

Biogas Development Potential in ASEAN

Clean Energy Expo, Singapore, 2010

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Electric Power Asia Pacific

Caterpillar Asia Pte Ltd



CAT Asia & Dealer Network

One powerful future.

Over 1/2 of the World's Population !

EPAP Regions
 North Asia
 South Asia
 South East Asia
 Australia, New Zealand
 & Pacific Islands

Singapore HQ
 Caterpillar
 ASEAN Headquarter &
 SEA Parts and Services
 Distribution Center



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South East Asia (ASEAN)

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Opportunities

- Improving Economies and Standard of Living
 - Large agro-based countries with positive GDP
- Lagging Utilities
 - Electricity: demand >> supply
 - Demonopolization of power generation
- Stimulating Incentives
 - Feed-in tariff plus adder in many countries
 - Global carbon trade
- Increasing Production Capacity and Environmental Control
 - Growing environmental awareness, enforcement and government incentives (including carbon credit)



South East Asia Country Statistics

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ASEAN Statistics, Emissions Limits and Feed In Tariff for Small (<10 MW) Gas Gensets or Power Plants

Category	Country	Cambodia	Indonesia	Laos	Malaysia	Philippines	Singapore	Thailand	Vietnam
General	USD Exchange Rate	4174	9158	8151	3.26	46.0	1.39	32.3	18785
	Population (M)	15	243	7	26	100	5	66	90
	GDP (2009%)	-1	5	6	-3	1	-2	-3	5

Emissions Regulation	Fuel		NG	BG/LFG	NG	BG/LFG	NG	BG/LFG	NG	BG/LFG	NG	BG/LFG	NG	BG/LFG	NG	BG/LFG	NG	BG/LFG
	NO _x	ppmv	NA	NA	244	244	NA	NA	293	293	244	244	341	341	120	200	415	415
	SO _x	ppmv	NA	NA	245	245	NA	NA			70	70	175	175	20	60	175	175
	UHC	ppmv	NA	NA			NA	NA										
	Particulates	mg/Nm ³	NA	NA	150	150	NA	NA	80	80	150	150	100	100	60	120	200	200
	O ₂	%	NA	NA	5	5	NA	NA	5	5	5	5	5	5	7	7	5	5

Electricity Tariff	Type	Rate	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell	Buy	Sell
	Wholesale _{max}	Local\$/kWH	748	750	395	NA	835	NA	0.348	0.350	12.000	10.000	0.258	NA	2.570	2.928	1714	NA
	Wholesale _{min}		598	750	154	NA	599	NA	0.266	0.280	10.000	8.000	0.258	NA	1.059	1.115	483	NA
	Fuel Transfer	Local\$/kWH														0.926		
	Adder	Local\$/kWH														0.300		
	Max Total Industrial	Local\$/kWH	748	750	395	0.000	835	0.000	0.348	0.350	12.000	10.000	0.258	0.000	2.570	4.153	1714	0.000
	USD/kWH	0.179	0.180	0.043	0.000	0.102	0.000	0.107	0.107	0.261	0.217	0.185	0.000	0.080	0.129	0.091	0.000	

**Population
GDP
Electricity Tariff**

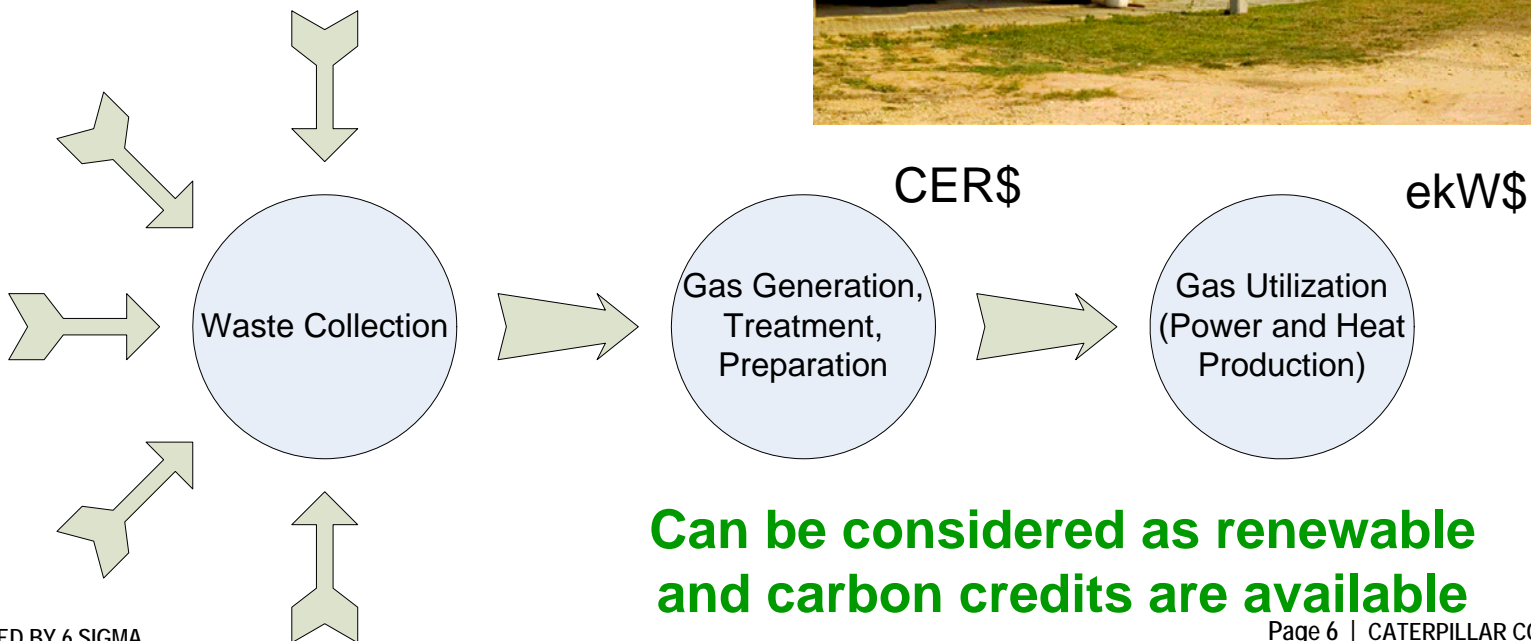
Emissions Level



Biogas Applications

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- **Agricultural waste/wastewater**
- **Animal waste/wastewater**
- **Industrial waste/wastewater**
- **Landfill (MSW and industrial)**
- **Domestic wastewater (sewage)**



Can be considered as renewable and carbon credits are available

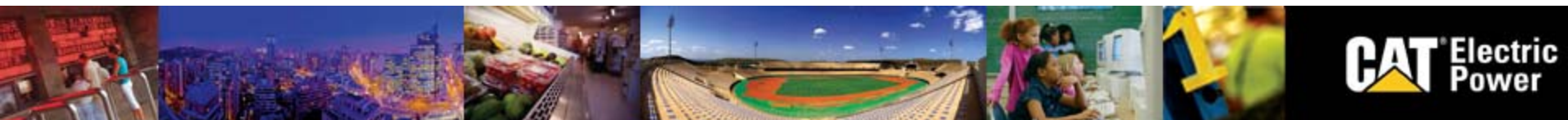
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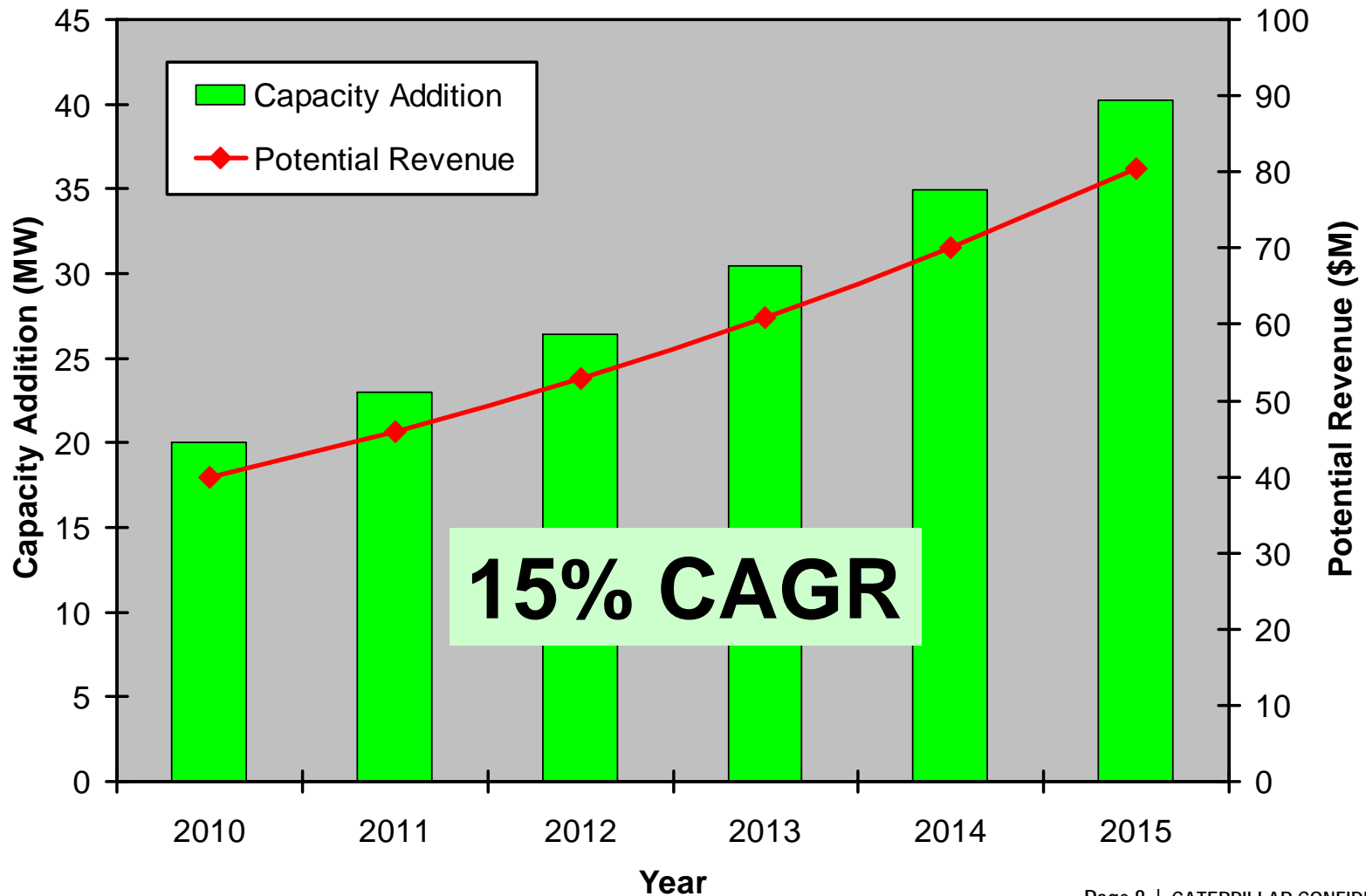


Biogas Project Potential

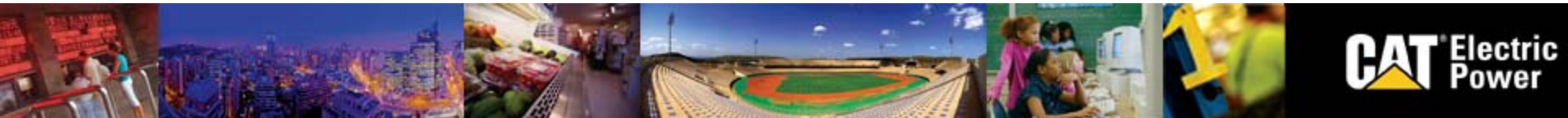
Country	Agro Wastewater	Livestock Wastewater	Landfill Gas
Thailand	Excellent	Excellent	Excellent
Malaysia	Excellent	Good	Good
Indonesia	Excellent	Good	Good
Vietnam	Good	Excellent	Excellent
Philippines	Good	Excellent	Excellent



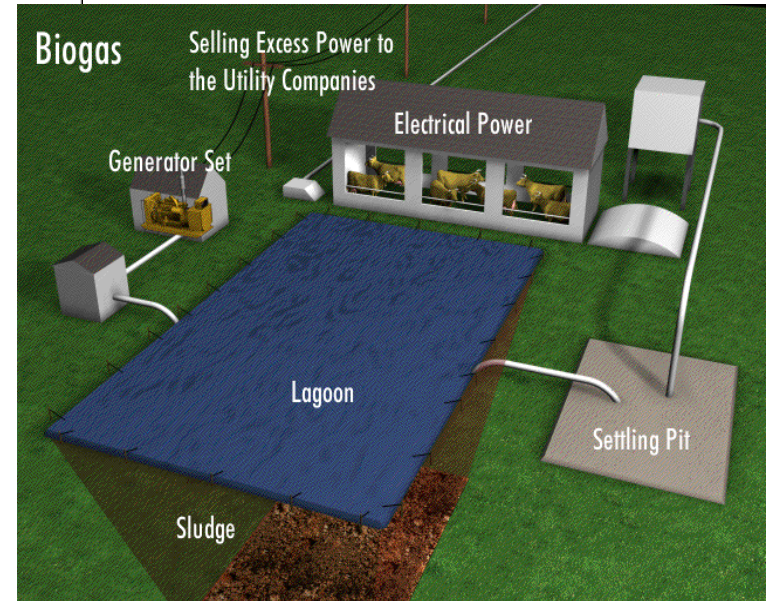
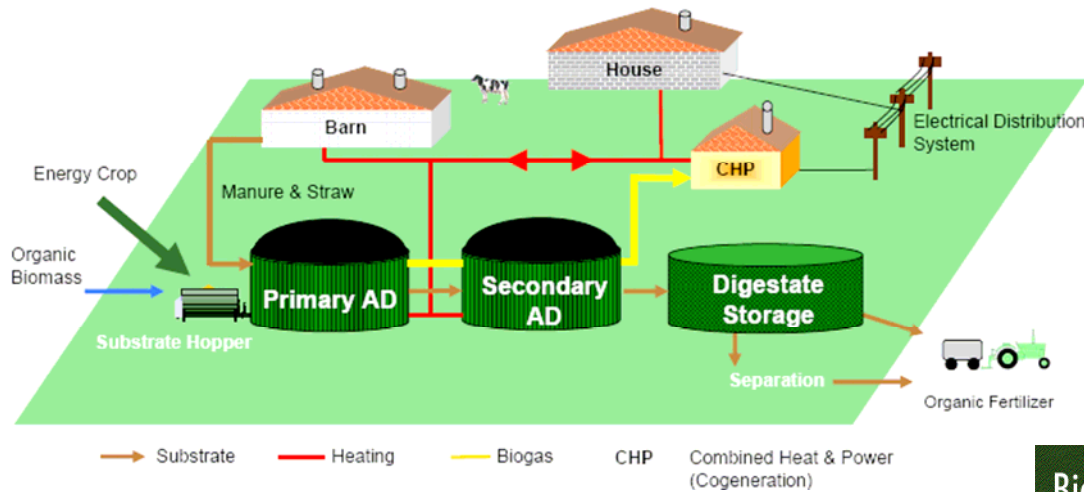
SEA Market Potential Forecast



15% CAGR



Typical Biogas Plant



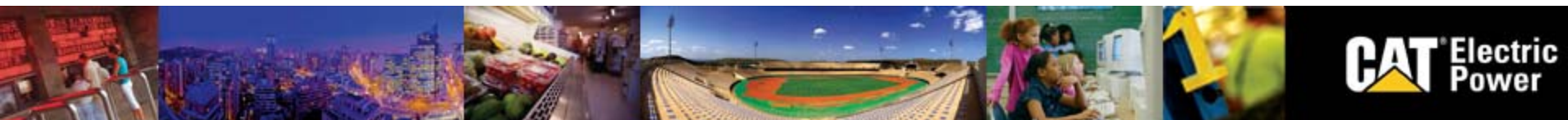
Key Components

- Waste Collection System
- Bioreactor and Conversion System
- Gas Treatment System
- Gas Generator and Electrical System

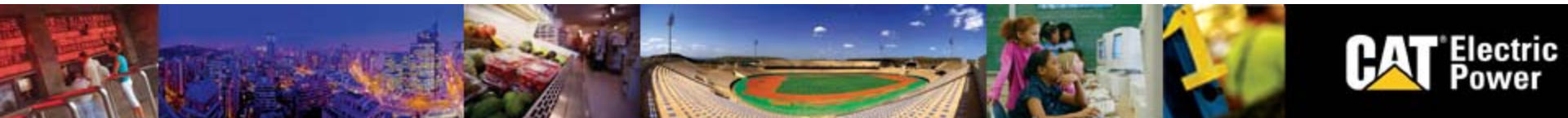


Market Requirements

- Uptime (ekW and CER Revenue/Savings)
 - Robust and tough products
 - Reliable products and services
 - Availability of parts and services
- Performance
 - High efficiency
 - Emissions compliant
- Life Cycle
 - Acceptable O&M expenditures



- Power Purchase Agreements with Utilities
 - Price, duration, interconnection requirements, transparency
- CDM Registration
 - Cost, complexity, delays (maturity)



Hardened Biogas Platforms

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G3306
64-75
ekW



G3406
103-137
ekW



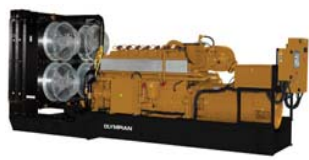
G3412
164-191
ekW



GEPG450
360
ekW



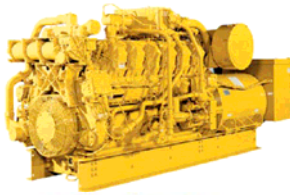
GEPG620
496
ekW



G3508
458
ekW



G3512
770
ekW



G3516
815-1600
ekW



G3520
1600-1966
ekW



Special Features

- Able to achieve high annual operating hours
- Able to run on low heating value fuels
- Able to handle corrosive gases

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