✓ Technology
  - ✓ Useable Biomass and the By-Products
  - ✓ Benefits - Social & Environmental
  - ✓ Modes of Generation and details
- ✓ Power to Rural Areas – Issues of Developmental Models
- ✓ Distributed Generation Models
- ✓ Issues and way forward
- ✓ Experience so far
- ✓ About Ankur Scientific

Problem Statement

- ✓ No / Bad Energy Access in rural areas.
- ✓ No / Limited Rural Development due to lack of Modern Energy systems.
- ✓ Lack of Employment Opportunities.
- ✓ Migration to Urban areas leading to infrastructural stress.

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Solution?

OFF-GRID, Decentralized Renewable Energy Systems for Cheap, Sustainable power to all.

RE Solution?

- ✓ Solution should be –
  - ✓ Simple
  - ✓ Sustainable
  - ✓ Scalable
- ✓ Sustainable from the point of view of
  - ✓ Individual and Community involvement
  - ✓ Environment
  - ✓ Health & Safety

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Current Electricity Options for Rural Areas

Diesel based gensets

Diesel based Power Generation

Pros	Cons
1. Proven technology	1. Very high cost of power – around US$ 0.25 per kW-hr
2. Reliable technology	2. Environmentally unfriendly technology
3. Large companies operating in the space	3. Fossil fuel based
4. Good After Sales service	

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Available Renewable Energy Options

1. Solar Photovoltaics
2. Wind Electric Generators
3. Mini Hydro Power Plants
4. Bio Energy →

Bio Energy Options

- ✓ Biogas
- ✓ Bio Diesel
- ✓ Biomass Combustion
- ✓ Biomass Gasification

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Solar PV based Power Generation

Pros

1. Proven technology
2. Reliable technology
3. Environmentally Friendly technology
4. No external fuel required
5. Roof top and Home lighting systems big potential

Cons

1. High Capex
2. High cost of power – around US $ 0.20/kW-hr
3. Power on demand requires batteries
4. Very site and season dependent

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Wind based Power Generation

Pros

1. Proven technology
2. Reliable technology
3. Environmentally Friendly technology
4. No external fuel required

Cons

1. High Capex
2. Power on demand not possible/ requires batteries (environmental issue)
3. Very site and season dependent

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Micro Hydro based Power Generation

Pros	Cons
1. Proven technology	1. High Capex
2. Reliable technology	2. Power on demand not possible
3. Environmentally Friendly technology	3. Very site and season dependent
4. No external fuel required	

Bio Fuel Options



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Bio Diesel based Power Generation

- ✓ Bio Diesel is still not widely available.
- ✓ Cost of Bio Diesel production is quite high.
- ✓ Engine generators proven on Bio Diesel are expensive and not easily available.

Biogas based Power Generation

- ✓ High Capex – about US $ 3 mil + / MWe.
- ✓ Require a lot of space.
- ✓ Waste stream from these plants not easy to handle.
- ✓ Biomass for Biogas more difficult to find for stand alone applications.

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Combustion based Power Generation

- ✓ Not relevant at the level we are looking at.
- ✓ Combustion systems are offered above the 1 MWe level, but start making sense only above the 5 MWe level (in terms of efficiencies).

Gasification - The Biomass Argument

(Logistics & Management)

- ✓ A distributed resource like biomass is best used in distributed manner.
- ✓ Large capacity plants need to cover larger areas for feedstock.
- ✓ Are more vulnerable on account of availability and price hikes.

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Biomass Gasification Technology

- ✓ One of the best options of Off-Grid RE.
- ✓ Most relevant at the level we are looking at.
- ✓ Wide range of power generation systems available right from 10-kWe to 2-Mwe levels.
- ✓ Can use different available Biomass / waste that are available in the specific rural areas.

Biomass that can be used…

Rice husk (as is basis & no need to briquette)	Agri-residues like Cotton / Soyabean / Mustard stalks, Corn Cobs	Shells of Arecanut, Almond, Cashewnut, Groundnut, Coconut
Waste Wood, Wood chips, Plywood & Saw mill wastes	Branches & Twigs	Bamboo pieces & Pine needles
Sugarcane bagasse & Sugarcane trash (briquetted)	Wild bushes and weeds like Prosopis Juliflora, Lantana, Invader Bush etc.	Greening of waste lands though production of sturdy Energy species.

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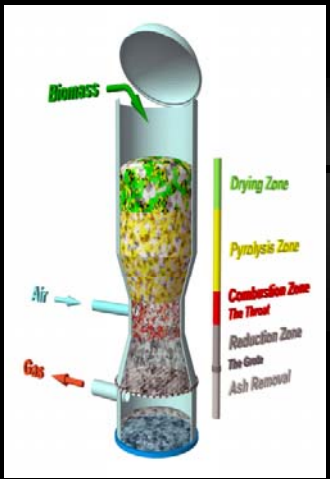
What is Gasification?

Gasification is conversion of various biomasses to a combustible gas called Producer Gas.

This gas can then be burnt in Engine Gensets to produce electricity or can be used for process heat applications.



The By-Product?







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Benefits apart from Cheap Power on Demand

Social Benefit

- ✓ Wealth from Waste.
- ✓ Large-Scale Employment Generation.
- ✓ Great boost to Rural Entrepreneurship.
- ✓ Positive Impact on migration to urban areas.
- ✓ Unlike other technologies, 70-80% of the revenue returns to the local economy).

Environmental Benefit

- ✓ The energy is clean and green.
- ✓ Reduces CO_2 emissions, thus reducing Global Warming

Modes of Power Generation

1. Dual Fuel Mode (Fuel = Diesel + Biomass)
   - ✓ Uses a Diesel engine genset (usually available, saving CAPEX).
   - ✓ Thereby saving upto 70% of Diesel and its cost.
   - ✓ Ideal for Telecom Towers for replacement of huge diesel they use. we
2. 100% Gas Mode (Fuel = Only Biomass)
   - ✓ Uses a Producer Gas engine genset.
   - ✓ Need 1.3 kgs of woody biomass / 2 kgs of rice husk to generate 1 kW-hr.

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Dual-Fueling

&

Power for Industries

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5 X 100 kWe at Sundarbans, West Bengal, India

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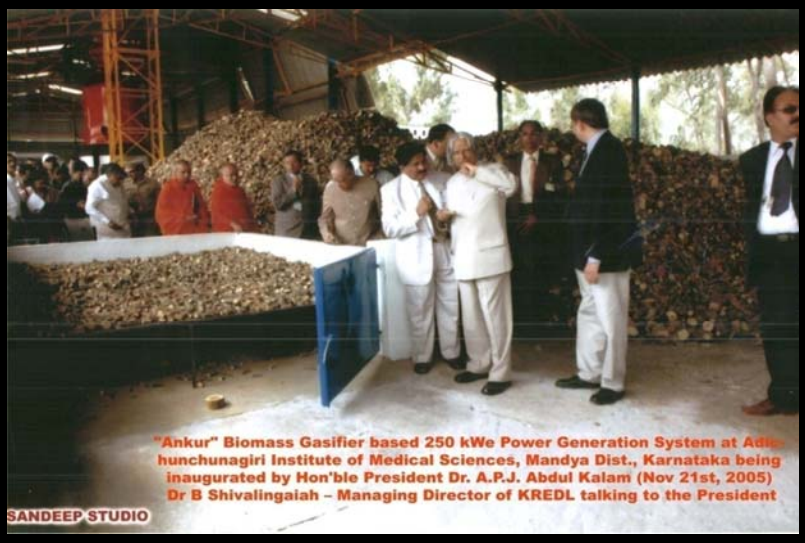
FBG-350 at Jasoriya Rice Mill, Burdwan, India

250 kWe at Medical Institute, India



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Power to Rural Areas – The Issue of Developmental Models

- ✓ Large power plants based grid extension.
- ✓ Decentralized Generation with increasing self-sufficiency for rural areas?
- ✓ Main focus so far on grid extension but need for an intelligent combination.
- ✓ For decentralized generation, biomass is the key option.

Distributed Generation - Three Basic Models

- ✓ Small Power Packs in Stand-Alone Mode
  - ✓ For remote / isolated villages and communities not connected to a grid and not likely to get connected in the near future.
- ✓ Small Power Plants in Grid Connected Mode
  - ✓ For grid connected rural areas with major problems of power availability and power quality resulting in very limited and poor quality electricity being available.
- ✓ Co-Generation of Charcoal and Electricity
  - ✓ Tremendous potential to address both cooking and electricity needs with very high biomass utilization efficiencies.

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Small Power Packs in Stand-Alone Mode

Small Power Packs - Features

- ✓ Locally available biomass as feedstock.
- ✓ Power Packs of 10 kW and above.
- ✓ Self-starting with no external start-up power; requiring less than 10 minutes start-up time.
- ✓ Could be operated round-the-clock/on-demand.
- ✓ Biomass consumption about 1.3 kg / kWhr.

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Power Pack for Village Electrification

Highlights

- ✓ First installation of GAS-9 100% Producer Gas system
- ✓ Start-up through battery
- ✓ Specific fuel consumption: less than 1.3 kg/kWhr
- ✓ Operated by Women's Self Help Group
- ✓ Has become a catalyst for economic growth in the village

Gasifier Model: 1 X GAS-9
Odanduthurai, India

Small Power Plants in Grid Connected Mode

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Guiding Philosophy

Size the power plants so that:

- ✓ Allow benefits to pass on to maximum number of people.
- ✓ Make the biomass procurement area as small as possible.
- ✓ Size of power plant such that it can be run like a commercial operation without a very high fixed cost.
- ✓ Standardize for easy Operation, Maintenance and Services. Also for cost cutting.

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MW Level Tail end Power Plants
An Exciting Opportunity

- ✓ Almost all rural grids have 1-2 MVA capacity
- ✓ Rural areas / grids feel the power shortage pinch the most – are the first ones to be off-loaded
- ✓ Appropriate capacity tail-end power plants (0.5 – 2.0 MWe) based on biomass gasification could totally eliminate this problem
- ✓ And can lead to the realization of the dream of equitable, round-the-clock quality electricity supply to Rural Areas.

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1.2 MW Power Plant at Sankheda, Gujarat, India

Projects Around the World –

A Glimpse

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Small Ratings for Distributed Power

11 kWe for Ice Cream making in Thailand

CHIDREN'S DAY BEFORE THE CHILDREN ARRIVE

THE ICREAM MACHINE NEXT TO THE GAS11 READY TO MAKE RENEWABLE ICECREAM - YEAH!

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Small Ratings for Distributed Power

11 kWe for Mobile Tower near Jodhpur, India

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Systems for Village / Rural Electrification

Small Ratings for Distributed Power

70 kWe for Village Electrification at Charchuk, Cambodia

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Sri Lanka Power Plants

Installations at Thirappane

- ✓ 500 kW Electrical Power Plant installed under Phase-I
- ✓ 1.5 MW Electrical Power Plant to be installed under Phase-II in 2013

Installations at Embilipitiya

- ✓ 1.5 MW Electrical Power Plant installed under Phase-I
- ✓ 1.5 MW Electrical Power Plant each to be installed under Phase-II and Phase-III in 2013 and 2014 respectively.

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700 kWe Power Plant using Rice Husk in Cambodia

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FBG-600 in Dual-Fuel Mode
Canadia Bank Project in Cambodia

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Upcoming Installations in Thailand

- ✓ 500-kWe at Nongbua Green Power Co. Ltd., Thailand
- ✓ 5-MWe at Plan Eco-Energy Co. Ltd., Thailand

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500 kWe Power Plant at Merced in California

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Upcoming Power Plants in Europe & USA

1 X WBG-1800 at Oakdale, California

✓ 3 X WBG-2200 – 5 MW to be installed in Bulgaria

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500-kWe Power Plant commissioned in Slovenia

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500-kWe Power Plant commissioned in Thailand




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Rice husk based 350 kWe, Dual Fuel Power Plant in India

250-kWe Power Plant for Captive Use

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Issues and way forward

✓ Off Grid RE projects have two phases …

Phase-I (Pre-setup)

1. Policies
2. Financing
3. Approvals
4. Technology, Investment & Infrastructure

Phase-II (Post-setup)

1. Biomass Logistics
2. Long term Operations and Maintenance
3. Disposal of Wastes
4. Collection of Revenues.

Experience so far

Phase-I - Challenges and Barriers

- ✓ Policy initiatives
  - ✓ Need to make projects bankable through policies like Subsidies, higher tariffs for power sale, GBI, Tax benefits.
- ✓ Financing
  - ✓ FI's / Banks - overly cautious towards funding decentralized projects
  - ✓ Need to enhance affordability through Long-term low-interest rates on loans

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Experience so far

Phase-I - Challenges and Barriers

- ✓ Approvals
  - ✓ Currently long and multiple approvals
  - ✓ Need Single window and fast approvals
  - ✓ Setting up of Centre-states co-ordination committee which can push for fast approvals.
- ✓ Technology – Options, Pros & Cons discussed earlier

Thus Phase-I is easier as it is more or less under Government control & could be managed.

Experience so far

Phase-I I - Challenges and Barriers

- ✓ Biomass Logistics
  - ✓ Ideal to make it a lucrative business for some local Entrepreneur – will define success or failure.
- ✓ Long Term O&M
  - ✓ Electricity use may be limited initially leading to low PLFs.
  - ✓ Thus initially the project may need much higher working capital.
  - ✓ Regular O&M – a model for that is still not all there. But a cluster approach a must.
  - ✓ Collection of revenues – smart metering etc. need to be considered.

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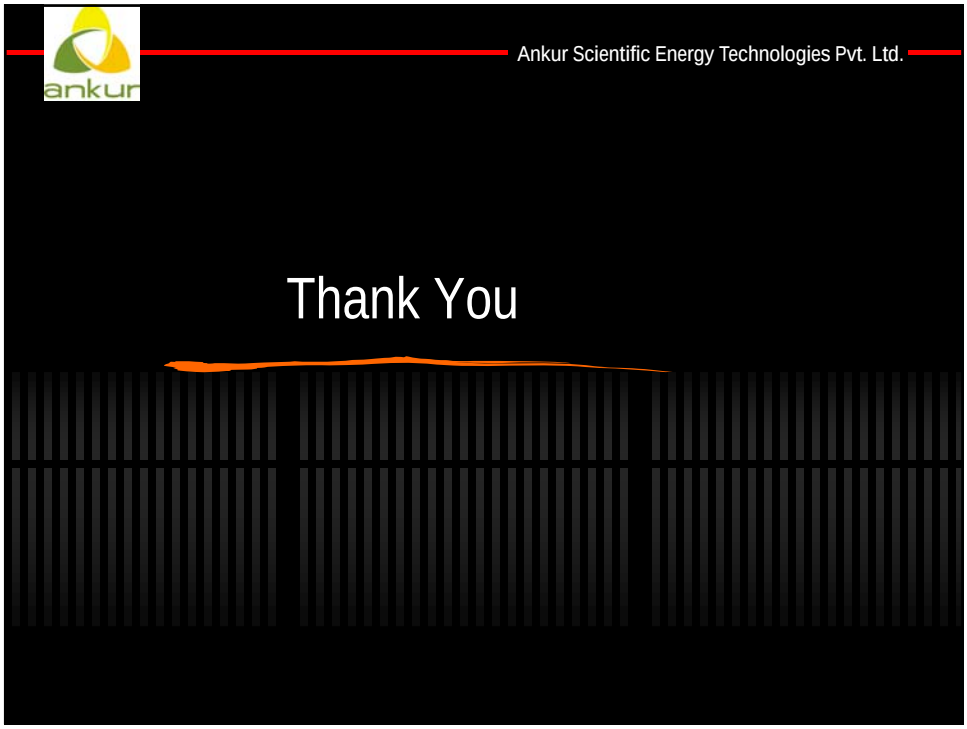
About Ankur Scientific

Founded in 1986 by Dr. B.C.Jain, an internationally acclaimed technocrat.

Since its inception, Ankur Scientific has been in the forefront of research and developmental activities in the area of non-conventional energy sources.

Have done more than 900 installations till date.

Have exported this indigenously developed technology to more than 25 Countries across the Globe. The company now has installations in USA, Chile, Brazil, Guatemala, Colombia, Italy, Germany, Russia, Australia, New Zealand, Sri Lanka, Myanmar, Cambodia, Vietnam, Malaysia, Indonesia, Ukraine, Slovenia, Latvia, Poland etc.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Thank You