

ENERGY TODAY AND TOMORROW A SUPPLIER'S VIEW

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WARTSILA NORTH AMERICA, INC.

PRESENTED TO CIBO ANNUAL MEETING
FT. LAUDERDALE, FLORIDA
OCTOBER 13, 2011

TOPICS TODAY

- **Brief Introduction to Wartsila**
- **Longer Segment on Modern Reciprocating Engine/Generator Technology**
- **European View of Benefits of CHP**
- **Case Studies and Quick Examples, mostly Photographs**

About Wärtsilä

*176 years of
experience*

Power PLANTs



Ship power



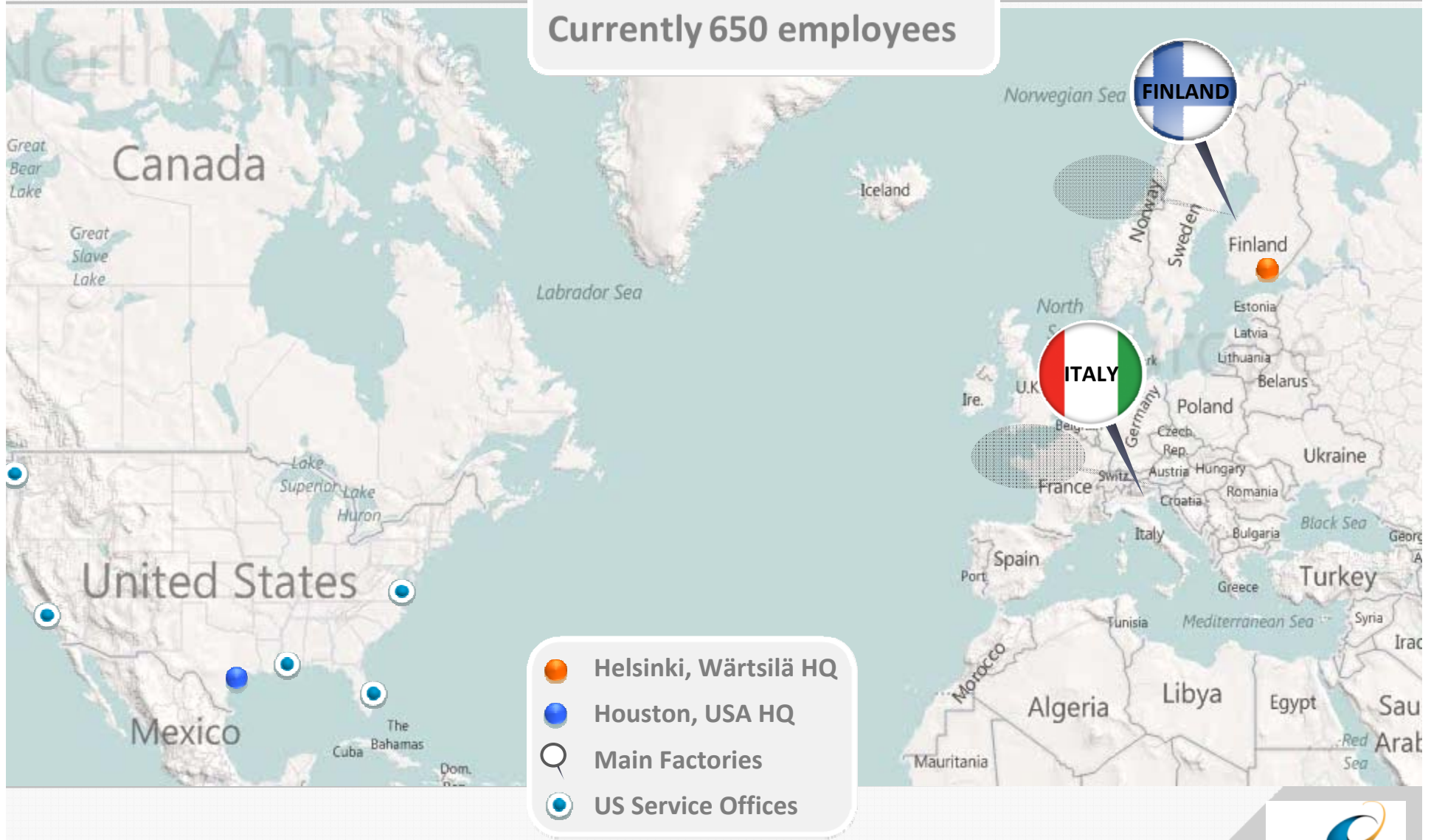
Services



- **\$7.1 billion sales in 2009**
- **17,000 employees in 70 countries**
- **Headquartered in Helsinki, Finland**
- **49,000 MWs Land Power + 120,000 MWs Ship Power**
- **Wärtsilä North America since 1979 (650 employees)**

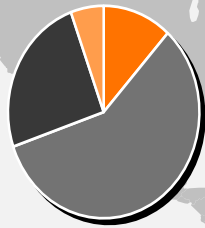
About Wärtsilä

Wärtsilä NA since 1979.
Currently 650 employees



Power Plant Installed Base

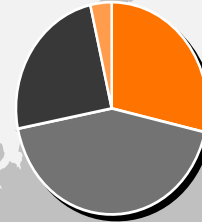
1,700 MW
Installed in the US



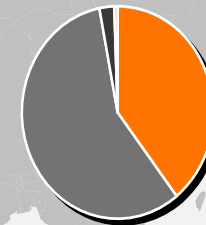
Americas
Output: 9,289 MW
Plants: 362
Engines: 1207

- Flexible baseload
- Grid stability & peaking
- Industrial self-generation
- Oil & gas

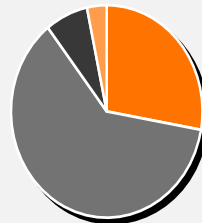
Total Output:
47,400 MW
Plants: **4,563**
Engines: **10,014**
Countries: **168**



Europe
Output: 11,330 MW
Plants: 1771
Engines: 3284



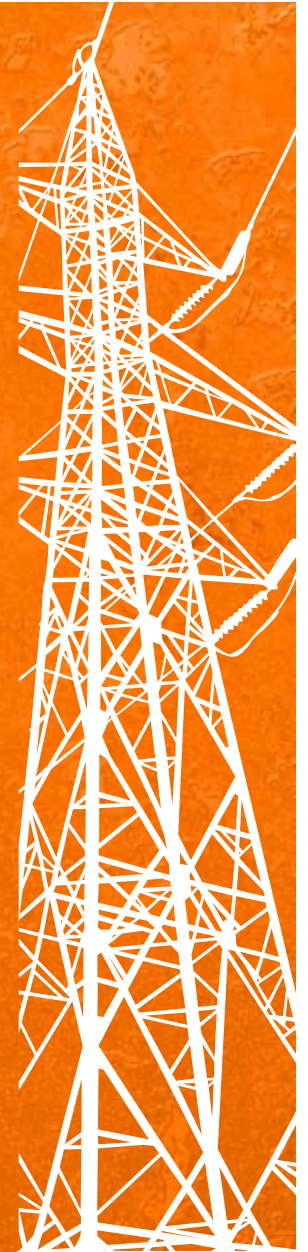
Asia
Output: 16,830 MW
Plants: 1608
Engines: 3456



Africa & Middle East
Output: 9,951 MW
Plants: 822
Engines: 2067

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MODERN RECIPROCATING ENGINE/GENERATOR TECHNOLOGY



Modern gas engine

	34SG	50SG
Gross output MWe	9.30	18.70
Heat Rate* (Btu/kWh) LHV / HHV	7796 / 8520	7376 / 8114
Speed	720 rpm	514 rpm
Weight (Ton)	145	403

* *Gross at generator terminals (0% tolerance) at ISO 3046 conditions*

Best simple cycle efficiency

The **best simple cycle efficiency** available in the market at **>46%**. Typical **net** plant heat rate of **8400** Btu/kWh HHV at **95 °F**

Our power plants achieve high efficiency in a **wide range of ambient conditions**

No start penalties & No start-up costs

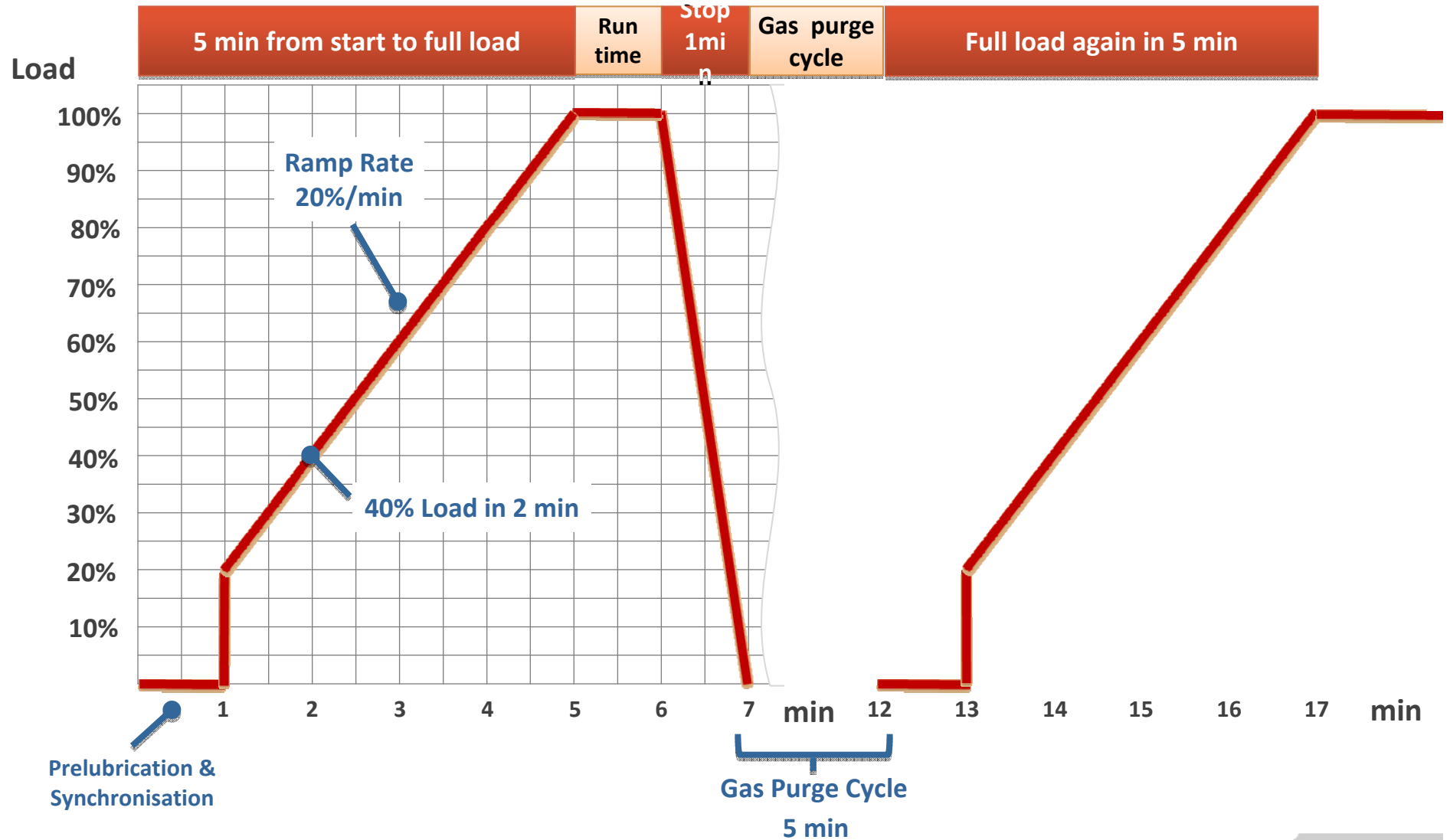
Unlimited starts & stops with **no impact** on cost or maintenance schedule.

This is unique, no other competing technology offers the same.

*Dispatcher's dream plant
Plains End 227 MW
Colorado*

Quick start/stop: 34SG

Applicable to the whole plant



Engines in HOT STANDBY mode, i.e. preheated (HT water temp. >70 °C)



Emissions

- » Nox - Nitrogen oxides: 5 ppm (0.064 g/kWh) (as NO₂)
(dry, at 15 vol-% O₂) - **with SCR**
- » CO - Carbon monoxide: 15 ppm (0.12 g/kWh)
(dry, at 15 vol-% O₂) - **with CO catalyst**
- » VOC 25 ppm (0.12 g/kWh)
(dry, at 15 vol-% O₂)
- » Particulates (total) (0.12 g/kWh)
(at 15 vol-% O₂)

Minimum water use

Wärtsilä' solutions minimize not only fuel but also water consumption thereby providing major environmental benefits. Our power plants use a **closed loop cooling system** that **requires minimum water**

Simple Cycle water consumption = **1 gal/engine/week**

Combined Cycle water consumption is **1/3 of GTCC Plant**

Low pressure gas

Wärtsilä power plants use **low pressure** natural gas (**75 psig**).
No need for aux. gas compressor
or high pressure gas line

Light industrial look to the plant

The design makes the project **look like a warehouse.** No visible smoke, fumes or steam release

Flexicycle: CC is just a CHP Application

100...500 MW **combined cycle**
power plant based on **18.7MW**
natural gas engine **18V50SG**

Simple cycle mode – for flexible power

- » 10 minutes to full load, 2 minutes to stop
- » **48.6%** plant efficiency
- » Unlimited starting and stopping

Combined cycle mode – for competitive base load power

- » **52.1%** plant efficiency
- » 35 minutes to full efficiency
- » Switch back to simple cycle
on the run

True electricity generation cost - USA

Wärtsilä Flexicycle

Configuration: **6 x 18V50DF**
Flexicycle **106 MW ***
Heat Rate (LHV/HHV) **7,139 / 7,916 ***

Dimensions	(feet)
Length	342
Width	105
Roof Height	52
Stack Height	95
Draught	13

*** Combined cycle output and performance at 95° F on natural gas
This configuration utilizes once-through cooling**

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European View of Benefits of CHP



Cogeneration a recognised and important EU instrument

- EU Cogeneration Directive
- EU Strategic Energy review 2008
- EU SET plan
- EU Energy Efficiency Action Plan 2006
- EU Directive on electricity production from Renewable energy Sources (RES)
- EU Performance of Buildings Directive

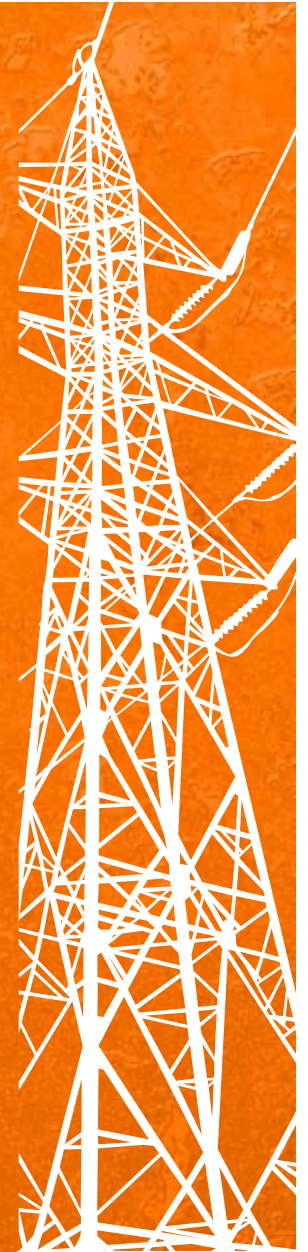
Targets for the Electricity Sector

1. Lower emissions
2. Lower costs
3. Higher reliability
4. Higher efficiency



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CHP Case Studies and quick examples, mostly Photographs

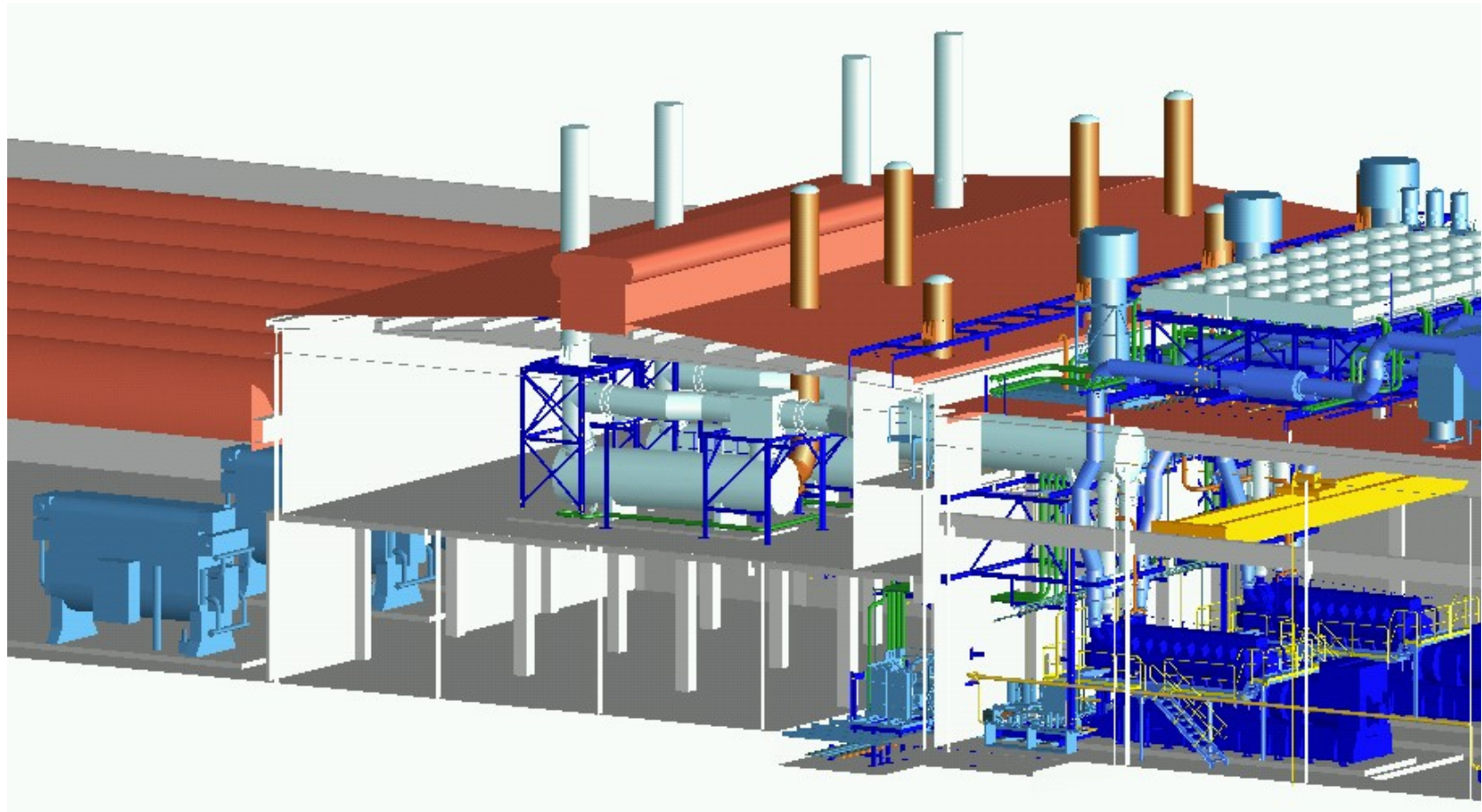


Trigeneration solutions

⋮
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Trigeneration solutions

Madrid airport multi fuel CHP plant



Broad chiller at Barajas airport



3300 kWc

4400 kWth

8,7 kWe

635 ton LiBr

28 ton working weight

CHP - Solo Cup

Case History Project Description:

- Off-taker is Solo Cup, Owings Mills, MD
- Utility is Baltimore Gas & Electric
- 2 X 18V34SG NG, Spark Ignition, Lean Burn Gensets -
5.76 MW Output Each
- 2 X 25,000 Lb/Hr Fired HRUs, 110 Psig Saturated Steam
- SCR for NOx control; Oxidation Catalyst for CO and VOCs

CHP - Solo Cup

Case History Project Description, continued:

Functional Guarantees at specific site conditions of 85 Deg. F, 60% RH and 485 FASL include:

Output - 5.76 MWs each genset

Heat Rate - Client requested confidentiality

Steam Output Each HRU, 110 psig with 212 Deg. F FW Temp.

Unfired - 7,200 Lb/Hr

Fired - 25,000 Lb/Hr Total for each HRU

CHP - Solo Cup

Case History Project Description, continued;

NO_x - 6 PPM following Genset and Fired HRU

CO - 80 PPM following Genset and Fired HRU

ACTUAL PERFORMANCE: All performance guarantees were met without modification to the original installation except for CO, which required HRU burner modification

CHP - Solo Cup

CHP, Greenhouse - Ringgold, PA

CHP, Greenhouse - Ringgold, PA

CHP, Processing Facility Example

CHP, a Processing Facility Example

ENERGY TODAY AND TOMORROW

CONTINUED PRESSURE FOR

- LOWER EMISSIONS
- BETTER EFFICIENCY – THEREFORE MORE CC AND CHP
- LOWER POWER PLANT WATER USAGE
- REPLACEMENT OF COAL WITH NATURAL GAS, AS LONG AS THE BELIEF CONTINUES THAT NG FUTURE IS \$5.00/MMBTU
- GRID STABILITY EQUIPMENT TO CORRECT FOR WIND AND SOLAR SINS - MUST BE ABLE TO GO FROM SHUTDOWN TO FULL PLANT OUTPUT IN LESS THAN 5 MINUTES, SEVERAL TIMES PER DAY

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Thank you for your attention

Dennis Finn

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