



# POWERING EVERYONE

GE's Distributed Power Customer Event 2016

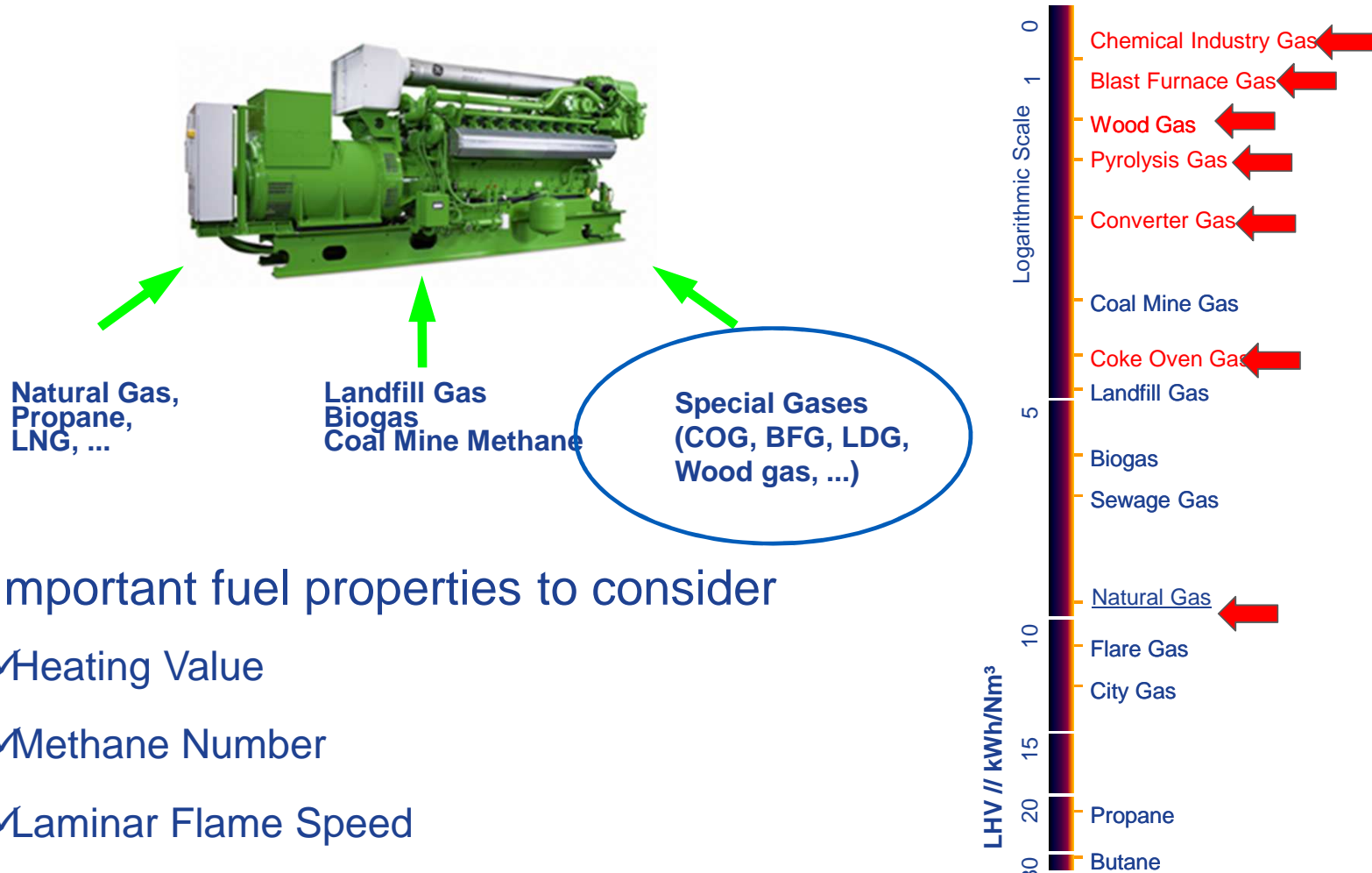




# Special gas utilization with gas engines

- Process gas utilization from Steel industry
- Gasification of Biomass or Waste
- Experiences and Lessons learned

# Fuel Flexibility with Jenbacher Engines



## Important fuel properties to consider

- ✓Heating Value
- ✓Methane Number
- ✓Laminar Flame Speed

# Gas Properties

## Heating Value

Calorific value and thermal value **indicate the energy content of a gas**. The former can be differentiated from the latter only through the heat of vaporization of the water resulting from combustion, the water is in liquid form after it has already liberated its condensation heat.

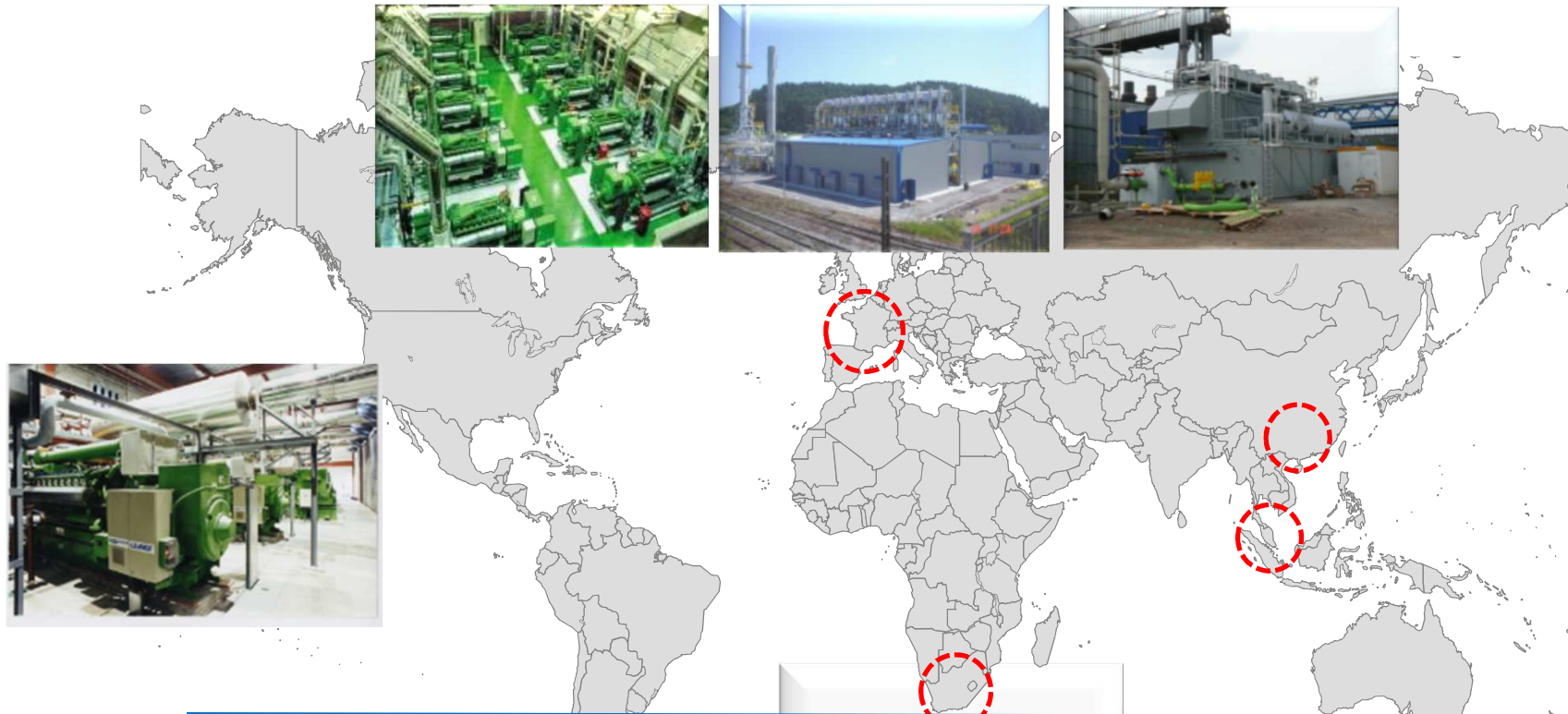
## Methane Number

**Determinant parameter for knocking resistance of a gas**. It is **comparable to the Octane Number** of gasoline and indicates the percentage methane volume ratio of a methane-hydrogen mixture which, in a test engine and under controlled conditions, indicates the same knocking resistance as the gas to be tested.

## Laminar Flame Speed

**Laminar flame speed is the speed at laminar front at which the oxidation takes place.**

# GEJ Steel Mill- and Ferro Alloy Gas References

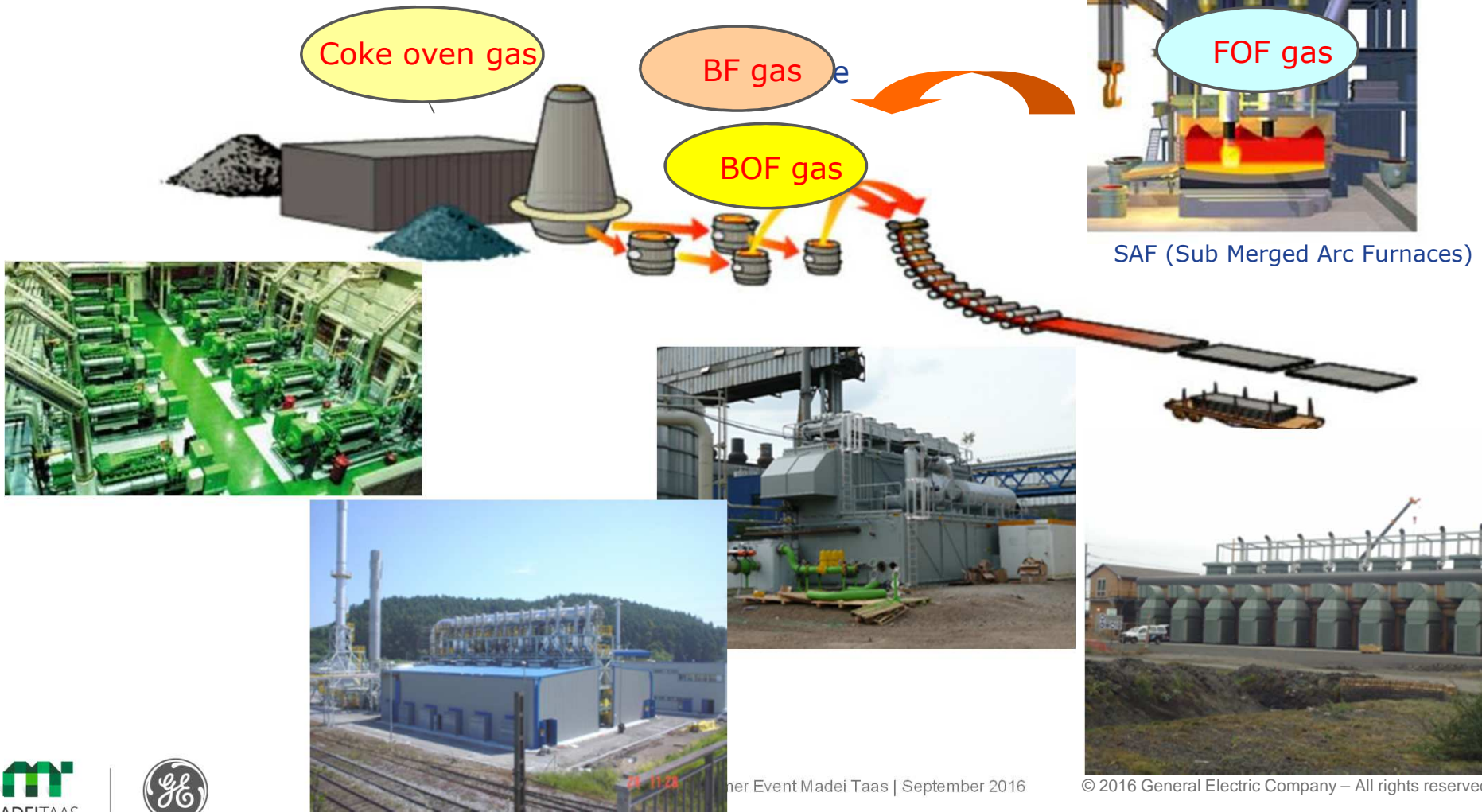


**...more than 80 MWe installed,  
more than 2 Mio oph experience**



## Integrated steel plant

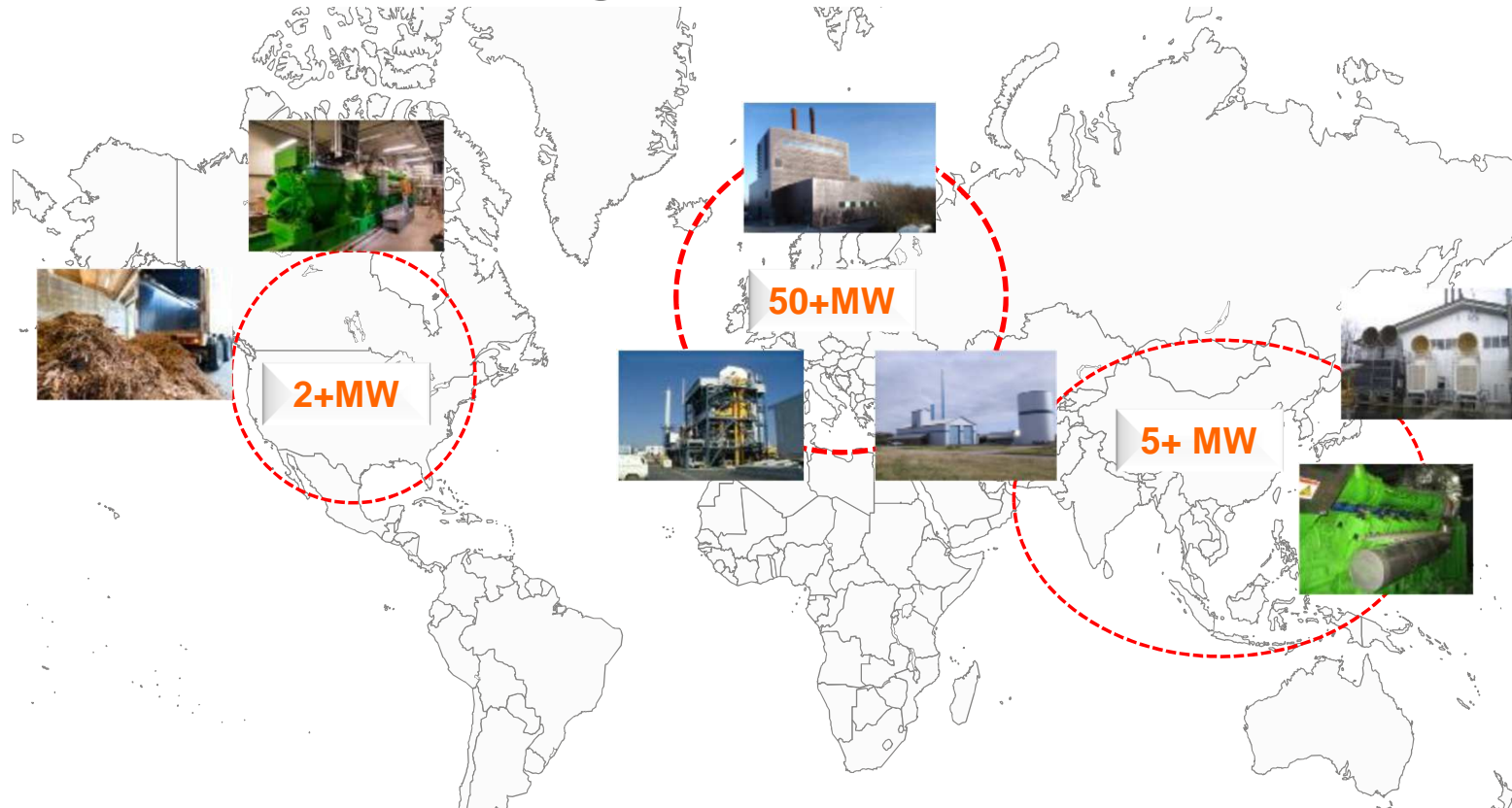
## Fe-Alloy Industry



Her Event Madei Taas | September 2016

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# B2E – Biomass gasification references



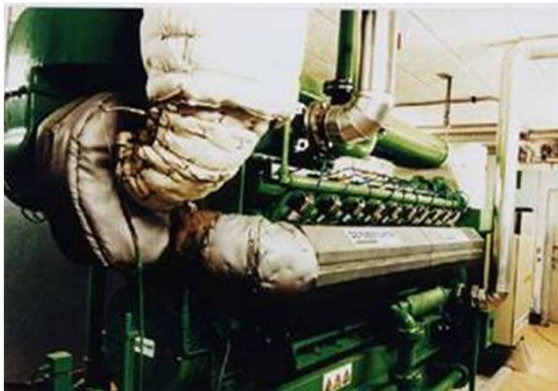
**...almost 60 MWe installed, ...majority in Europe  
more than 300k oph experience**

# Biomass Gasification Harboøre/Dk



Harboøre/Denmark  
2 x JMS 320 GS S.L

**Concept:**  
Fixed bed updraft  
from B&W Vølund



**2 x J320**  
**2 x 760 kWe**

wood gas:

H <sub>2</sub>	15 - 18%
CH <sub>4</sub>	3 - 5%
CO	25 - 28%
CO <sub>2</sub>	7 - 10%
N <sub>2</sub>	50 - 55%
LHV	6.8 MJ/Nm <sup>3</sup>

...more than 105,000 ophs (09/2012), ...increased output (bmep = 13bar) in



# Biomass Gasification Güssing/A



Concept:  
fluidized bed steam  
gasification



Wood chips: 8 MWth input

Wood gas:     $N_2$         3 %  
                   $CH_4$       10 %  
                   $CO_2$      23 %  
                   $H_2$         40 %  
                   $CO$         24 %  
LHV            10.5 MJ/Nm<sup>3</sup>

1 x J620

1 x 1.97(2.3) MWe

...more than 50,000 ophs (05/2012), ...commissioning 04/2002

Güssing/Austria

repotec  
renewable power technologies



1 x J620 1 x 2.3 MWe

Ulm/Germany

repotec  
renewable power technologies



2 x J620 2 x 2.1 MWe + 0.8MWe ORC

Villach/Austria

ORNER



2 x J620 2 x 1.97 MWe

Oberwart/Austria

ORNER



2 x J612 2 x 1.2 MWe + 0.4 MWe ORC

.....already 3 follow up projects from Güssing....

# Biomass gasification Molla/Spain



Wood chips: N<sub>2</sub> 48 %  
CH<sub>4</sub> 6 %  
CO<sub>2</sub> 16 %  
H<sub>2</sub> 12 %  
CO 15 %  
LHV 5 MJ/Nm<sup>3</sup>

**2 x J320**  
**2 x 765 kWe**

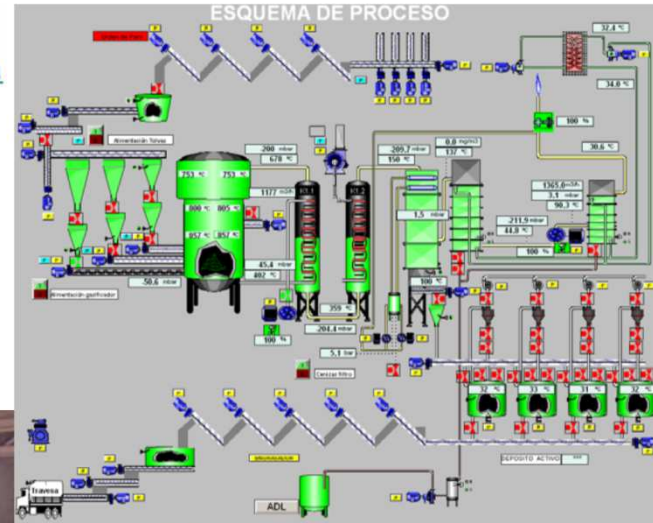
**2 x J320**  
**2 x ~825 kWe**



... ~10,000 ophs (09/2012), ...commissioning 2010



# Biomass Gasification Movialsa/Spain



Biomass from olive  
production

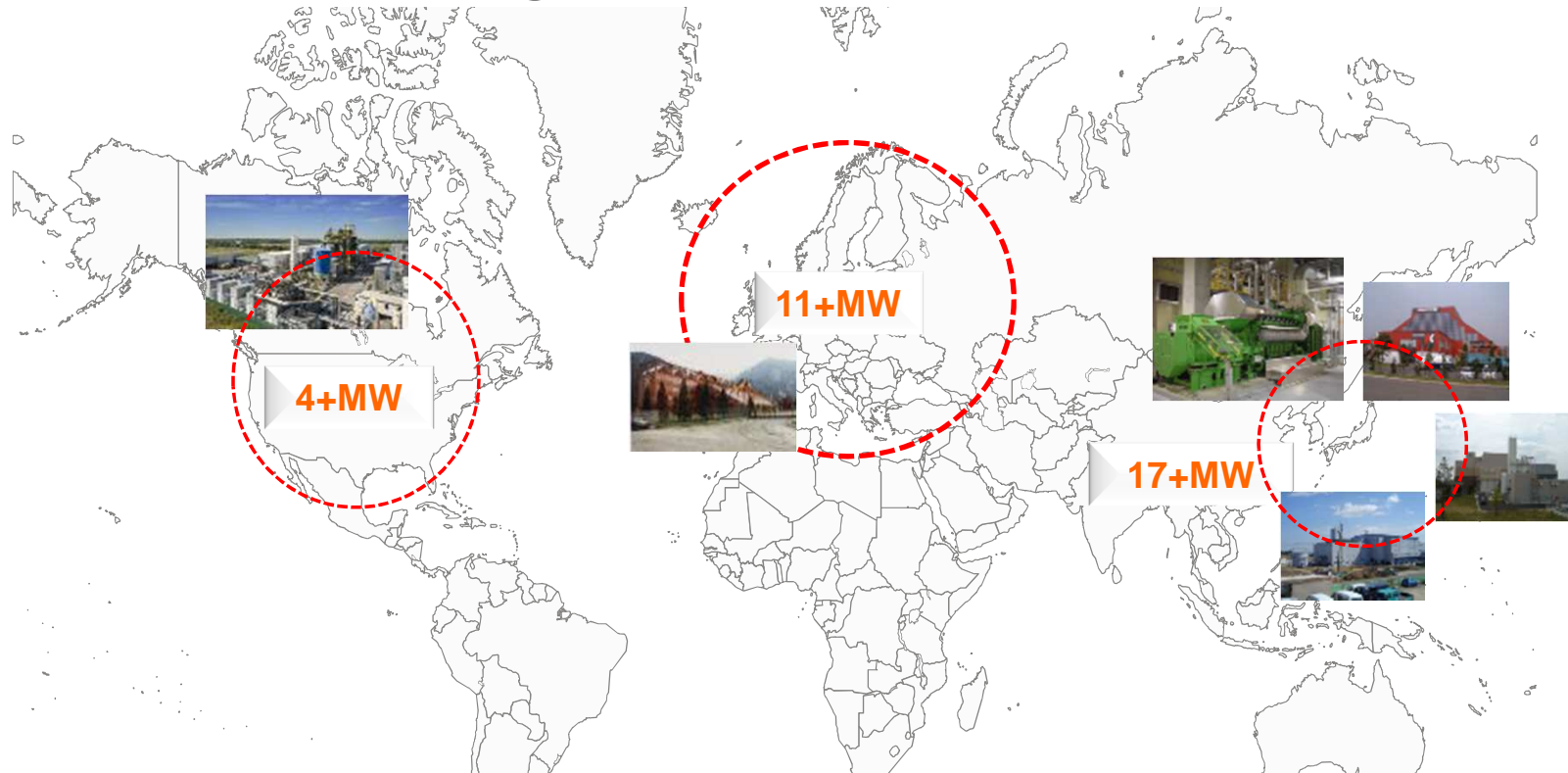
3 x J620

3 x 1.97 MWe

.....commissioning 2010,

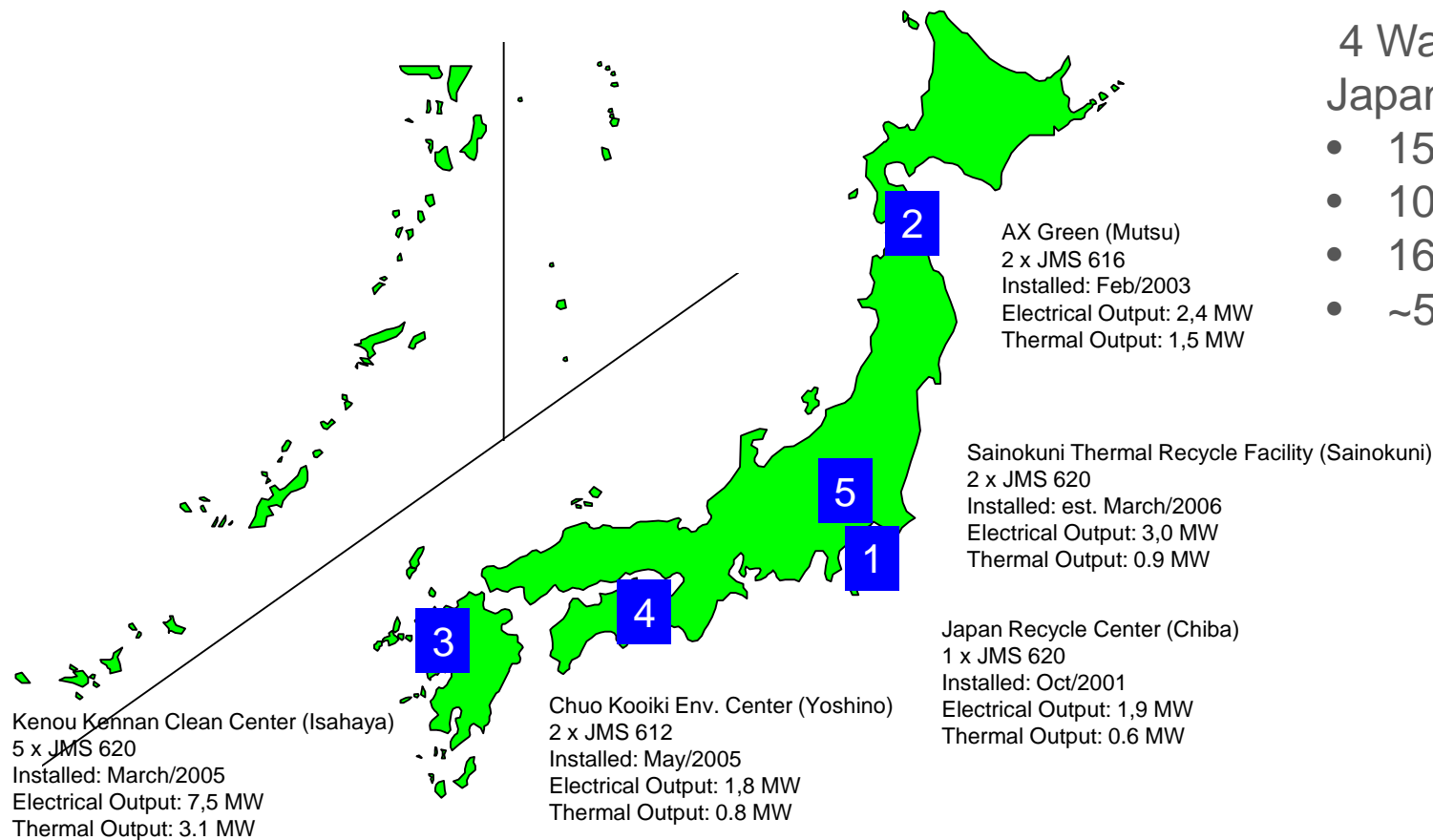


# W2E - Waste gasification references



**...approx. 32 MWe installed ...majority in Japan  
more than 500k oph experience**

# W2E plants Japan



# Waste gasification Thermoselect Mutsu/JP



Thermoselect Mutsu/JP  
2 x JGS 616 GS SN.L

Pyrolysis gas:

H<sub>2</sub> 20 - 40%

CO 35 - 40%

CO<sub>2</sub> 25 - 35%

N<sub>2</sub> 2 - 5%

LHV = 1.5 - 2 kWh/Nm<sup>3</sup>

Commissioning: 2/2003

> 57,000 oh (04/2011)

# Waste gasification Thermoselect Isahaya/JP & Joshino/Jp



Thermoselect Isahaya/JP  
5 x JGS 620 GS SN.L  
Commissioning: 3/20053  
> 12,000 oh (10/2006)

Thermoselect Yoshino/JP  
2 x JGS 612 GS SN.L  
Commissioning: 10/2003  
> 60,000 oh (5/2011)



# Plasco "Trial Road" Ottawa 5xJ320

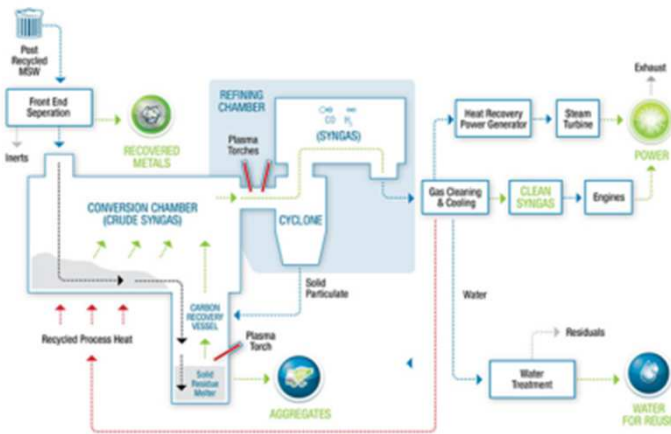


## Ottawa/Ca

Waste gasification

5x J320 ~ 3.5MWe

H <sub>2</sub>	12 - 17%
CH <sub>4</sub>	2 - 3%
CO	11 - 15%
CO <sub>2</sub>	10 - 12%
N <sub>2</sub>	50 - 55%
Hu	1.5-1.8 kW/Nm <sup>3</sup>



# Special gas development

## Jenbacher gas engines

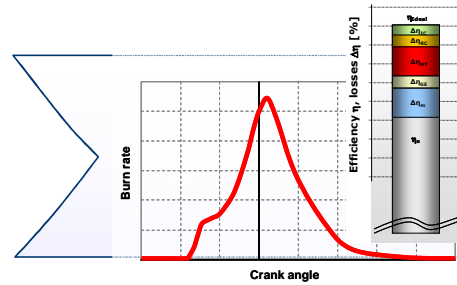


# Special gas development

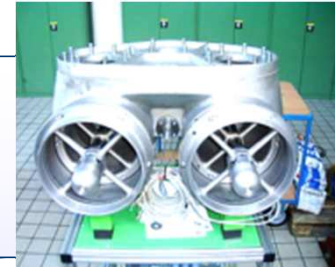
50+ years experience



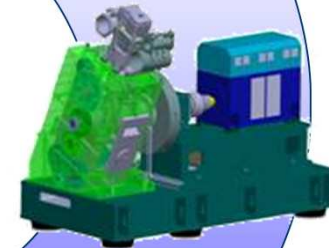
comprehensive data  
base & analytical  
methods



conceptual  
studies



component  
Test



Single cylinder  
test



Full engine test

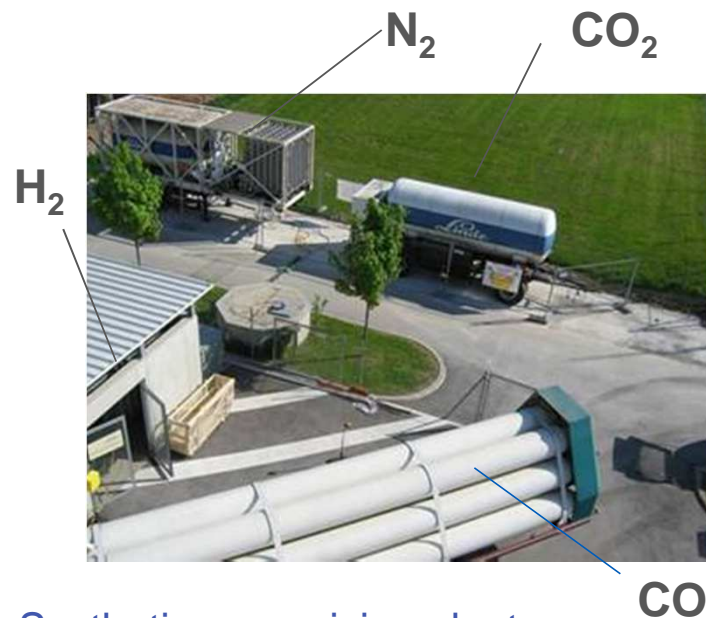


Pilot plant

# Special gas product development

## Combustion development at single cylinder engine test bench with artificial special gases

- Various test runs with different combustion concepts
- Gas type specific concept selection



Synthetic gas mixing plant



Single cylinder test bench



# Biomass Gasification Güssing/A

1 x J620E 1.9 MWe



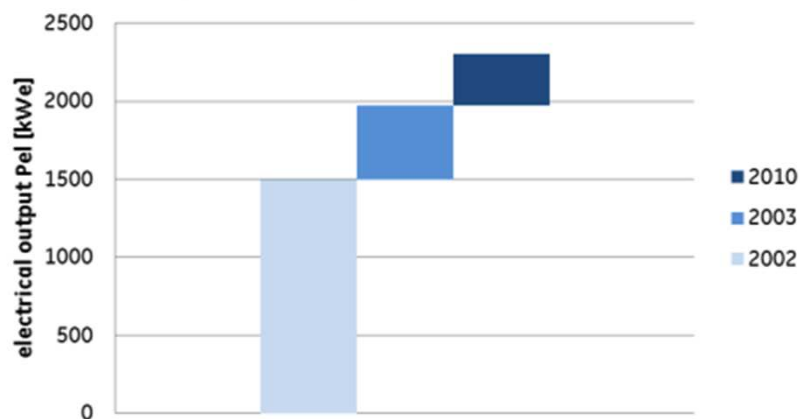
Engine Upgrade

10/2010

J620F 2.3 MWe



Output development Güssing J620



Efficiency development Güssing J620

