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Energy Efficiency: Equipment, Process and System Development

能源效率：设备，工艺和系统的发展

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Agenda

- New Development of Gas Turbine Technology燃气轮机新技术开发
- New Application of CHP热电联供新技术应用
- Projects Introduction 案例介绍

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New Development of Gas Turbine Technology

燃气轮机新技术开发

Mar, 2012, China

New Development of Gas Turbine Technology燃气轮机新技术开发

- **Low NOx combustion system, ultra low NOx level (15 ppm to 3-5 ppm) 低Nox燃烧系统，超低排放**
- **Continuous development of high efficiency 持续向高效率发展**
- **Wide range fuel development 向更加宽广燃料发展**
  - **From NG to COG, Landfill gas (medium Btu) 从天然气向焦炉煤气，沼气（中热值）延伸**
  - **To burn low Btu synthesis gas in small GT 在小型燃机内烧低热值合成气**

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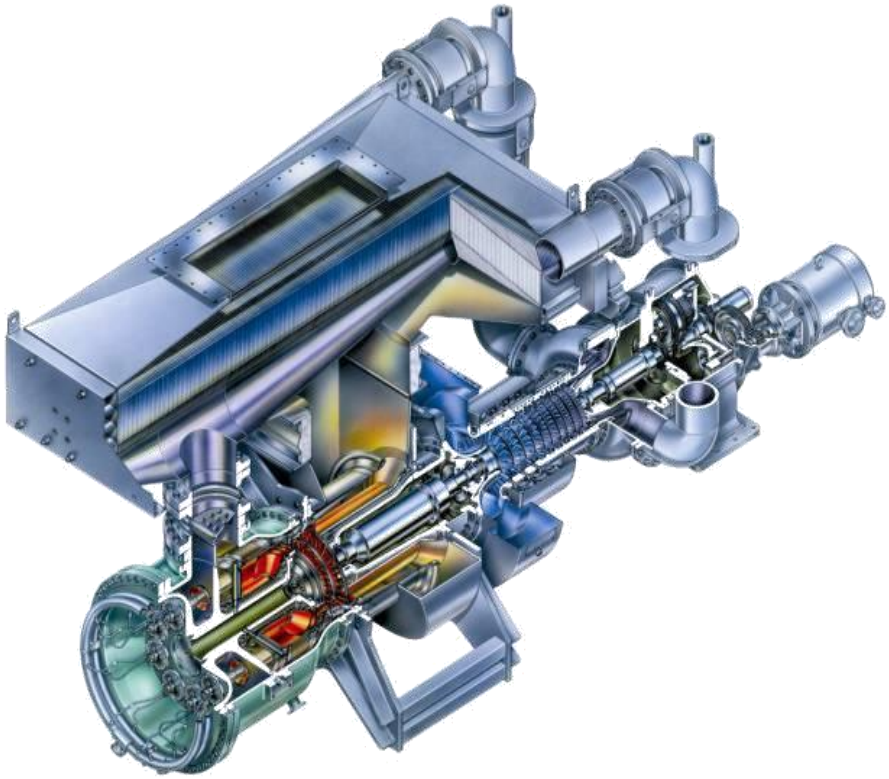
Mercury 50 advanced gas turbine system

- 4600 kW Output
- 38.5% Efficiency
- 5 ppm NOx
- 10 ppm CO
- Exhaust Temperature 365°C



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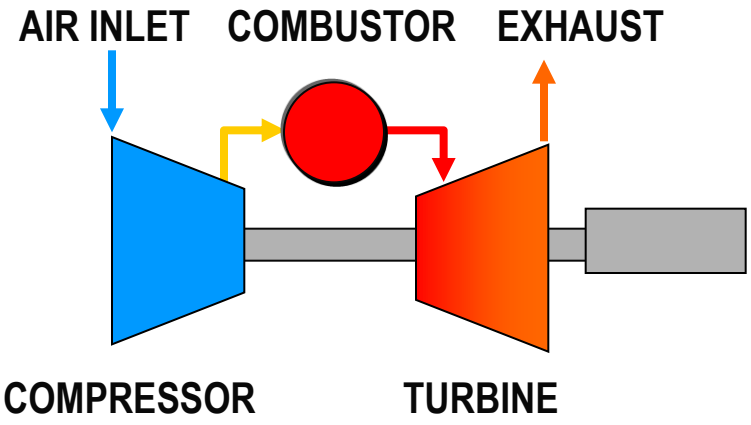
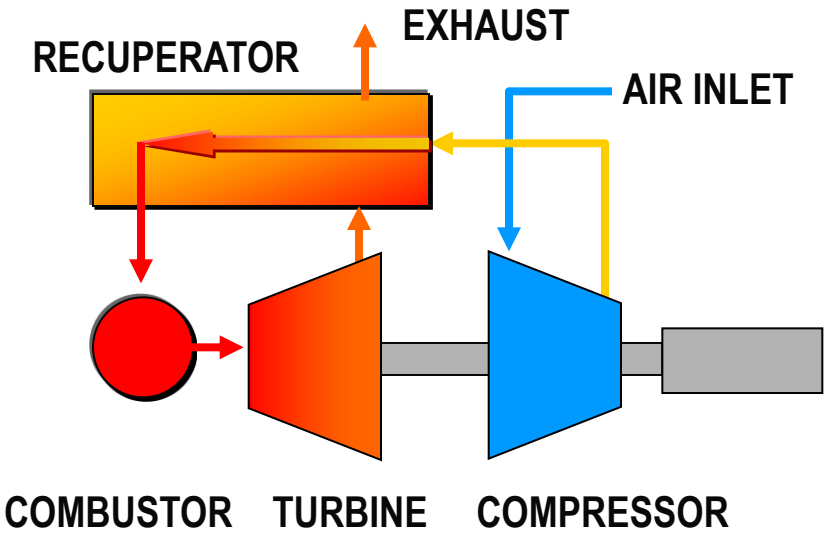
RECUPERATED CYCLE OBJECTIVES

Simple Cycle简单循环



- Increase Pressure Ratio
- Increase Firing Temperature
- Reduce Cooling Flow

Recuperated Cycle – Mercury 50
水星50回热器循环

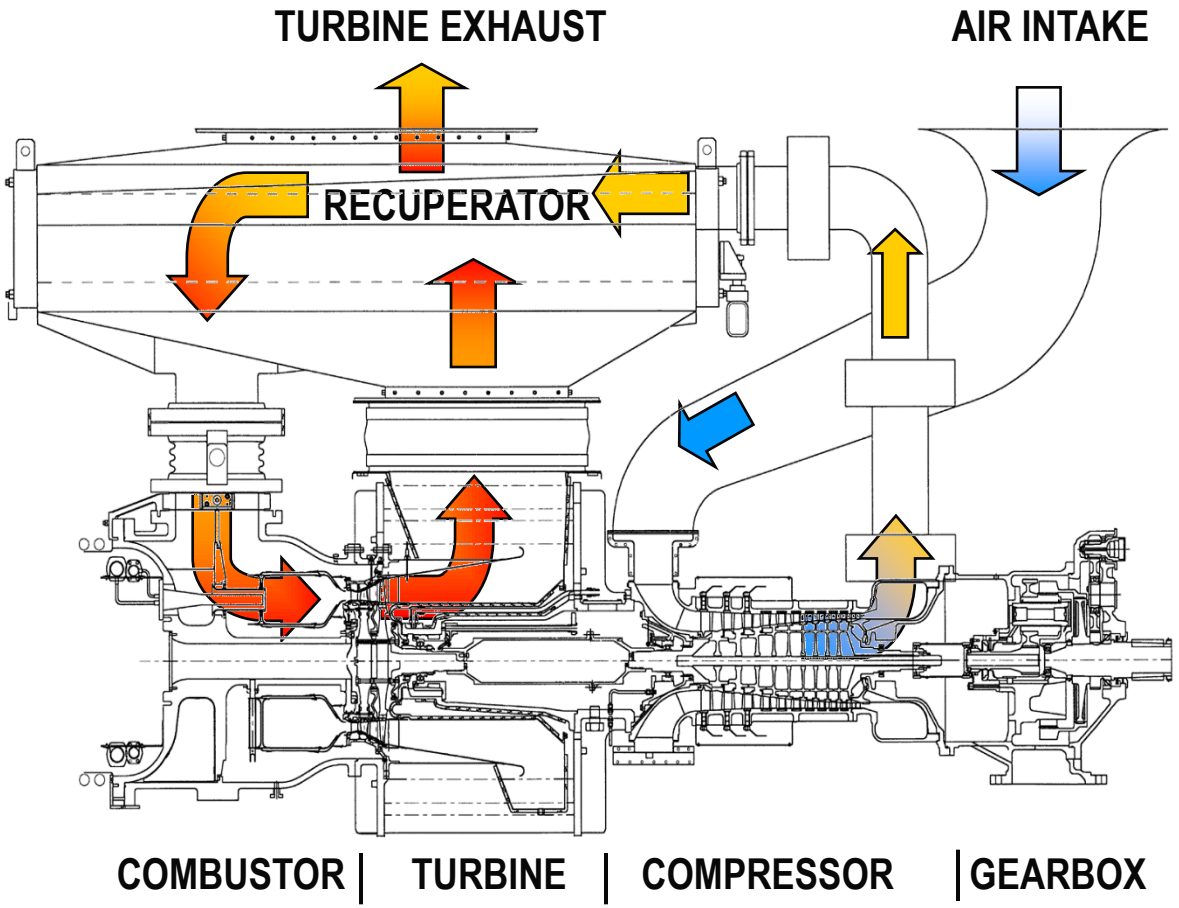


- High Efficiency Components
- Improved Thermal Efficiency
- Lower Emissions

Caterpillar:
Confidential Green

ADVANCED GAS TURBINE MERCURY 50 FLOW PATH
水星50先进燃机流程

Turbine Configuration Optimized for Recuperated Cycle



Fuels Defined气体燃料定义

Wobbe Index华白指数

$$WI = \frac{LHV}{\sqrt{SG}}$$

LHV = Lower Heating Value

SG = Specific Gravity

US Pipeline Natural Gas Ranges管道天然气范围 Gas Processors Association (1998) 天然气协会1998				
	Btu/scf		MJ/Nm ^{3}	
	Minimum	Maximum	Minimum	Maximum
Higher Heating Value	950	1150	35.4	42.9
Lower Heating Value	856	1040	31.9	38.8
Wobbe Index	1085	1296	40.5	48.3

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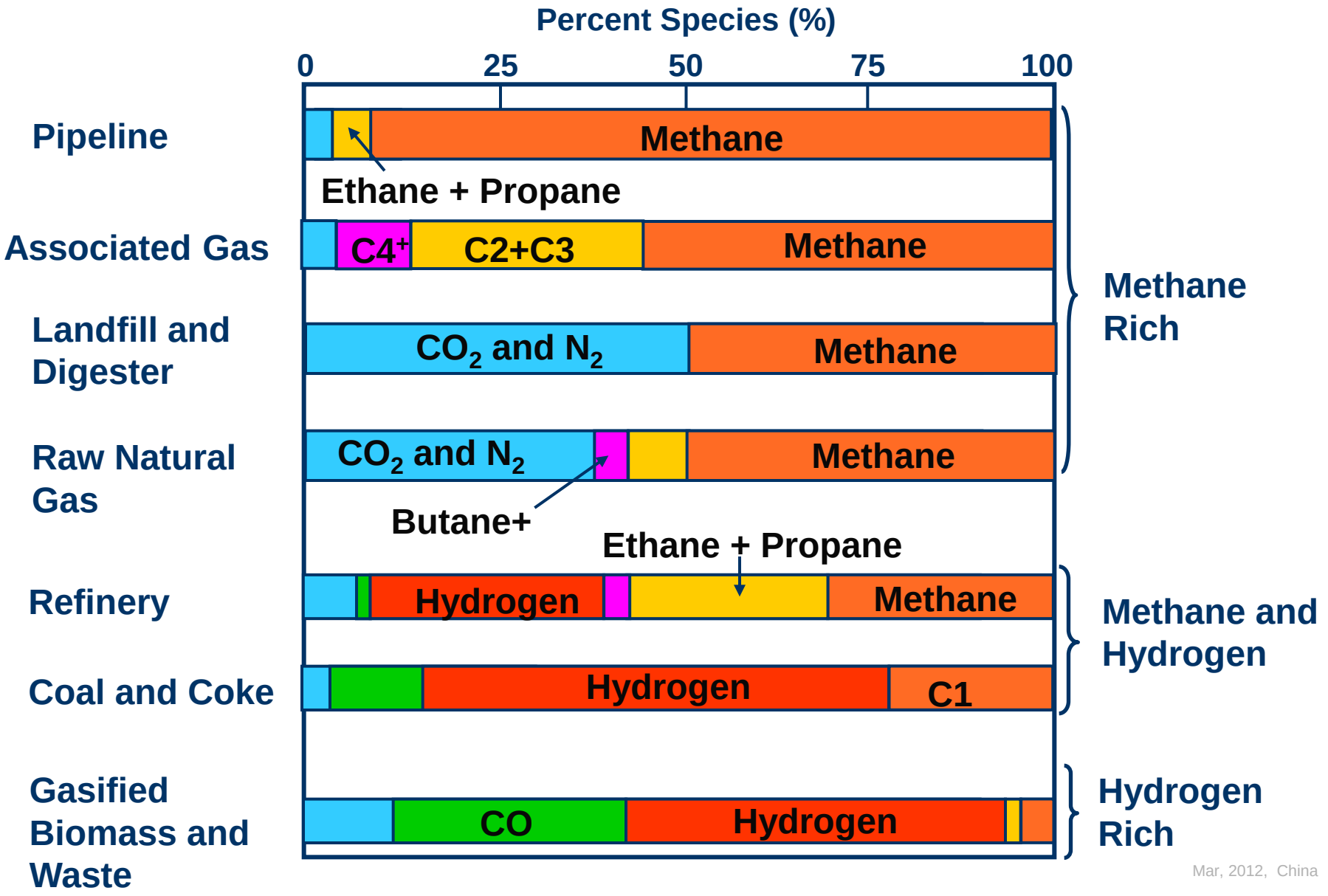
Low and Medium Btu Fuels中低热值燃料



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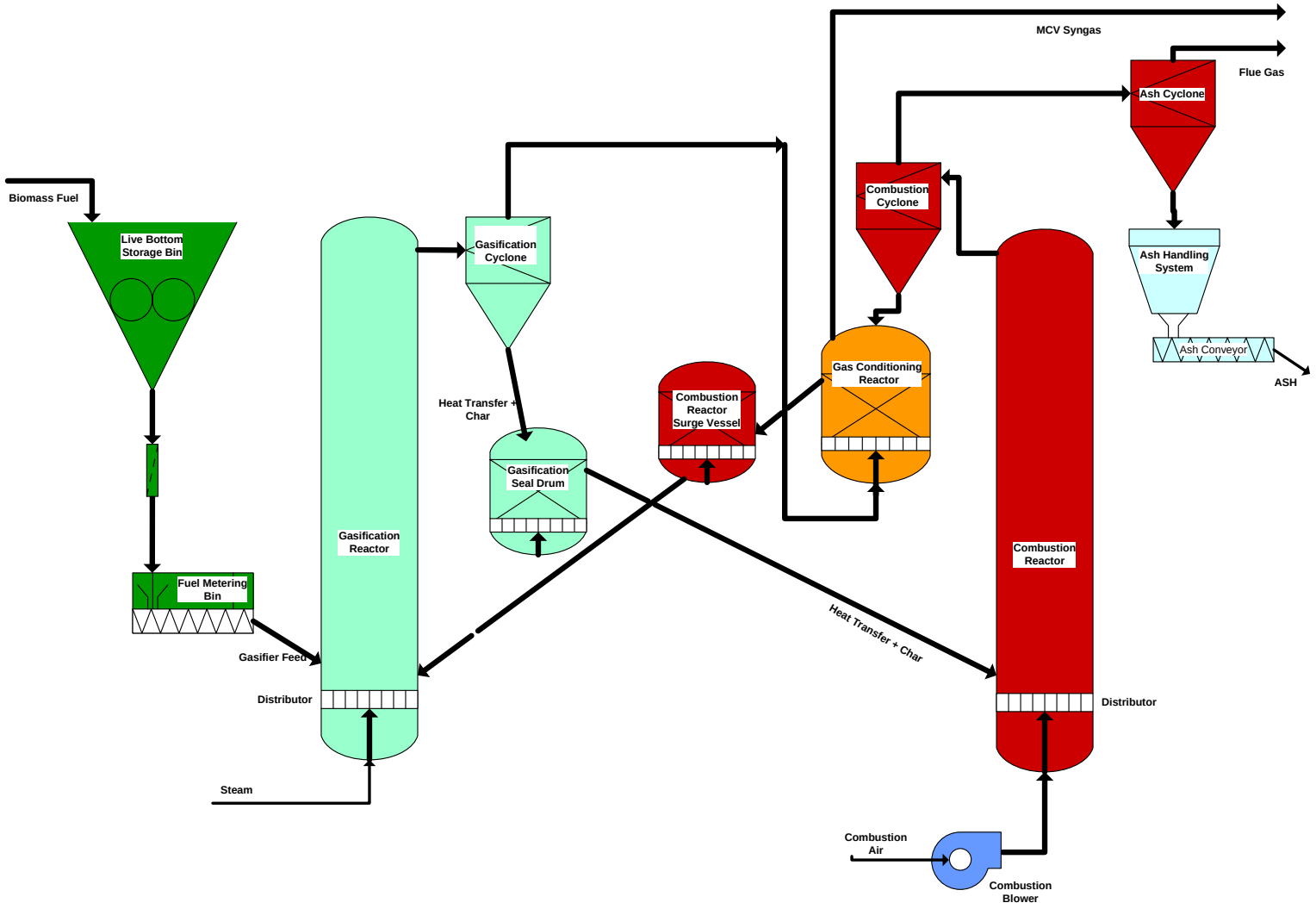
Steam Fluidized Gasifier Produces MBTU Syngas



Typical Biomass Gas 典型生物质燃气组份

Fuel Wobbe Index: 430 LHV 334.71 Btu/scf

H2	47%
CH4	12.17%
C2H4	2.56%
C2H6	0.07%
N2	0.68%
CO	17.38%
CO2	20.03%
H2O	0.11%

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Plasma Gasification for Difficult Waste

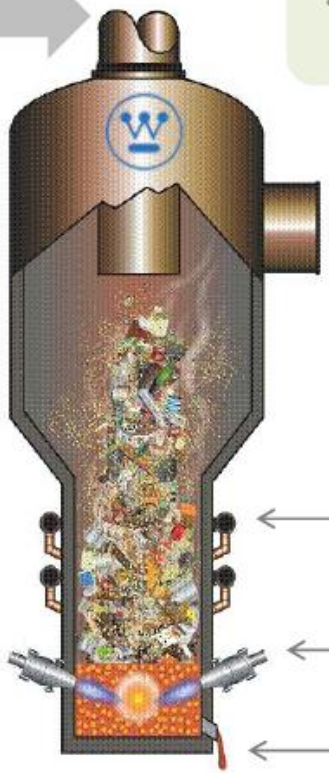
ALTERNRG

WHAT IS PLASMA GASIFICATION?

WASTE
COAL
BIOMASS
PETCOKE

FEED HANDLING

- Gasification is not incineration
- Gasification creates Hydrogen and Carbon Monoxide: An energy rich gas stream



GAS COOLING → GAS CLEAN-UP → SYNGAS

- The facility exports 80% of the energy input to Syngas
- Plasma torches use 2% to 5% of the energy input

POWER
ETHANOL
DIESEL
HYDROGEN
STEAM

WIDE VARIETY OF FEEDSTOCKS
LOW $ COST

→ FLEXIBLE PROCESS
GASIFIER

→ WIDE VARIETY OF PRODUCTS
HIGH $ VALUE

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Typical Synthesis Gas 燃气组份, 热值Btu/scf

		热值 231.64 WI 263	热值213.16 WI231.56	热值219.94 WIB244.54
HYDROGEN	31.3200	25.9600	29.0100
METHANE	1.3700	1.4500	1.4500
ETHYLENE	0.0300	0.0300	0.0300
ETHANE	0.1500	0.2000	0.1500
NITROGEN	8.7389	11.3387	10.5589
CARBON MONOXIDE	40.6500	38.9900	38.7500
CARBON DIOXIDE	17.4600	21.7500	19.7700
HYDROGEN SULFIDE	0.0011	0.0013	0.0011
WATER	0.2800	0.2800	0.2800
TOTAL	100.00	100.00	100.00

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New Application of CHP

燃气轮机热电联供新应用

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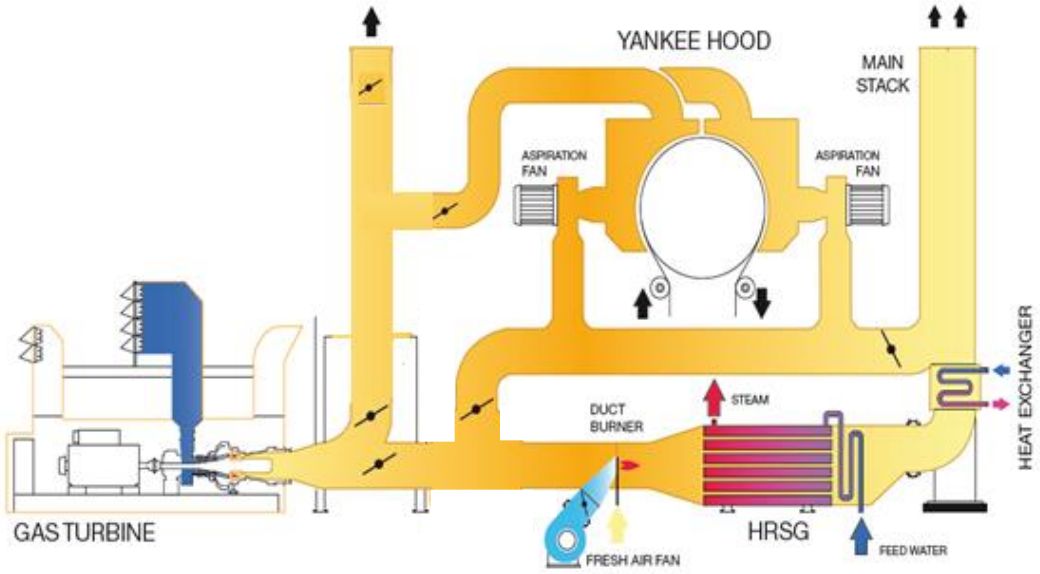
直接干燥工艺应用



- **Clean exhausts** for clean **end-product.** 洁净尾气用于洁净终端产品
- **Part of Process** 嵌入到工艺中
- **Significant increase** of the Plant **energy efficiency over 15%.** 大幅度提高工厂能效**15%**以上
- **Operation flexibility** covering **all** user **operation modes.** 应用灵活覆盖所有运行模式
- **More precise temperature regulation** at user. 更加精确的温度控制
- Potential **increase in production** 还可以提高产能

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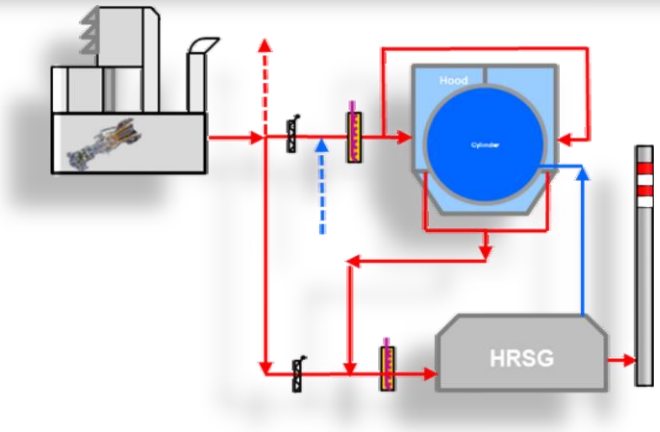
案例介绍

Italy Example

- 1 x Taurus 70
- New Cogenerative Air system to Yankee Hood: Yankee Hood burners are now OFF.
- Replaced combined cycle



Savings: 15-20% in Energy costs

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英国某城市垃圾气化发电

等离子气化装置，日处理900吨城市生活垃圾和淤泥（1期工程）

配置2XT130(2X15MW)燃气轮机联合循环

启动燃料为天然气，主燃料为合成气，合成气的热值大约2000-2200大卡。

垃圾气化发电特点

比起直接焚烧方式，同样的垃圾量可以多发电大约24%以上

二噁英分解率达到99.77%，几乎完全解决了二噁英的排放问题，解决了民众担心的问题

相对于直燃技术，固体排放物再减少30%

解决了直燃工艺中飞灰问题，节约了了巨大的飞灰处理费

无机物部分最终变成发泡玻璃体，是很好的建筑隔热材料

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G65等离子反应炉

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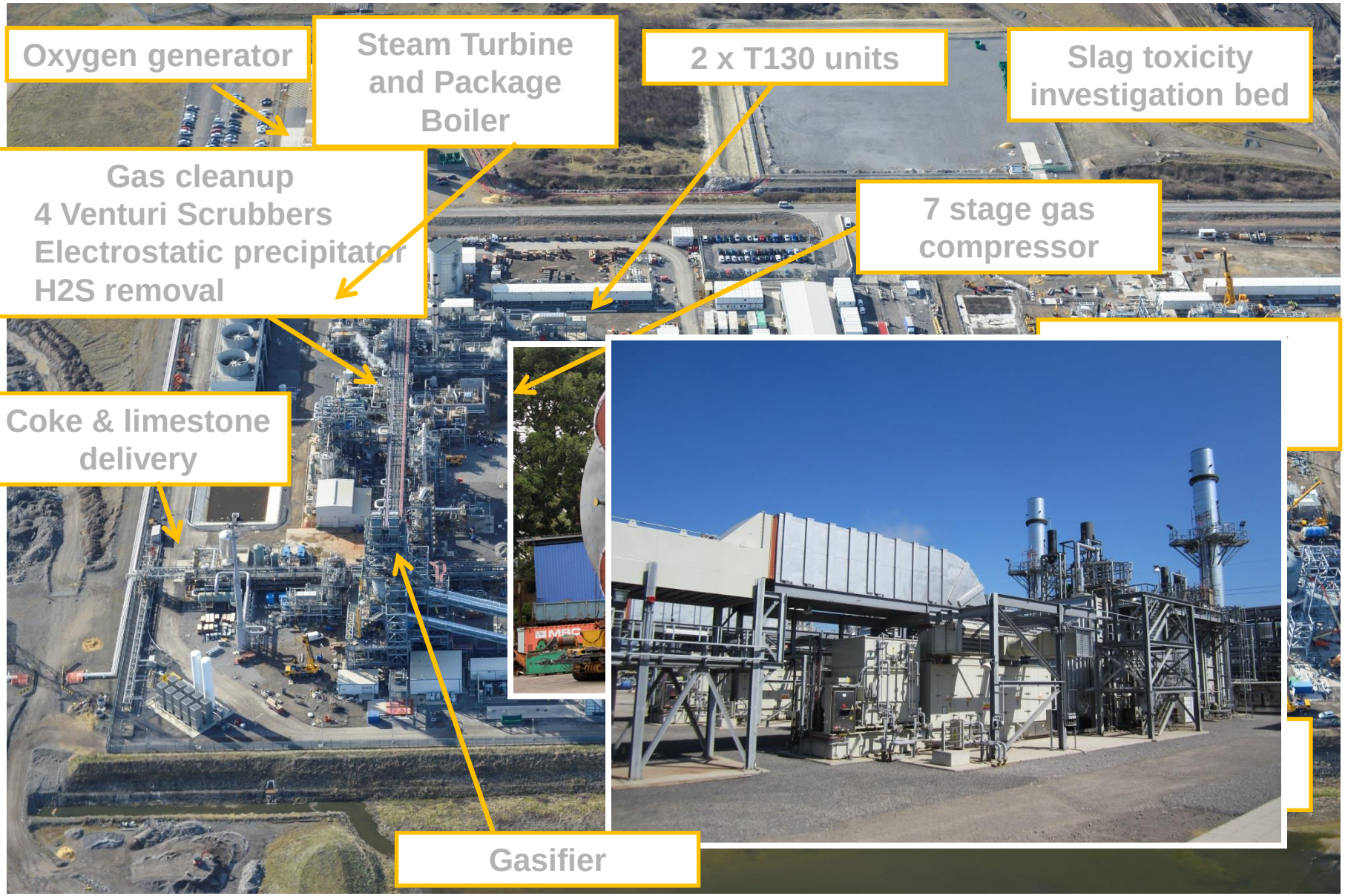
Site View



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谢谢!

Thank You!