Breaking the shackles on Biomass to Energy in India: A corporate view

Need for an integrated technological, social & financial instruments coupled with policy and regulatory practices

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The “Factfile” on Bio energy: Industry perspective

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1. Majority of industrial scale bio energy plants are languishing at the borderlines and facing huge challenge for their survival

2. Technological developments have been sketchy with no concerted efforts on building credible technology base on bio energy

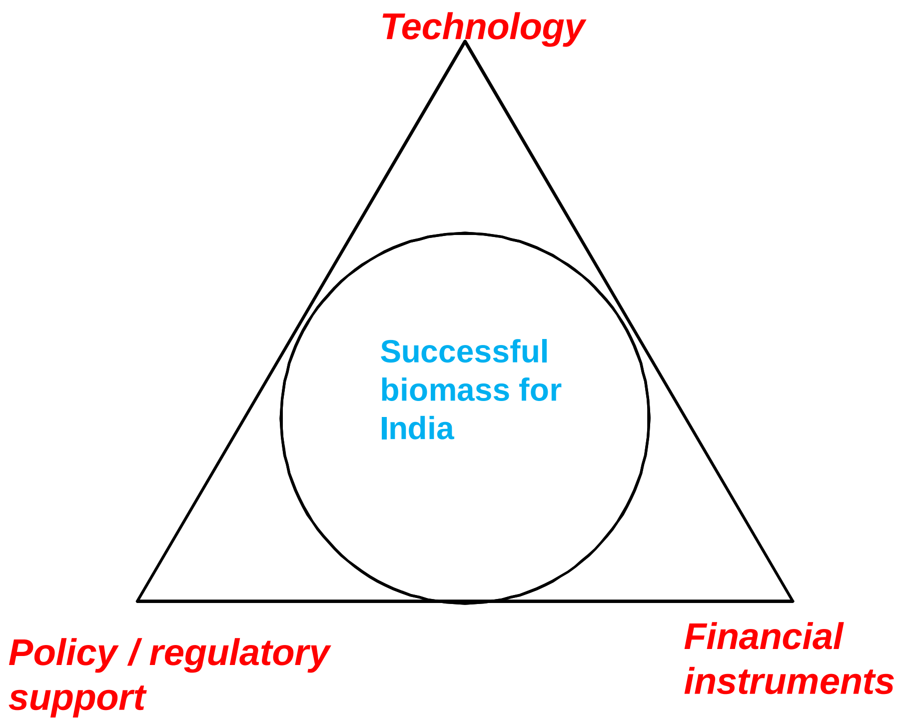
3. Inadequate policy support instruments, banking / funding institutions not enthusiastic

4. Throttled supply chain posing a major challenge

1. Biomass remains a very potent renewable energy option in India
2. Distributed energy solutions in combined or co-generation form can become a viable option
3. Developments at multiple scale in an integrated manner are needed for bringing bio energy to the center

TRIPOD FOR BREAKING THE SHACKLES ON BIOENERGY FOR INDIA

Intense technological developments in combustion, gasification & bio methanation processes for diverse biomass



Feed in tariff, subsidy, RPO & Dis gen mechanism

Grants for application R&D, Demonstration projects & viability gap funding

Nexus in sourcing ; technology ; funding (STF)

BIOMASS SOURCING: Sources & social intervention and new instruments

Total potential >25,000 Mwe /yr & is equivalent to 100,000 Mwe of solar/wind

Source no 1: Agro – farming / forestry

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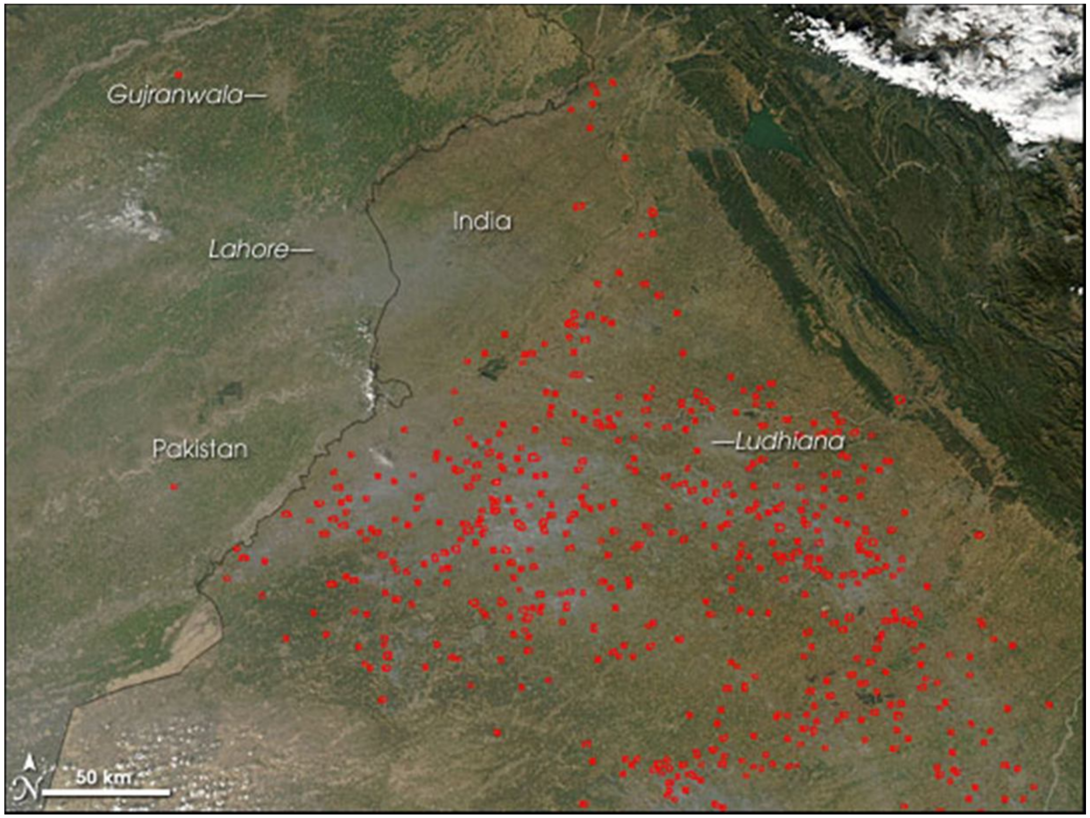
Diversity of the residue is a very challenging problem: Seasonal variations

Biomass World

1. **Woody biomass**
2. **Agricultural biomass**
3. **Energy Plantations**
4. **Residue from bio fuels**

Sourcing to conditioning the biomass : Briquetting is posing a challenge

Source 2: Stack residue burnt NASA Picture of Punjab fire: Easy availability but difficult to handle



Oct 31st 2012 global

- Kills Microbes
- Smog in North India
- Climate Change

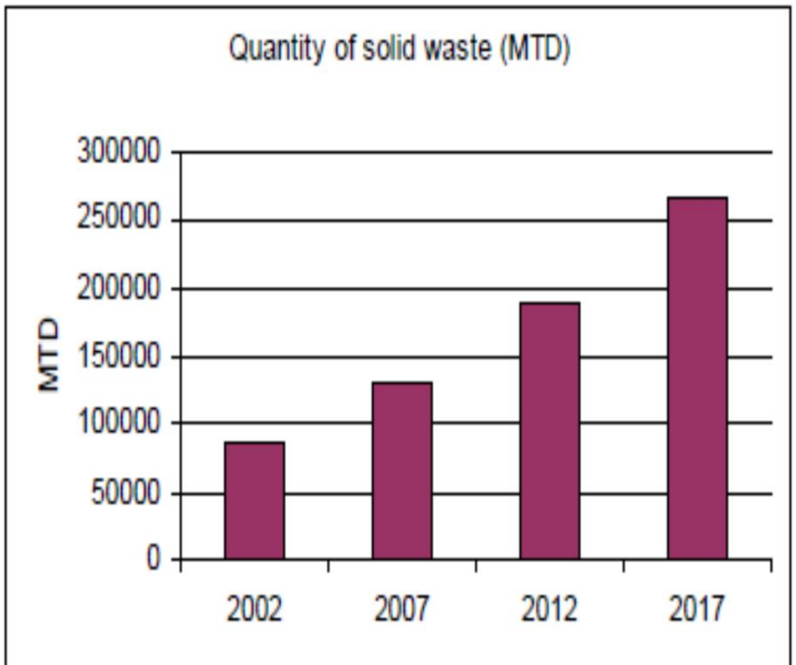
This could be used for energy generation

Source 3: Municipal Solid waste (MSW) Energy-Environment

188500 tonnes per day → 66990 tonnes per day

Total Municipal solid Waste (MSW) Generated in Indian metros, class I & II cities

MSW generated in major 16 cities producing more than 1000 tones per day



Generation trends

TEN LARGEST MSW PRODUCING CITIES IN INDIA

City	Waste generation (kg/cap/day)	k tonnes per year	Tonnes per day
Delhi	0.57	2 161	5 920
Greater Mumbai	0.45	1 941	5 320
Chennai	0.62	1 108	3 035
Kolkata	0.58	968	2 650
Hyderabad	0.57	798	2 185
Bangalore	0.39	609	1 670
Ahmedabad	0.37	475	1 301
Pune	0.46	428	1 172
Kanpur	0.43	401	1 098
Surat	0.41	365	1 000

INSPIRATION : CHATTISGARH EXAMPLE ; SOCIAL EXMAPLE

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Minor Forest Produce

- Chattisgarh has 44% area under forests : good bio-diversity
- Non Wood Forest Produce – e.g. Tendu Leaves, Sal Seeds, Harra, Gum of Kolhu, Babool etc.
- Chattisgarh state NFP cooperative federation
- Taskforce under Conservator of Forests ensures Non-destructive harvesting

Size & Spread

- 10,080 collection centers spread over the length and breadth of the state
- 13.76 lakhs forest produce gatherer families
- Assured market tie-up: Mitsui alone buys for 140 Cr/pa
- Total Trade – Rs. 1500 crore both 50% Nationalized
- Payment to collectors through district level co-operative unions
- Disposes nationalized forest produce through tenders and auctions

The Collection Centre

- Each primary society has 10 to 20 collection centers
- MFP is purchased and purchase price is paid to collectors.
- Each primary co-operative union has separate area of jurisdiction with field officers.
- The collection centres are managed by Phadmunshis, appointed for that purpose by the societies.
- These collection centres are supervised and guided by Forest Department Officials.

This model can be multiplied in India……………..

Technologies for Energy Conversion

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Power or Fuel (transport sector)? The technological developments were very marginal and considered as extension of coal fired systems

Conventional Options

1 Combustion (power)

2 Gasification (power + fuel)

3 Anaerobic digestion (fuel +power)

Emerging Options

1 Lipids from energy plantations (fuel)

2. Enzymatic conversions to ethanol (fuel)

3. Artificial Photosynthesis

4. Microbial fuel cells

Comparison of process parameters coal Vs Biomass for a 5 MW plant : Conventional Combustion based Steam based systems

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COAL BASED PLANT

- Boiler rating: 24 TPH
- Outlet Flow: 22.50 TPH
- Boiler Pressure Temp: 67 Ata/ 485 Deg C
- FWT: 130 Deg C
- Fuel Consumption: 5.00 TPH ~ 120 TPD Approx
- Station Heat Rate: 2500 Kcal / Kw Approx

BIOMASS BASED PLANT

- Boiler rating: 28.00 TPH
- Outlet Flow: 26.85 TPH
- Boiler Pressure Temp: 45 Ata/ 440 Deg C
- FWT: 130 Deg C
- Type of condenser: ACC
- Fuel Consumption: 8.0 TPH ~ 192 TPD Approx
- Station Heat Rate: 3550 Kcal / Kw Approx

Biomass technology needs more technological developments

Fouling, corrosion, deposition and reliability issues in biomass

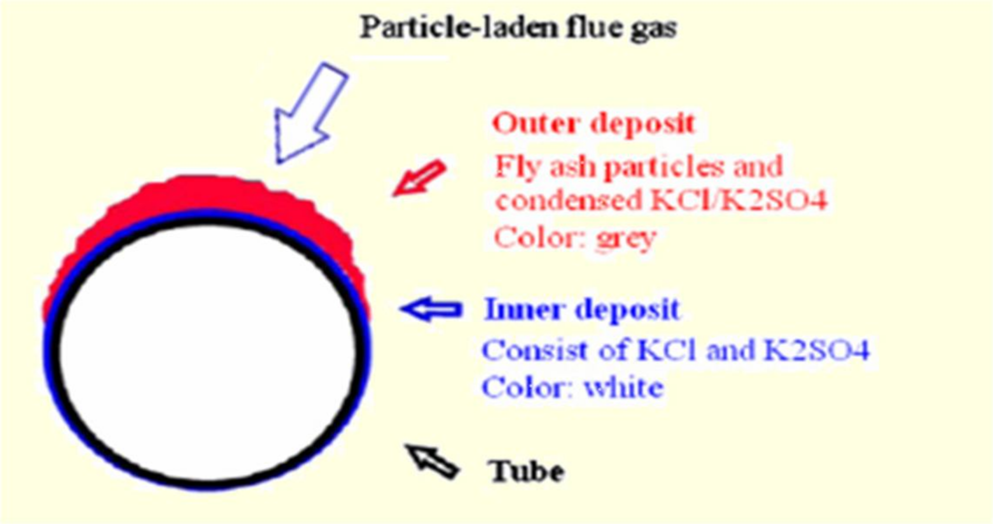
Na/K (15 %) > fouling

Silica (70 %) > Slaging /Erosion

Cl (0.15%) > Corrosion

Developmental Matrix

- Right combustion systems
- Fuel feeding / pollution control systems
- Organic Rankine Cycles for co-generation systems
- Water free cooling systems



Biomass gasification based systems:

- Existing biomass gasification technology is not refined for power generation

- Poor grid synchronized operation due to:
    - Inconsistent quality of gas from gasifier into the engine
    - Substantial deviation in quantity of syngas, most systems are under rated

- Such poor performance ultimately reflects in high net specific cost of manpower and maintenance

- Scale-up of the existing technology for MW capacity is limited

Biomass Utilization : New technology

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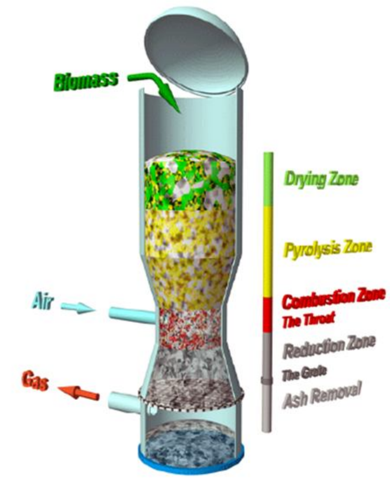
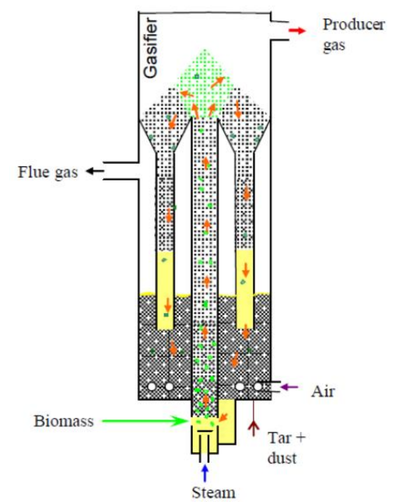
New technology : ECN -Holland, Thermax & RSIL Under MNRE/UNDP Technology demonstration project

No.	Criterion	Existing plants	Proposed plant
1.	Conversion efficiency	80-85%	>95%
2.	Fuel consumption/kW	1.3kg/kW	0.9kg/kW
3.	Gas calorific value	1200 kCal/kg	3223 kCal/kg
4.	Availability	Less than 60%	> 85%
5.	Bleed treatment	Difficult to treat	Simple and much cleaner
6.	Overall plant size	Relatively bulky	Compact

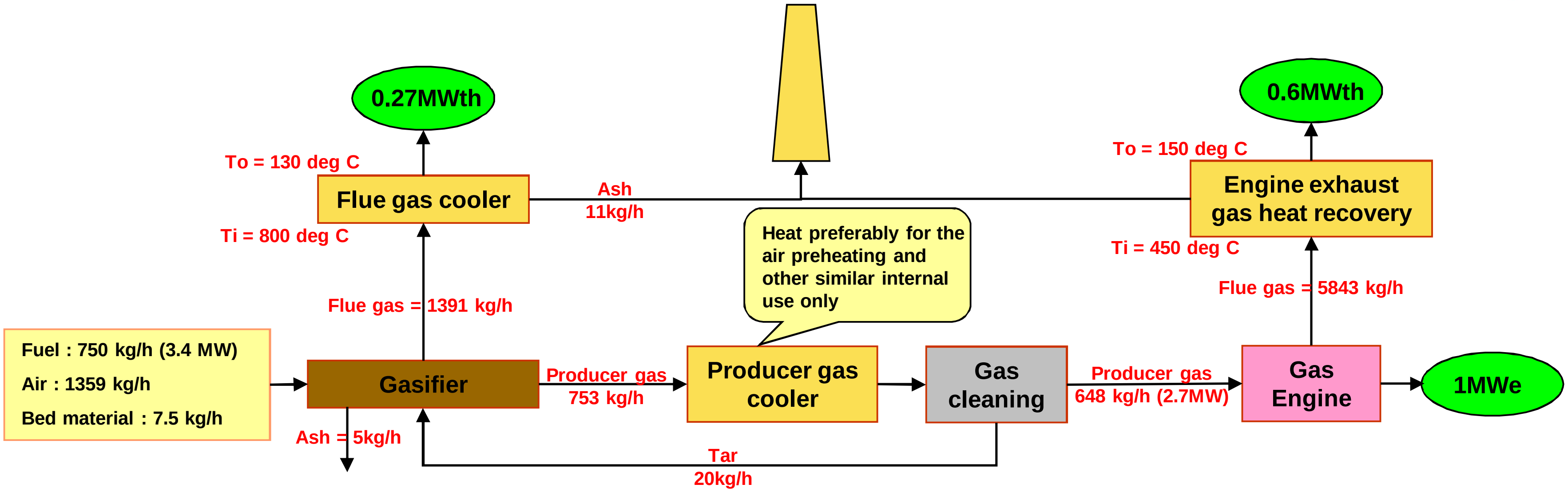


Existing



Proposed

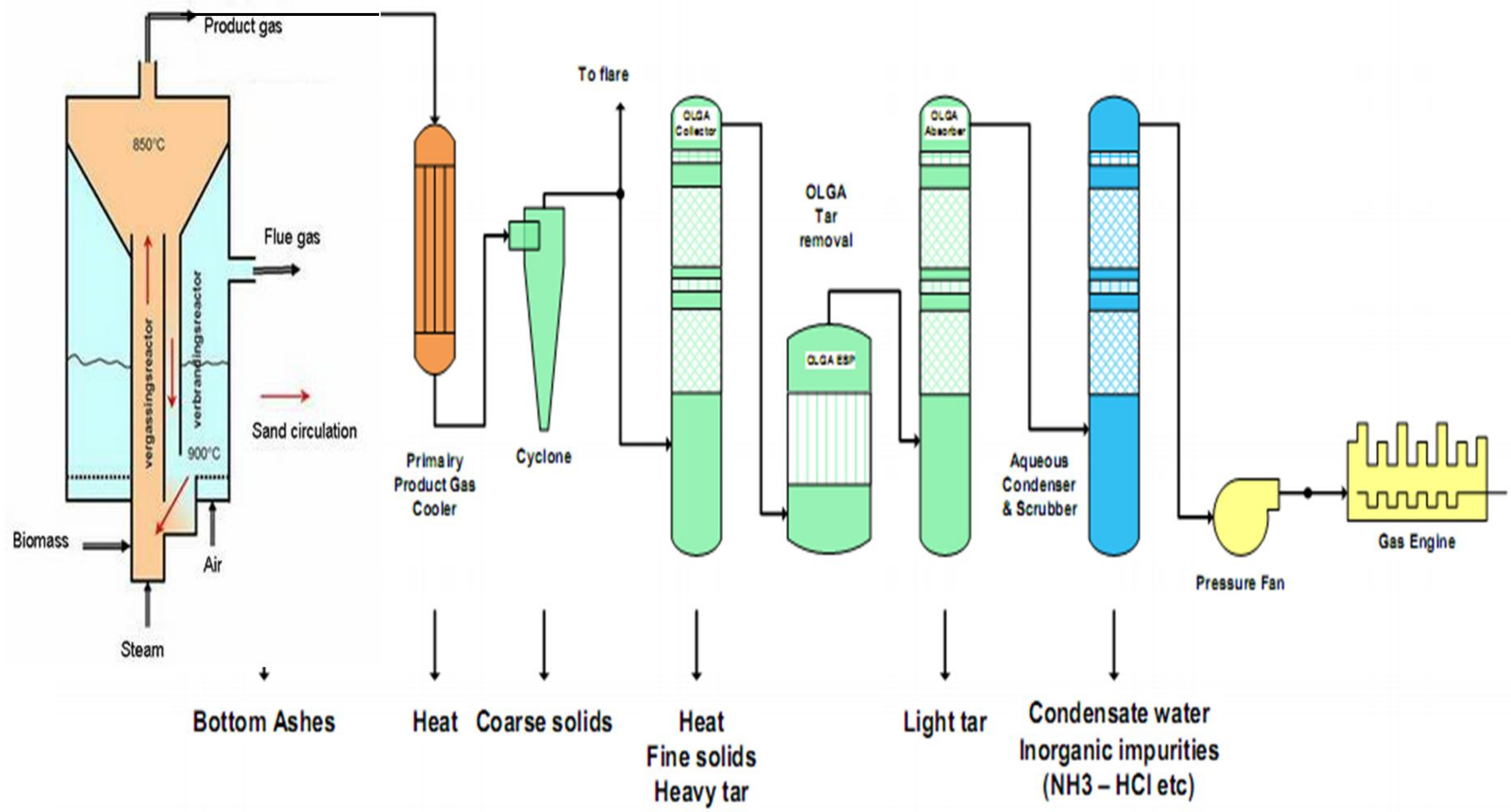
Uniqueness of Proposed Technology



Internal electricity consumption for 1 MWe plant is approximately 85 kWe

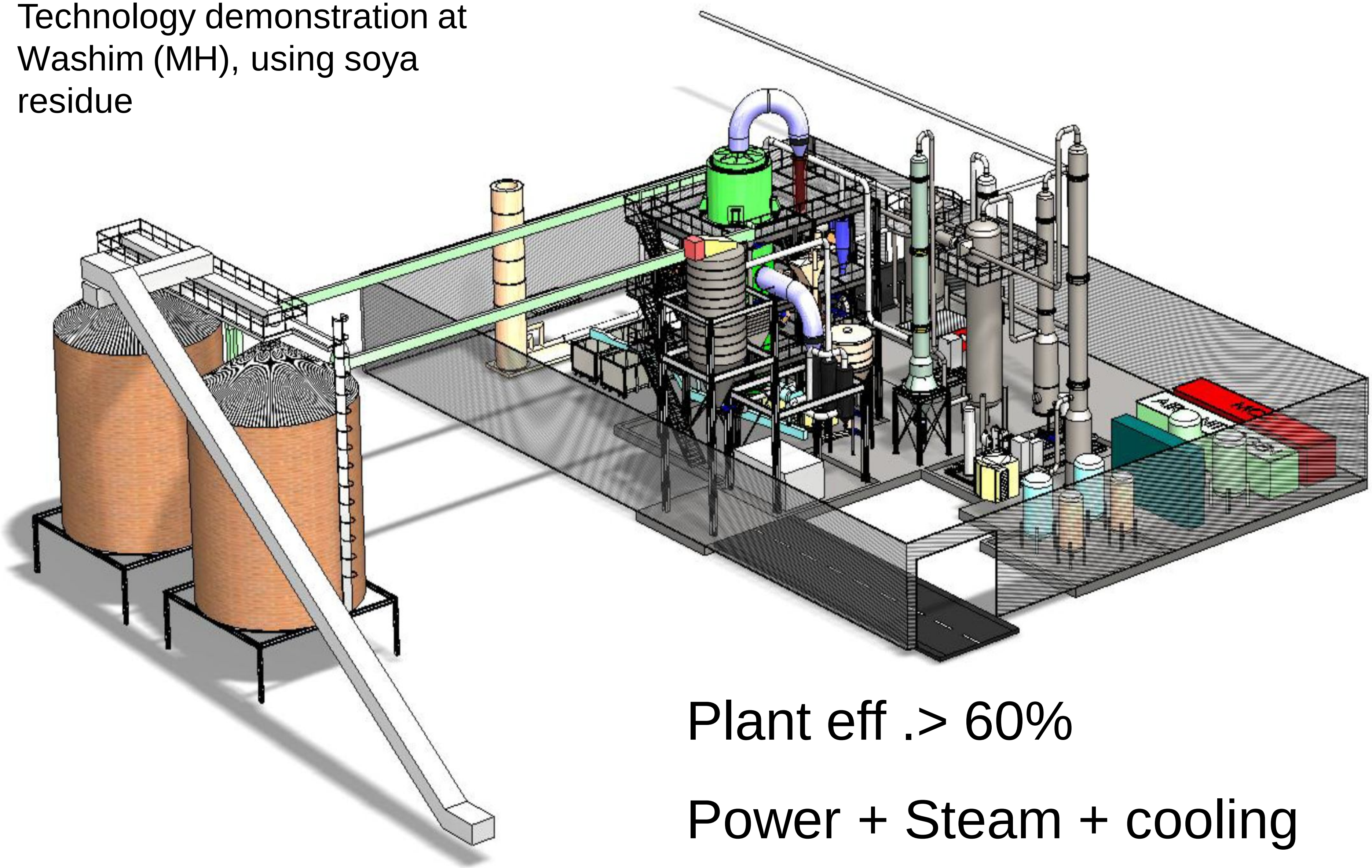
- In-situ reduction of heavy tars by using olivine as bed material, which has a catalytic effect
- Recycling of the tars leads to high carbon conversion ~98%
- Higher and consistent CV of the producer gas leads to stable engine operation
- Gas cleaning system removes 99% of tar as against 60% removed by water scrubbing method employed currently.

Biomass Utilization – ECN – Gasification System



Gasifier based plant

Technology demonstration at Washim (MH), using soya residue



Plant eff .> 60%

Power + Steam + cooling

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HYBRID SOLAR WITH BIOMASS SYSTEMS: UNIQUE INTEGRATION TO REDUCE DEPENDENCE ON BIOMASS

Schematic of Solar Biomass Hybrid Power Project

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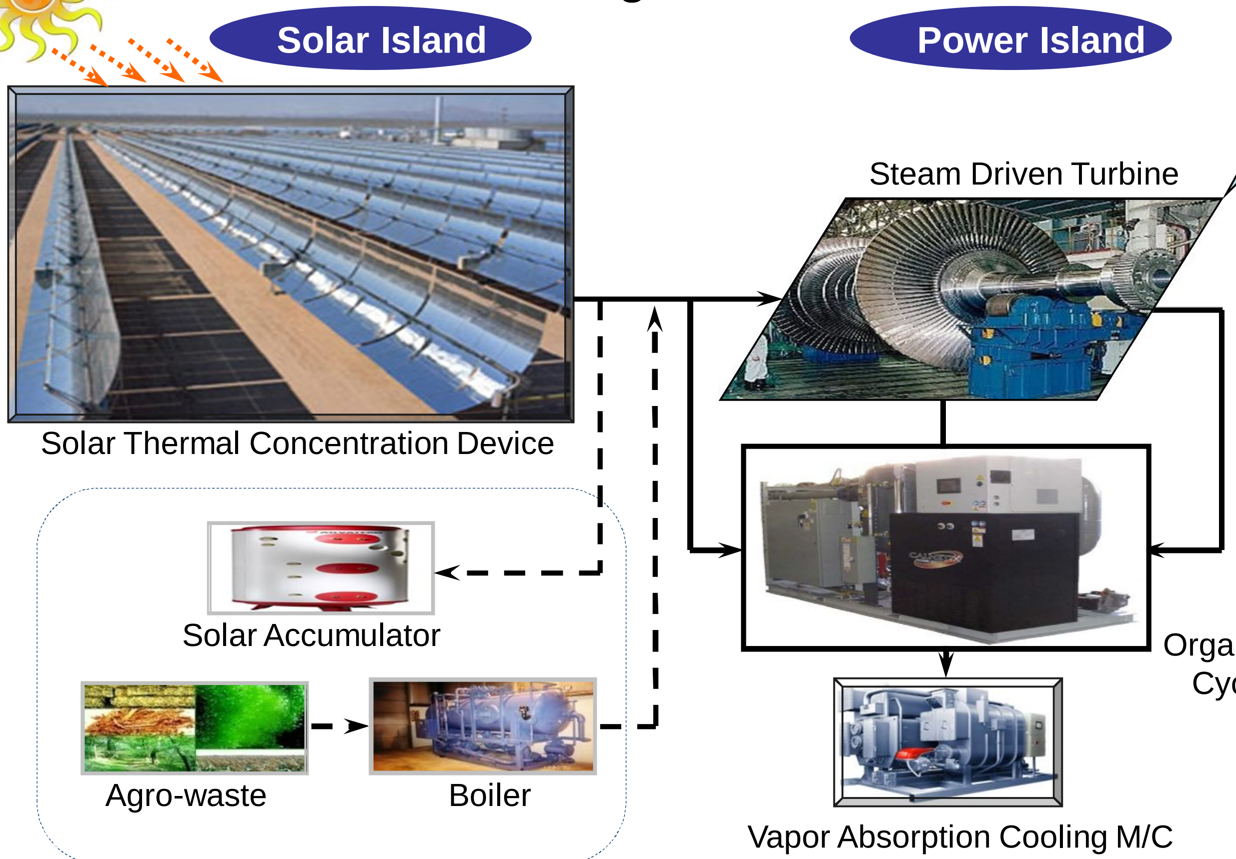
Medium temperature, 24*7 (hybrid), high efficiency, low cost FOAK design



Organic Rankine Cycle (ORC)

Sr. No	Steam Only	ORC + VAM
Power	256 kW	256kW + 110 TR
Eff.	8.1%	32.5%

This is known as SHIVE MODEL

256 KW 24X7 Generation

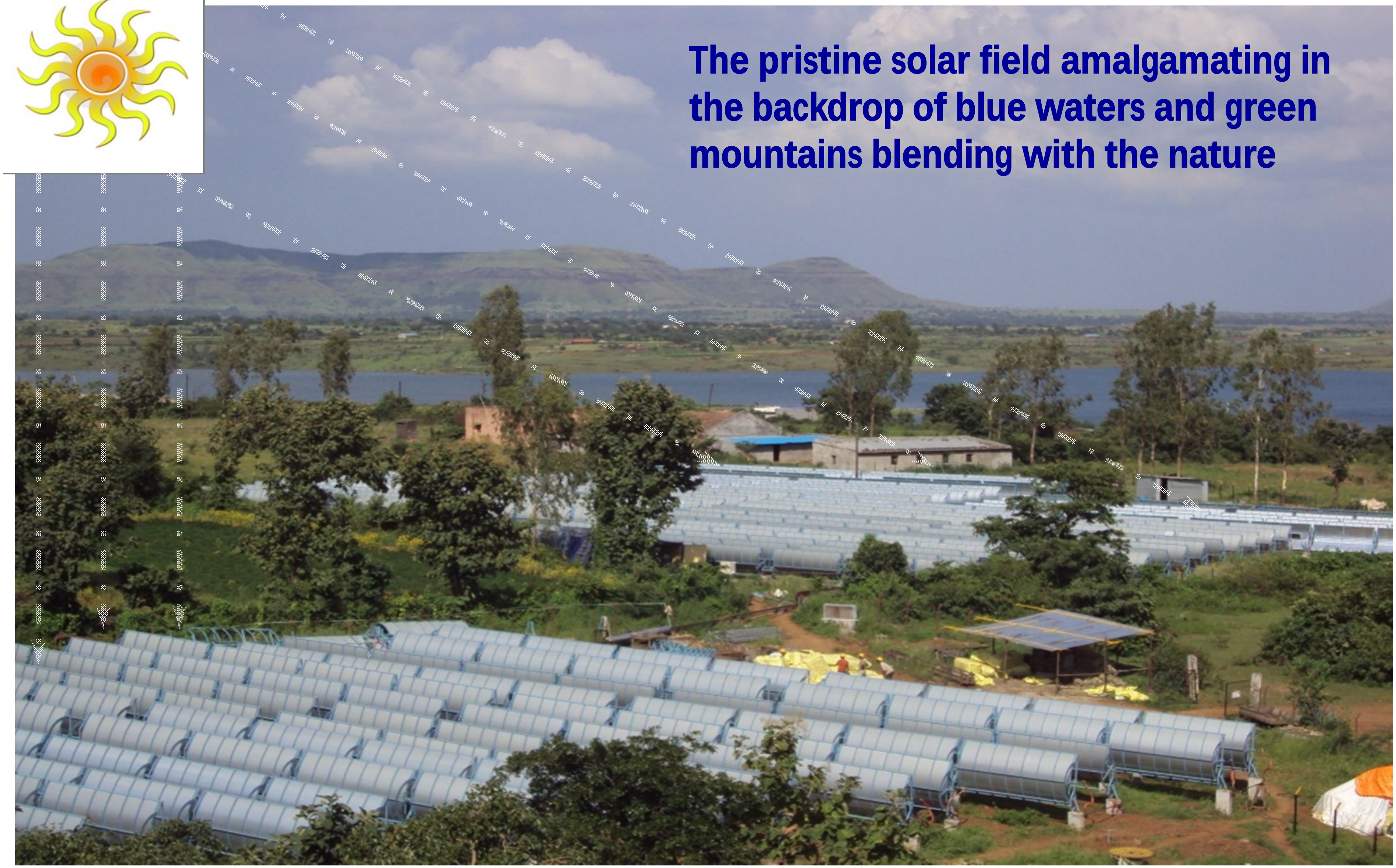
Biomass Hybridization Using local Agro waste

ORC Integration to boost efficiency

Integration with Heating & Cooling applications

Project approval received in Dec 2009 with a project completion by June 2011.
DST (Govt of India) approved cost of the Project is 9.11 Cr including R&D costs of Rs 1.36 Cr

Shive Project : Unique “model” project

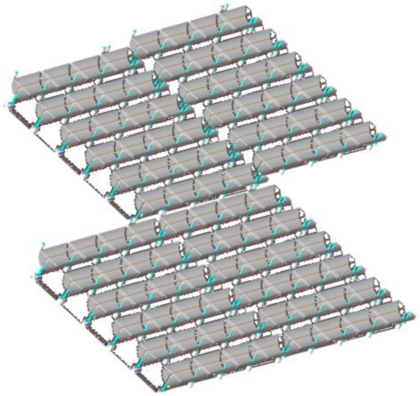


The pristine solar field amalgamating in the backdrop of blue waters and green mountains blending with the nature

A 3 Mwe EU Solar Biomass Project

10.5 million Euro, EU Funded

Solar Field



Biomass Boiler

Biomass Superheater

Steam Turbine

$\eta = 22\ \%$

Biomass Gasifier

Medium Temperature Solar - High Solar Efficiency
Biomass Super heater – High Cycle Efficiency

WAY FORWARD

EU Solar Biomass Project – Responsibility Matrix

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CENTER FOR STUDY OF SCIENCE, TECHNOLOGY & POLICY

- Land
  - Demarcation
  - Preparation
  - Clearances
  - Fencing
- Power
  - Evacuation Infrastructure

- ECN Holland : Gasification
- CNRS : France Simulation, modeling

BSPGCL

बिहार सरकार
GOVERNMENT OF BIHAR

- Land
- Evacuation
- Energy Utilization
- Biomass for operations
- O&M resources

PROJECT

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- Erection, Procurement and Commissioning
- Operation & Maintenance Supervision

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Bio degradation from waste to power and fuel

S. No	Substrate for Biogas production	Biogas Yield (m3/kg)
1	Spent Grain	0.6
2	Spent Fruits	0.7
3	Slaughter House waste	0.7
4	Animal Fat	1.0
5	Vegetable waste	0.4 – 1.0
6	Waste from food industry	0.9
7	Molasses	0.7
8	Waste from household	0.3-1.0
9	Waste from paper	0.2
10	Cattle Excreta	0.8
11	Sewage sludge	0.3

This indicates all degradable biomass can be utilized for biogas generation with much water input

Best suitable scenario for MSW utilization: Power + Fuel + Manure

66990 tonnes per day MSW from 16 major cities

33495 tonnes per day biodegradable organic waste

20770 tonnes per day non-biodegradable organic waste

CBG route

1 TPD = 44 kg CBG

Manure

1 TPD = 0.16 tons

RDF - Power route

1 TPD – 480 kW

CBG – 1473780 kg

Manure – 5359 tons

Power – 9970 MW

Cost of methane is close to what is available as piped natural gas

CONCLUSION: STARTEGIC SHIFT IN PARADIGMS (**THREE PHASE PROGRAMME)**

NEED FOR VIABILITY GAP FUNDING

1

- Biomass energy for distributed energy applications has been globally described as the “sleeping giant” from the renewable energy utilization perspective.

2

- Biomass gasification and combustion in co-generation mode is the best technological options. New gasification technologies, High efficiency engines, Organic Rankine Cycle generators, High efficiency Methanation technologies are crucial . Large industries are using Biomass energy for process heating and these to be converted into co-gen systems

3

- Biomass can seamlessly be integrated with solar as well for heating, cooling and power generation- Gasification or combustion route

4

- Out of 70 million tons of oil consumed in India, 20% is used in industrial or commercial heating applications. Biogas can make a difference.

Estimates of Potential Capacities from Renewable Energy Sources (in GWs)

table 6.1: india: projection of renewable electricity generation capacity under the energy [r]evolution scenario

IN GW

	2005	2010	2015	2020	2030	2040	2050
Wind	4	12	29	69	143	200	224
PV	0	0	2	10	118	486	1,093
Biomass	0	1	4	8	19	41	70
Geothermal	0	0	0	2	6	18	30
Solarthermal	0	0	0.5	3	23	70	151
Ocean energy	0	0	0	1	3	5	11
Total	**4**	**13**	**35**	**92**	**310**	**819**	**1,579**

Source: India Ministry of Non-Conventional Energy Sources

Details of Capital Subsidy to Promoters

Sr. No.	Waste /process/Technologies	Capital subsidy
1.	Industrial waste to biogas	
i)	Biomethanation of low energy density and difficult industrial wastes (i.e. dairy, tannery, slaughter house, sugar (liquid),bagasse wash, textile (liquid), paper (liquid), and pharmaceutical industry)	Rs. 1.0 crore / MWeq. (12000 Cu.m. per day)
ii)	Bio-methanation of other industrial wastes	Rs. 0.50 crore / MWeq. (12000 Cu.m.per day)
2.	Power Generation from Biogas	
i)	Boiler + Steam Turbine Configuration	Rs. 0.20 crore / MW
ii)	Biogas Engine + Turbine Configuration	Rs. 1.00 crore / MW
3.	Power Generation from solid Industrial Waste (boiler + Steam Turbine Configuration)	Rs. 0.20 crore / MW

This hardly in line with the real need…

COST ECONOMICS IN BIOMASS ENERGY SYSTEMS: need for VGF

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1. The technologically driven biomass power plants in the scale of 1-5 Mwe during the induction stage will be cost around 8-9 cr / Mwe .

2. Such plant using locally available biomass would produce power with an LCOE of 6-7 `/unit

3. This will not meet the grid parity requirements and hence would need multiple policy and financial instruments . A three phase programme will be very critical to make this happen

Considering Existing Capital Subsidy on the biomass power plant						
Year	1	2	3	4	5	6
Capital Investment	-75.0	-25.2	-12.7	-5.2	2.2	9.6
Accelerated Depreciation	19.8	5.0	-	-	-	-
Capital Subsidy	22.5	-	-	-	-	-
Operational Expenditure	-0.8	-0.8	-0.8	-0.9	-0.9	-1.0
Energy Savings@Rs. 5/unit	8.3	8.3	8.3	8.3	8.3	8.3
Net Cash Flow	-25.2	-12.7	-5.2	2.2	9.6	16.9

Payback in the vicinity of ***4-5 years***

BARRIERS TO PROLIFERATION

Proliferation of biomass technologies are hindered by serious challenges which prevent it from reaching the stage of sustained growth

Technology Barriers

- ► **Customisation : The size of the biomass power plants standardized.** Industrial co gen application needs a tailored approach. There is no off the shelf solution
- ► **Lack of economies of scale** higher costs and higher capital investment required
- ► **Technology Efficiency** Higher efficiencies with better reliability and pollution control measures ability to capture local biomass characteristics.
- ► **Effective application engineering development & integration capability**
- ► **Availability of performance measurement standards**

Demonstration & Replication Barriers

- ► **Wide range of technologies are yet to be demonstrated** in India in an industrial setup
- ► **Lack of public domain information**

Policy Barriers

- ► **High Initial capital cost**
- Need for **Indian standards for biomass to power** technologies
- ► **Revised subsidy policy in India needed to ensure sustained operations of systems**
- ► **Revised subsidy to incentivize systems** with better efficiencies and heat grade of collector/concentrator

Other Barriers

- ► **Low awareness among** end users/ consultants
- ► **Lack of relevant experienced and skilled workforce** for system design, installation and effective O&M

THANK YOU

Contact Us: rsonde@thermaxindia.com