

Distributed Power Solutions

Lower Mekong Clean Energy Business Dialogue

Manila

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Imagination at work



Power & Water diverse solutions

>40,000 employees 700 locations







Overview

GE's distributed power solutions provide businesses and communities the ability to generate reliable and efficient power anywhere, anytime—whether on or off the grid.

Our products cover power generation, compression and mechanical and heat recovery applications from 120 KW - 100 MW, featuring fast, flexible and reliable aeroderivative gas turbines and gas engines fueled by liquid and gaseous fuels* with efficiencies up to 95 percent.

Key Segment Served

Power Producers

- IPP's, Utilities
- Grid stability, fast start

Commercial, Institutional and Municipal

- Hospitals, Universities, District Heating
- Combined heat and power, grid synchronization

Industrial Manufacturers

- Pulp & Paper, Chemicals, Automotive, Food & Beverage
- Cogeneration, process heat

Oil & Gas

- Exploration, Production, Midstream, Transmission
- Transient response, durable

*Natural gas, biofuels, landfill gas, coal mine gas, special gases









GE's Distributed Power Business



The broadest gas-fired portfolio ... 100 kW to 100 MW



Biomass outlook



Substantial economic growth continues ... Developing regions growing at >5%



Energy deficit concerns ... Multiple technologies for power generation



Diesel to power... requires fit in solution replacement Abandoned availability of biomass ... potential segment



Global pressure to reduce carbon foot print Force action ... including technology incentives

Biomass availability & power Demand - ASEAN





GE's Gasification Experience

- •1961 ... First oil gasification plant
- •1978 ... First coal gasification plant
- •1984 ... First pet coke gasification plant
- •30 gas turbines operating on syngas > 1+ million operating hours
- •3 GW with GE technologies

Successful commercial operation of worlds largest IGCC at Duke, in Indiana 618 MW net

GE's Jenbacher gas engines special gases experience

- 150+ MWe installed
- 2+ Million oph experience with
 - Woodgas
 50+ units sold/delivered to 10 countries
 5 units AUT, 4 units CH,
 - 15 units UK, 2 units Japan
 - Steelgas
 - Waste gasification
 - Coke oven gas
 - Landfill gases

GE's Jenbacher gas engines is a leader in special gas applications

Integrated Biomass Gasification Solutions



- Integrated biomassto-power solution that produces expected 0.2-2MW output
- ✓ Flexible to be configured for power or combined heat & power (CHP) application



Benefits

- Over 2 Million operating hours experience with special gas engines
- Reduced emissions, higher availability compared to conventional biomass to power solutions

Features

- Integrated solution with wrap guarantee
- Gasifier modules, fuel preparation, and feedstock processing
- High operating range

Ideal biomass to power solution for small to medium scale industries (>10 MW requirement)

Biomass Gasification Value Chain



Case example of biomass power plant

Typical biomass gasification project <9MW



Typical cost structure



Project economics (1MW solution)*

Total installed cost :		\$ 4 millions
Specific fuel consumption	•	1 kg/Kwh
Evaluation Period :		5 years
Fuel cost + O&M:		\$0.06/Kwh
Electricity output :	0.9 1	MW
Capital cost (70% financir	ng):	\$0.62 /kWh
Typical cost avoidance:	~\$0.0	05+ /kWh
Typical feed-in-tariff bene	fit	~\$0.025 /kWh
ROE:	17%+	

Project Scope



- Biomass in power out as overall scope of the product, effluent treatment in GE's scope
- Two train X 900 kg/hr gasifier reference plant design ready with 2 X J420 Engine ~2 MW



Using Grass As A Greener Source of Energy



Clean Cycle heat to power generator



Benefits

- One unit generates 50-140kW of electricity from a heat source
- Heat is the only input; **no additional fuel** required **or emissions** generated
- Low maintenance: magnetic bearing generator, no lubricants, no overhauls
- Called an ORC because it utilizes the **Organic Rankine Cycle** to generate power from heat



How the Clean Cycle works

Clean Cycle[™] technology is based on the Organic Rankine Cycle (ORC), which utilizes an organic working fluid with a lower boiling point than water to generate electrical power from heat

> The cycle is closed loop – there is no combustion and no emissions





Benefits of 100kW of fuel free power



Reliable electricity

Electrical output is grid quality, at a power factor of 1, and often at a capacity factor that exceeds 90%



Savings or revenue

Electricity can be sold to the grid or used on-site to offset local consumption



No added fuel

Heat is the only input required for the Clean Cycle unit to generate electricity ≻ One unit avoids 196,000 liters of diesel / year*



No added emissions

The energy conversion process is closed loop and involves no combustion > Carbon savings from diesel offset = 143,000kg/yr



Proven performance

Requires no major overhauls, no lubricants, and produces electricity at a power factor of 1



Summary

- "One GE Solution" for various configuration based on rich experienced and proven technology
- Higher engine efficiency, complete plant performance solution according to specifications, integration expertise and strong service support
- Grow fuel envelope and different scale options to continue biomass gasification technology development



