BIOMASS POWER

- A Techno-Economic Analysis

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"A Cleaner, Brighter Future"

Presented at:

Sensitisation Workshop and Skill Development Training on Sub-MW Scale Biomass Power Generation for Southern Region

4th Feb 2013

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CONTENTS

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Technological Options for Biomass to Energy

Gasification Vs. Combustion & Why Gasification?

Why IISc technology?

Technology configuration in AllGreen's plants

Operational & Economic Parameters of AllGreen's plants

TECHNOLOGICAL OPTIONS FOR BIOMASS TO ELECTRICITY

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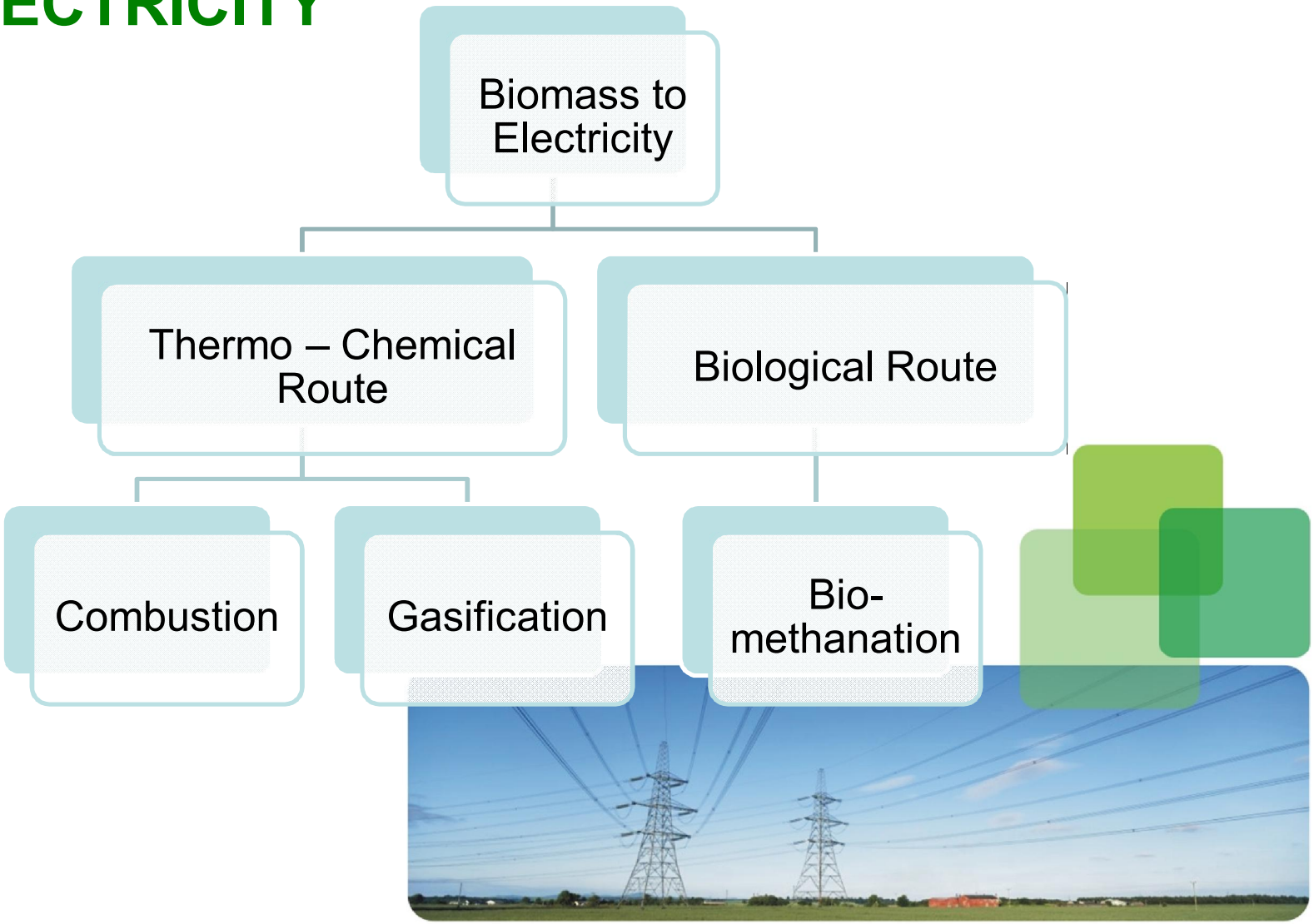

CONTENTS

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Gasification Vs. Combustion for Power - A Technical Comparison

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Parameter	Combustion	Gasification
Technology Status	Proven	Commercially Proven, Relatively new
Capacity installed in India	~ 2862 MW (incl. co-gen plants)	~ 140 MW
Scale of operation	Min 6 MW	Scalable from 100 kW upwards
Thermal Efficiency	20 – 23% (w/o co-gen) 75 – 80% (with co-gen)	30-35% (w/o waste heat recovery) 60% (with heat recovery)
Feedstock Adaptability	Can accept biomass / coal / both Certain biomass (agri wastes with alkali content) can cause coating of tubes. Reduces PLF	Designs for coal and biomass are different. Biomass gasifiers can accept all biomass Low density agri wastes have to be briquetted. Alkali content in biomass has no effect on PLF
By-products	Nil	Charcoal / Activated Carbon, VAM Chilling from waste heat
Emissions	Yes	Particulate – Negligible, Others – within permissible limits
Water consumption	5 – 6 ltrs/kWh	~ 1.5 ltr / kWh
Capital costs / MW	INR 4.6 – 5.6 Cr	INR 8.5 – 9.0 Cr

GASIFICATION Vs. COMBUSTION

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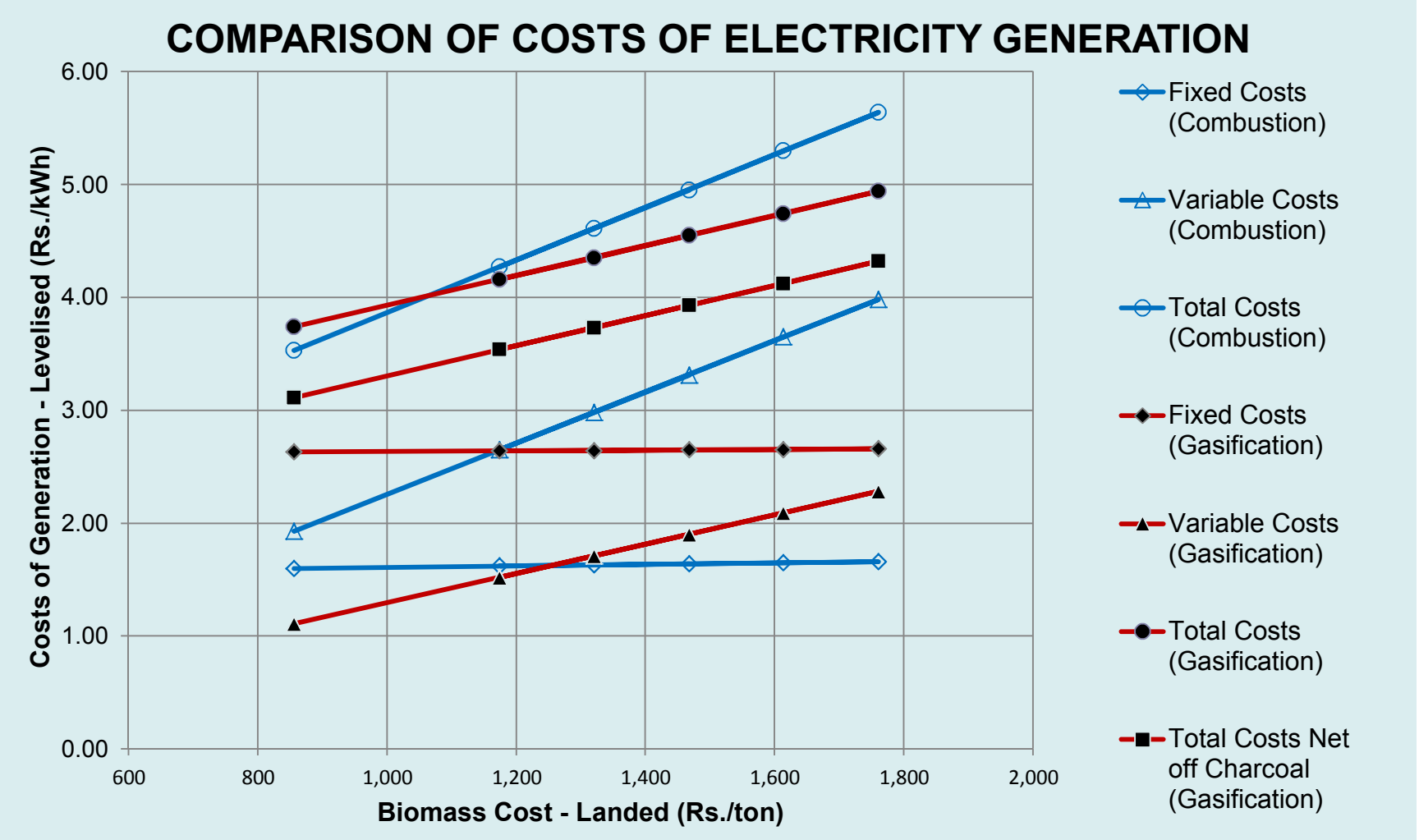

TO BE NOTED

The reduced variable costs with gasification more than compensates for the higher fixed costs

WHY GASIFICATION?

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⇒ Competitiveness
- ⇒ Although "capital costs" are higher with gasification, the total cost of generation is lower
  - ⇒ Higher thermal efficiency leads to lower biomass costs
  - ⇒ The incremental capital costs of Rs. 3.5 Cr/MW is offset through savings in Biomass costs
- ⇒ Increasing cost of biomass makes gasification even more competitive

⇒ Multiple revenues
- ⇒ Charcoal / activated carbon as by products
- ⇒ Waste heat can also be used for revenue generation

⇒ Lower environmental footprint
- ⇒ Negligible emissions
- ⇒ Lower water consumption
- ⇒ Contributes to building a good relationship with local community

⇒ Scalability
- ⇒ Capacity can be increased in small steps to match biomass availability

These factors lead to the selection of gasification technology

CONTENTS

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OPTIONS FOR BIOMASS GASIFICATION TECHNOLOGY IN INDIA

TECHNOLOGY PROVIDERS & TYPE

- Indian Institute of Science – Downdraft, open top
- Ankur Scientific – Downdraft, closed top
- TERI – Downdraft, closed top
- Grain Processing – Updraft

WHY IISc TECHNOLOGY?

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⇒ Feedstock flexibility

⇒ Can work with any biomass after suitable preparation such as cutting, drying & briquetting

⇒ Gas Quality (Critical for health of engine)

⇒ Proven to deliver producer gas with least tar & particulate matter (measured to be as low as 4 ppm)

⇒ Various design features to reduce tar & particulate production

⇒ An efficient cooling and cleaning system to remove the tar & particulate matter produced

⇒ Proven in commercial environments

⇒ More than 70 installations for electricity generation & about 30 installations for thermal applications (in India and abroad)

⇒ More than 20 installations generating more than 100 kW electricity

⇒ Technology licensed to 9 parties in India and abroad

⇒ Enjoys confidence of engine manufacturers

⇒ Cummins and GE Jenbacher offer their gas engines with commercial warranties when integrated with IISc technology gasifiers

CONTENTS

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TECHNOLOGY CONFIGURATION FOR ALLGREEN'S PLANTS

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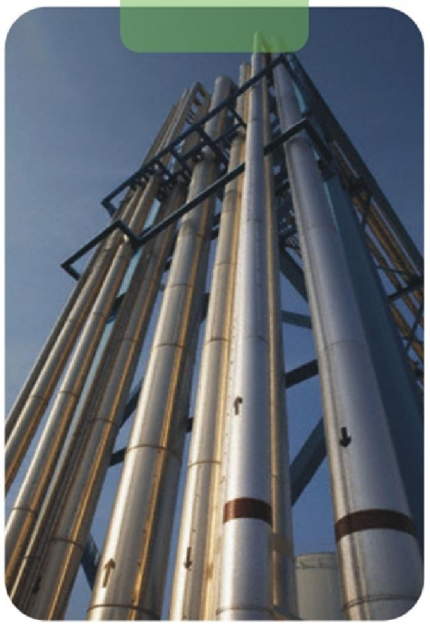
- Grid Synchronized Plant
- Combined cycle configuration comprising of:
  - 3 lines of "gasifier – gas engine" each line generating 1.95 MW
  - Bottoming cycle plant generating 0.55 MW
    - Uses waste heat from engine exhaust
    - Steam generated from waste heat in a Waste Heat Recovery Boiler
    - Steam expanded in a turbine to generate electricity
  - Total generation capacity (3 X 1.85+0.55 = 6.4 MW)
- VAM Chillers using engine jacket heat for generating chilling capacity for Process Chilling & cold storage
- Provision for setting up cold storage
- Provision for adding activated carbon plant



PROCESS FLOW FOR 6.5 MW BIGCC POWER PLANT, ACTIVATED CARBON PLANT & COLD STORAGE

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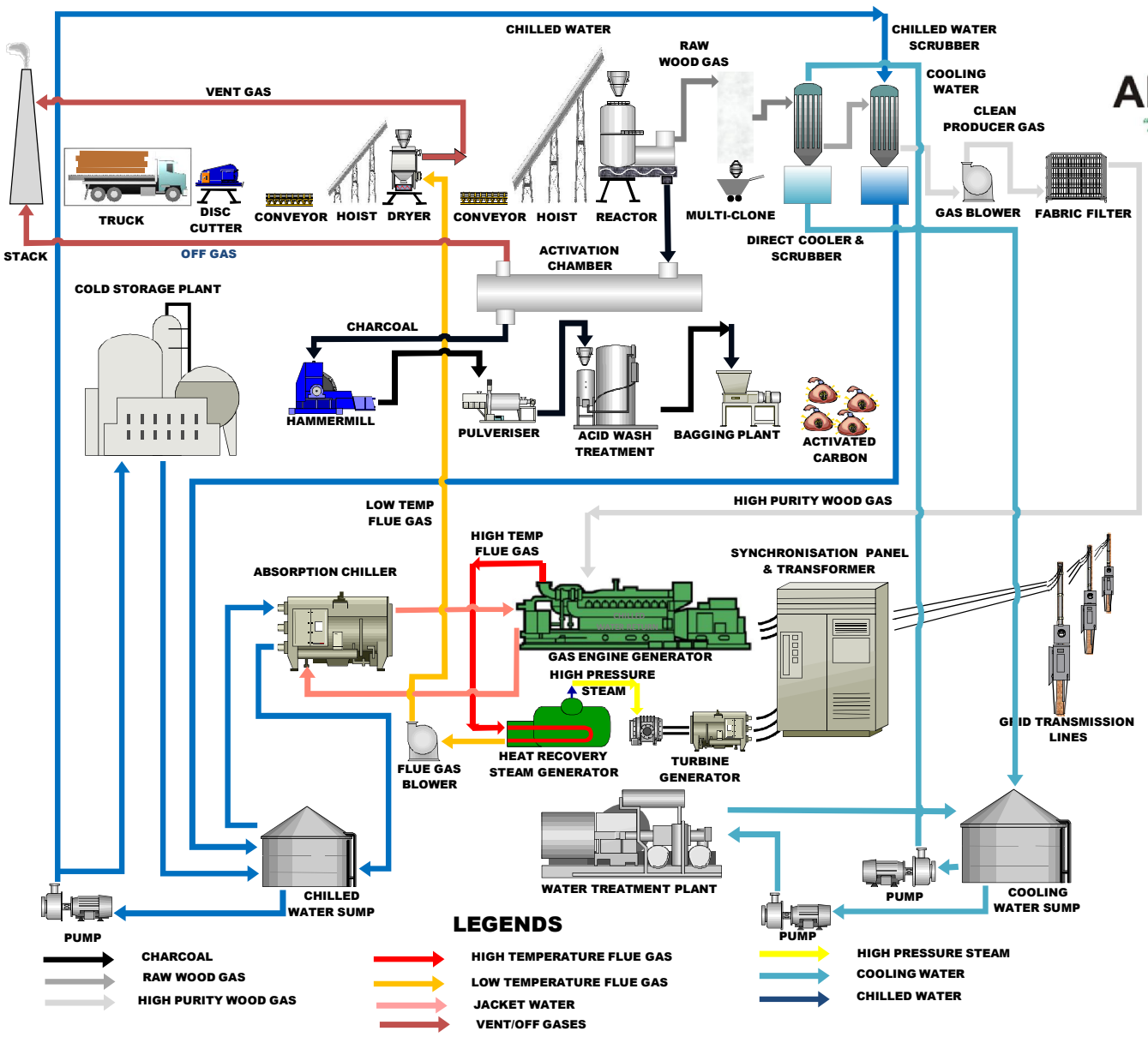

CONTENTS

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Plant Capacity : **6.4 MW**

Location : **SIPCOT, Perundurai, Erode Distrct, TN**

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Total Project Cost : **Rs. 60.25 Cr**

Power Generation

Particulars	Million Units
a) Gross Units generated	46.08
b) Net Exportable	39.90
c) Auxiliary Consumption	6.18 (13.41%)
d) Plant Load Factor	82%
e) Billed Electricity (after transmission losses)	37.26

CER Generation - 33,917 pa

Charcoal Generation : 3375 MT/annum

Wood	5 %
Agri Residues	10 %

Operational Parameters

Biomass Mix

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Biomass	Cal Value as received (kCals/kg)	Proportion	Quantity (tons/ annum)
Coconut Fronds	2999	20%	8,079
Cane Trash	3057	50%	19,813
Wood	3300	30%	11,012

Station Heat Rate - 2587 kCal/kWh

Water Consumption - 220 cu.m/day

Profitability Analysis (Levelised)

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Revenue Particulars	Rs. / kWh
Power (Rs./kWh)	7.66
REC (Rs./kWh)	1.62
Charcoal (Rs. /kWh)	0.50
Total Levellized Revenue	**9.78**

Cost Particulars	Rs. / kWh
Biomass Cost	3.39
O&M Engine Cost	1.08
O&M Gasifier Cost	0.14
Other O&M Costs (including Briquetting, Water, Charcoal Bagging & Admin)	1.48
Depreciation	0.90
Interest	1.05
Total Levellized Costs	**8.03**

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Question / Clarifications

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THANK YOU