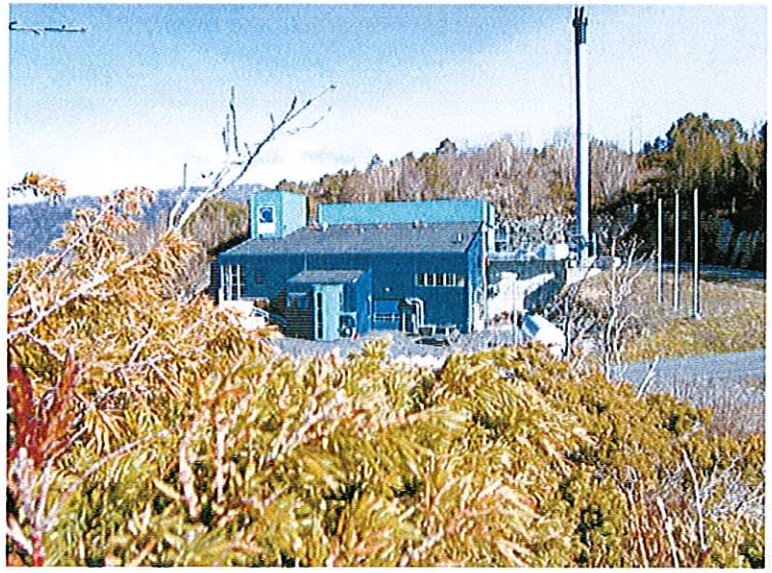
Introduction

ENERGOS

"Energos has an excellent environmental performance and is currently the strongest competitor in the small scale waste-to-energy sector."

Detailed review of the Energos system carried out in 2001 by Juniper Consultants



Track Record

ENERGOS

- Clear and demonstrable technology leadership in gasification - based waste treatment
- Commercially proven - Six turnkey plants built & operating in Germany & Norway
- Superior environmental record that is verified, approved, and observable (150,000+ operational hours)
- Meets the definitions of an Advanced Conversion Technology under the UK Renewable Obligation (not applicable in Jersey)

Local Solution

ENERGOS

Energos Solution: "Local-Scale" Problem Solving

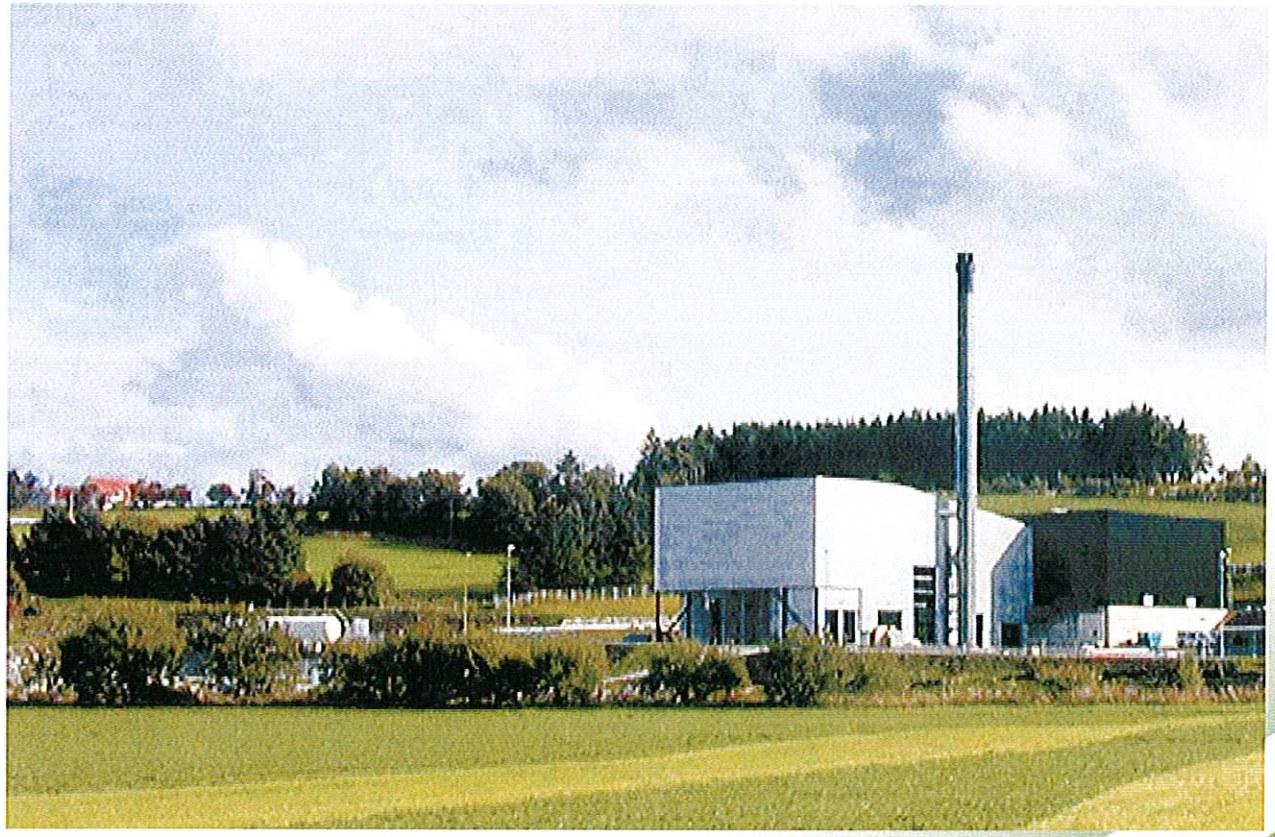
The Averøy Plant is built 150 metres from a fish feed factory. Replaces 3.6 M litres of fuel oil per year, eliminating 11,000 tonnes CO2 emissions per year.

The Ranheim Plant stands 200 metres from a residential area.

Local Solution

ENERGOS

Energos Solution: "Local-Scale" Problem Solving

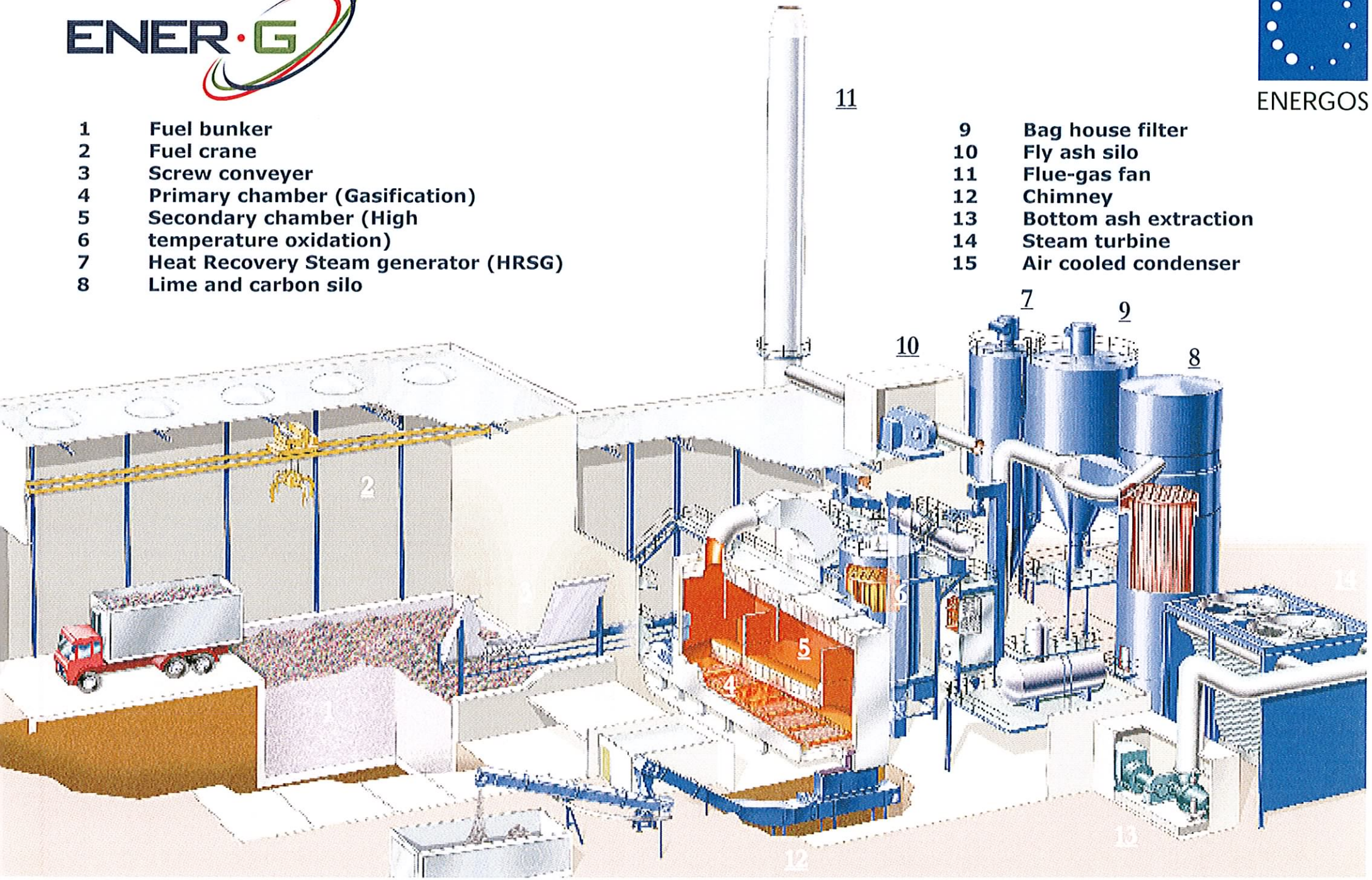


The Forus plant uses local MSW and supplies district heating & electricity to the grid.

ENER·G

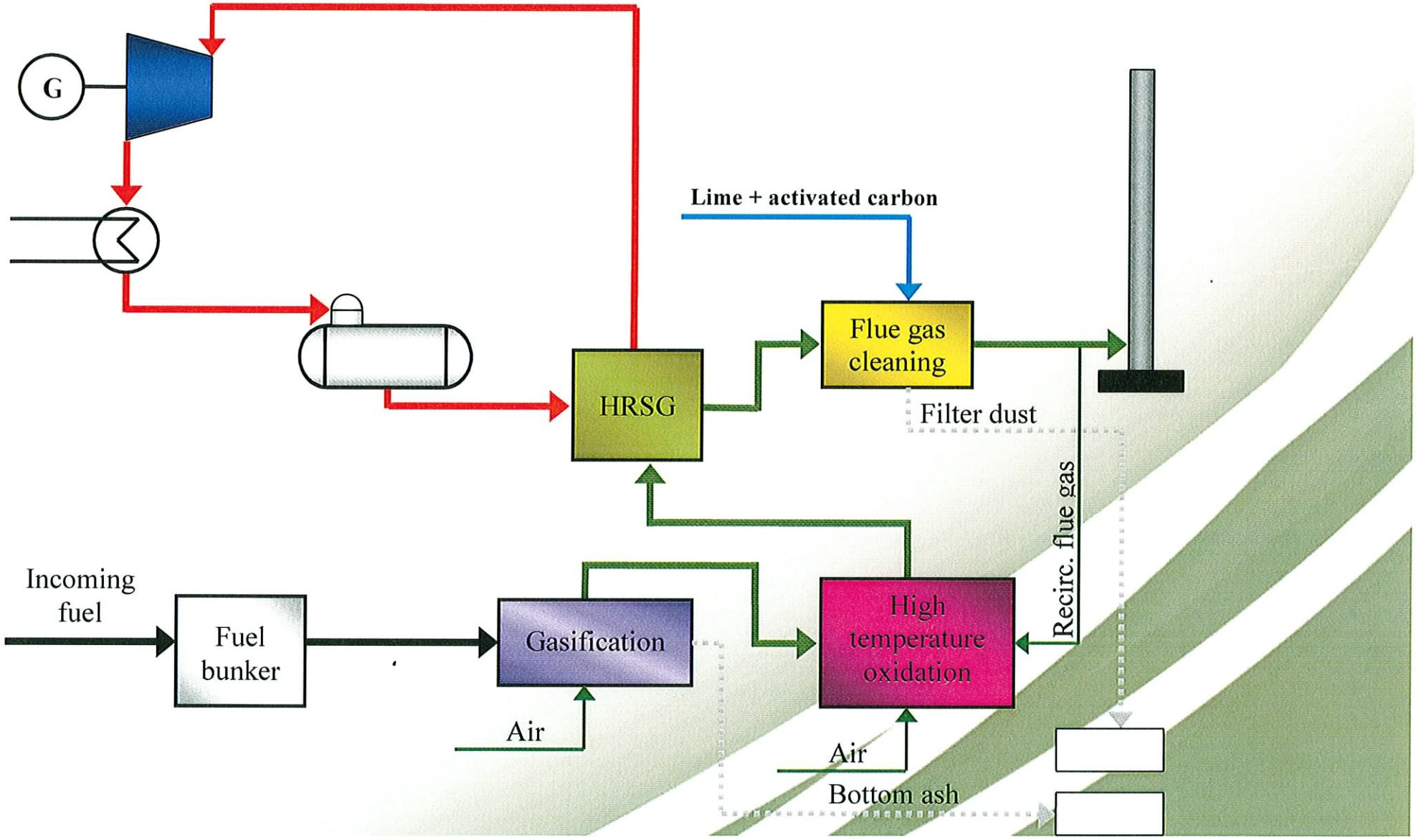
ENERGOS

1 Fuel bunker
2 Fuel crane
3 Screw conveyer
4 Primary chamber (Gasification)
5 Secondary chamber (High
6 temperature oxidation)
7 Heat Recovery Steam generator (HRSG)
8 Lime and carbon silo
9 Bag house filter
10 Fly ash silo
11 Flue-gas fan
12 Chimney
13 Bottom ash extraction
14 Steam turbine
15 Air cooled condenser



Process Flow

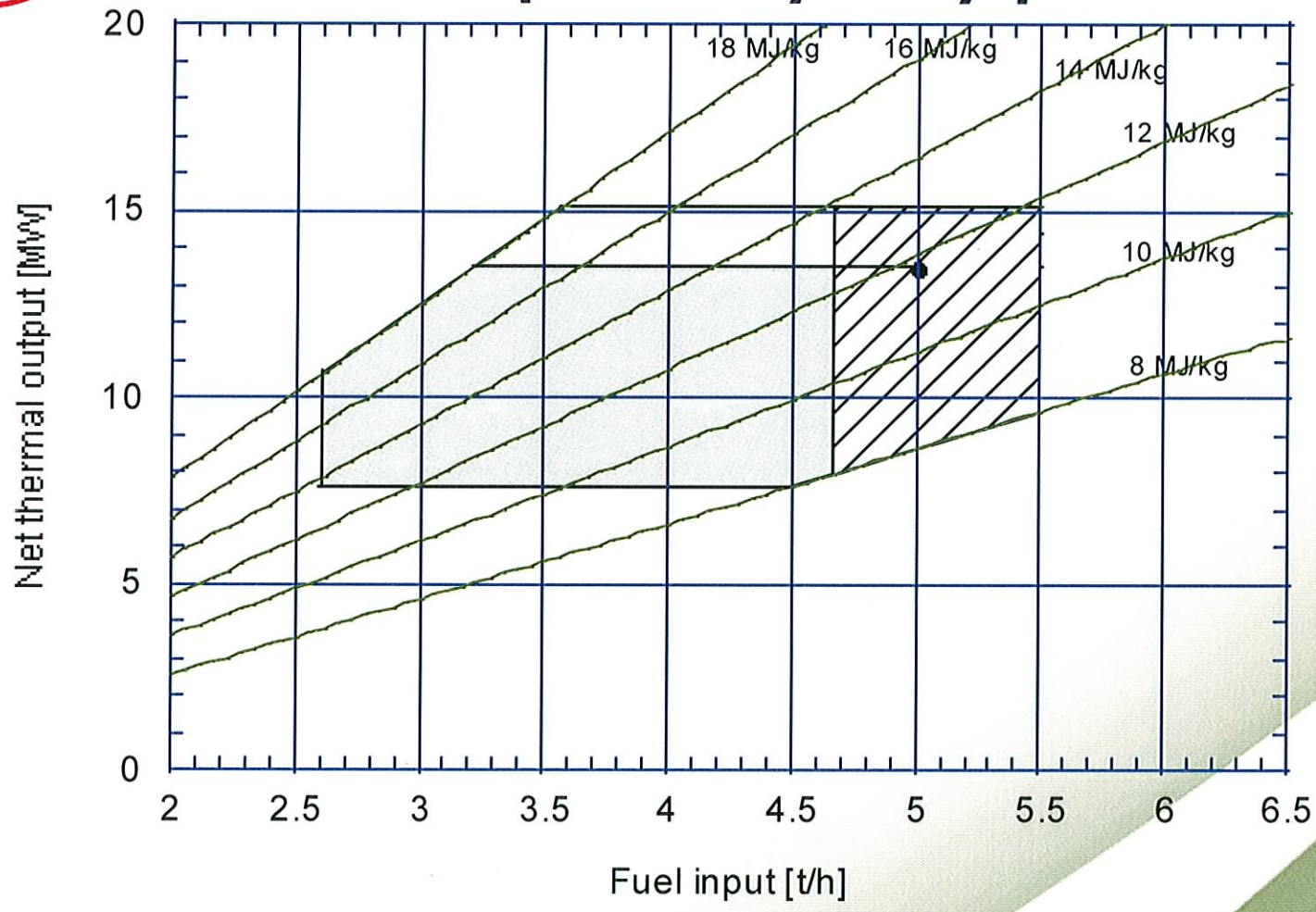
ENERGOS



ENER·G

ENERGOS

Capacity Type 41



Maximum fuel moisture content is 60% for a fuel consumption less than 4.67 t/h.
The maximum fuel moisture content decrease linear from 60% at 4.67t/h to 35% at 5.5t/h.

Normal operating area

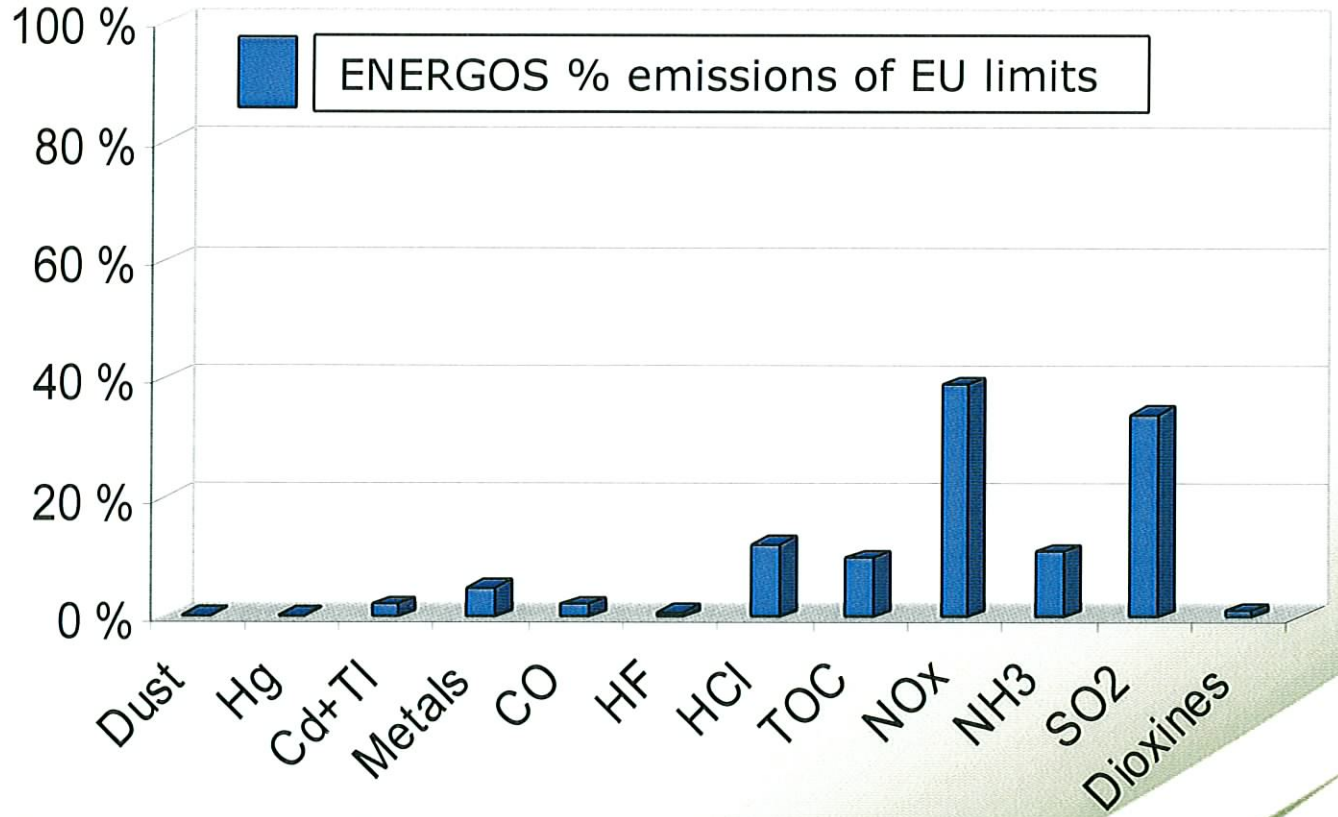
Margin for transient operation only

Emissions

ENERGOS

Energos' Advanced Thermal Treatment uses a patented 2-stage process with gasification to yield a "clean burn"

Energos plant emissions are significantly below existing EU emission standards



	EU Limits	Energos
Dust	10	0.01
Hg	0.03	0.0001
Cd+Tl	0.05	0.001
Metals	0.5	0.024
CO	50	1
HF	1	0.0082
HCl	10	1.225
TOC	10	1
NOx	200	78
NH3	10	1.083
SO2	50	17
Dioxines	0.1	0.0009

Measurements taken at Sarpsborg, Norway plant May 2003 by independent agency, TUV NORD Umweltschutz, and submitted to Norwegian Environmental Agency for regulation purposes. All measurements at 11% Oxygen. Limits are mg/Nm3, except Dioxine / Furans at ng/Nm3.

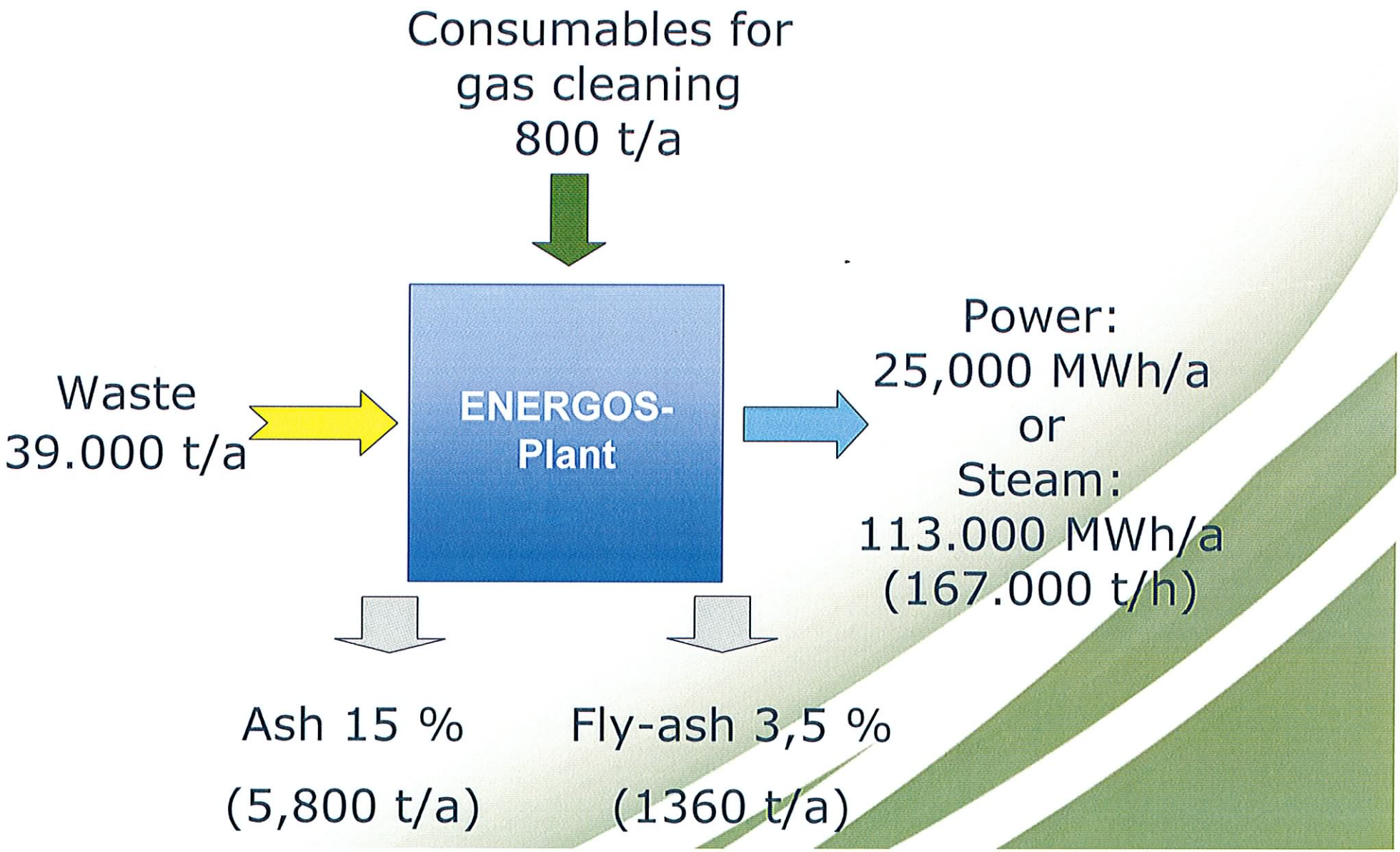
Emissions

ENERGOS

"The claim by ENERGOS that the Process is 'environmentally friendly' is backed up by very low pollutant levels measured at Hurum and Averøy. These emissions are probably the lowest measured anywhere for this type of process, particularly the NOx figures which can only be achieved by competing technologies with the application of de-NOx systems."

Juniper Consultants, Biffa Waste Services Limited Future Perfect Report 2003

Mass Balance



Gasification

ENERGOS

Under the UK Renewable Obligation gasification is defined as:

- A Sub-stoichiometric process (less than Lambda ratio 1)

The test required is to be able to detect 2 out of 3 of the following components of syngas:

- Hydrogen, Carbon Monoxide and Methane

Measured (by an independent lab) in the transfer channel between the primary and secondary chamber:

Air Fuel Ratio: - Lambda 0.8

Syn-gas measurements:
- Hydrogen 8%
- Methane 3%
- Carbon monoxide 10%

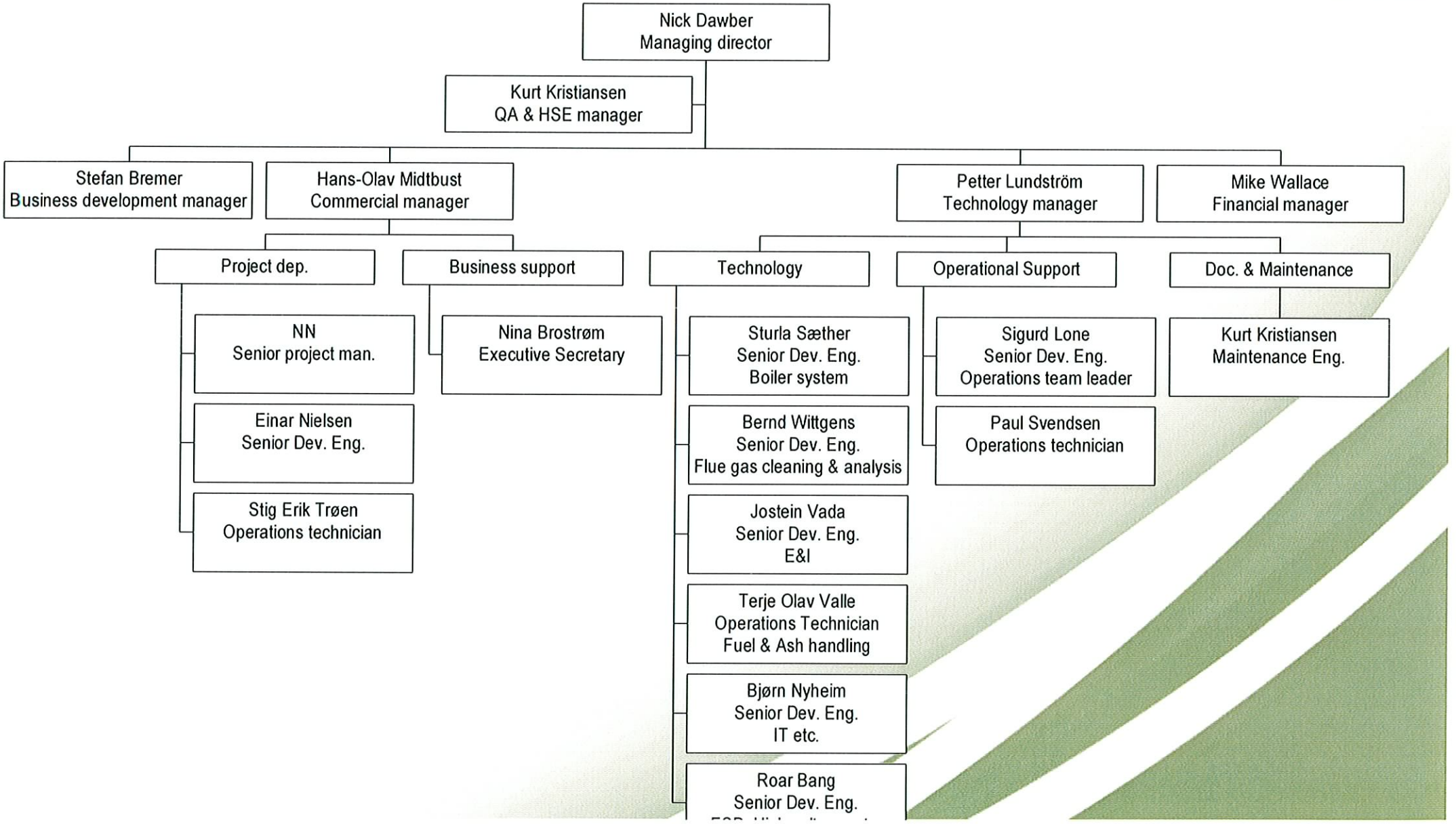
The syngas is then transferred to the secondary chamber where high temperature oxidation is undertaken

Stability

The Energos plant was designed to minimise emissions, not only has that been achieved but in addition it provides

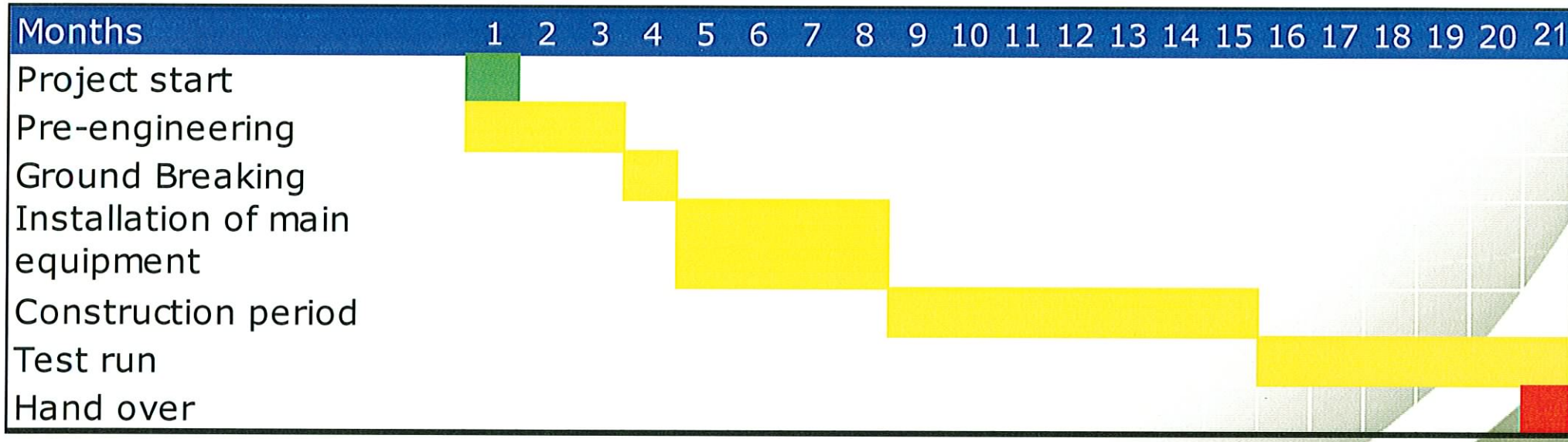
- Low carbon content in bottom ash (<3% TOC)
- Low and stable NOx without the need for de-NOx systems to achieve EU limits
- Low and stable CO and TOC emissions
- High degree of organic substance cracking

Organisation



Delivery

ENERGOS



- Projects completed within 21 months from order
- 12 months from ground breaking to completion of plant
- 6 month test run

Operational Plant

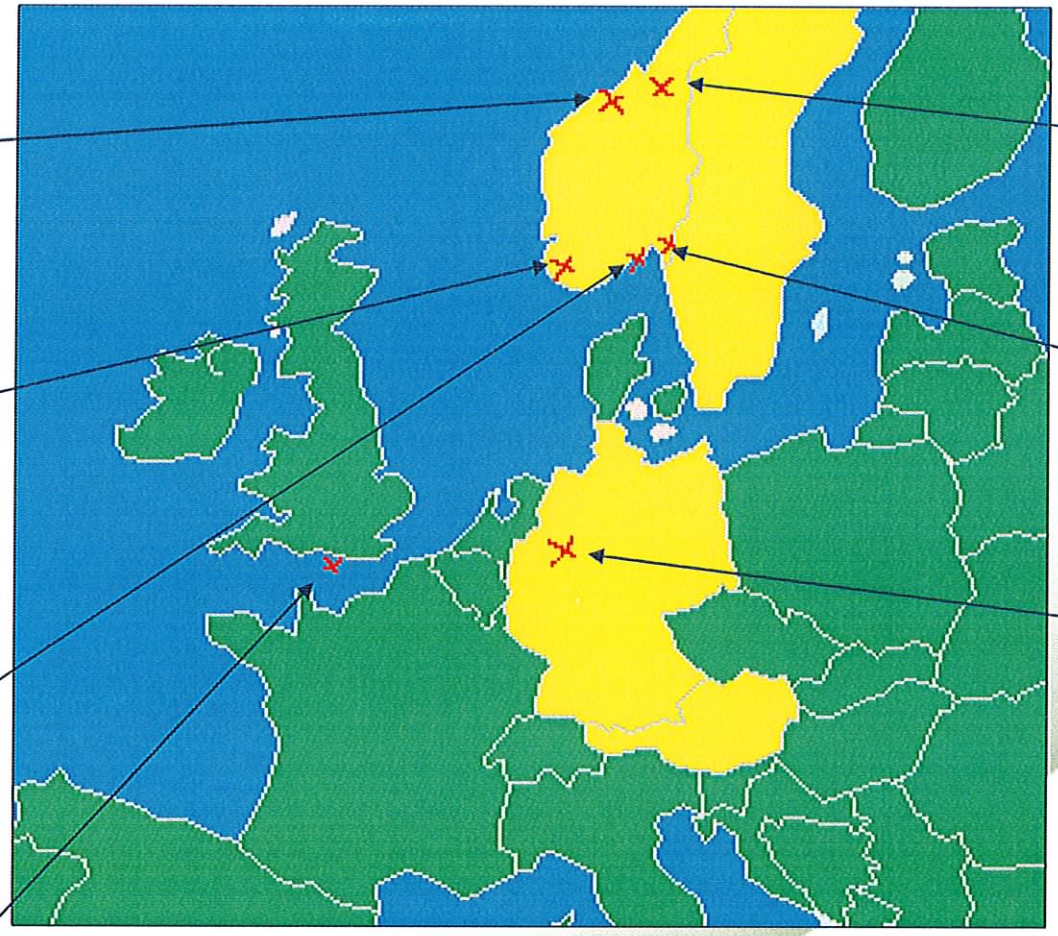
ENERGOS

Averøy
Opened: 2000
Waste: 34,000t
Energy: Steam / Elec.

Forus
Opened: 2002
Waste: 38,000t
Energy: Steam /Elec.

Hurum
Opened: 2001
Waste:
36,000t
Energy: Steam

Isle of Wight *
Opened: 2000
Waste: 30,000t
Energy: Elec.



Ranheim
Opened: 1997
Waste:
10,000t
Energy: Steam

Sarpsborg
Opened: 2002
Waste: 75,000t
Energy: Steam

Minden
Opened: 2001
Waste: 37,000t
Energy: Steam

* To be converted

Ranheim - 1997

ENERGOS

Plant Description

- Pilot plant built with support from the Research Council of Norway, the Department for the Environment and the Norwegian Water Resources and Energy Directorate (NVE)
- Fuel capacity: 10,000 tonnes per year
- Energy production: 25 GWh per year
- Footprint 380 m2. Fuel bunker capacity 560 m3

Ownership & Partners

- Energos AS 100%

Waste Contracts

- Local industrial waste
- Paper waste from Peterson Ranheim Linerboard

Energy Contracts

- Peterson Ranheim Linerboard, a paper mill specializing in manufacturing paper from recycled cardboard

Averøy - 2000

ENERGOS

Plant Description

- First commercial plant
- Partnership of local municipalities (estimated population 100,000)
- Fuel capacity: 34,000 tonnes per year
- Energy production: 65 GWh per year
- Footprint 1200 m2

Ownership & Partners

Energos AS 48%

Nordmøre Energigjenvinning KS and Others 52%

Waste Contracts

Municipal Solid Waste from Nordmøre Interkommunale Renovasjonsselskap (NIR), a waste management network comprising of 11 local municipalities of which Kristiansund is the largest

Energy Contracts

Thermal Steam for Skretting AS, a wholly owned subsidiary of the Nutreco Group

Electricity for local grid

Hurum - 2001

ENERGOS

Plant Description

- First plant under standard design
- Fuel capacity: 36,000 tonnes per year
- Energy production: 90 GWh per year
- Footprint 1200 m2
- Fuel bunker capacity 1300 m3

Ownership & Partners

- Diamyo AS

Waste Contracts

- Municipal Solid Waste ROAF, a waste management company owned by several municipalities north of Oslo
- Commercial waste from international flights to Oslo Airport Gardermoen (OSL)
- Industrial waste (paper rejects)
- Fabrikker, Sundal Eker, and Peterson Moss

Energy Contracts

- Thermal Steam for Hurum Fabrikker AB, a paper manufacturer

Minden - 2002

ENERGOS

Plant Description

- First turnkey, operations, and equity stake in Germany
- Beginning of partnership with E.ON
- Fuel capacity: 37,000 tonnes per year
- Energy production: 110 GWh per year

Ownership & Partners

- Energos Deutschland GMBH 100%
  (E.ON 100% following bankruptcy of Energos ASA)

Waste Contracts

- Local Municipal Solid Waste and manufacturing waste

Energy Contracts

- BASF PharmaChemikalien GMBH
- Steam from the Energos plant replaces 19 Million m3 of natural gas

Forus - 2002

ENERGOS

Plant Description

- First plant with integrated pre-treatment facilities
- Fuel capacity: 38,000 tonnes per year
- Energy production: 86 GWh per year
- Footprint 1200 m2.
  Fuel bunker capacity 1300 m3

Ownership & Partners

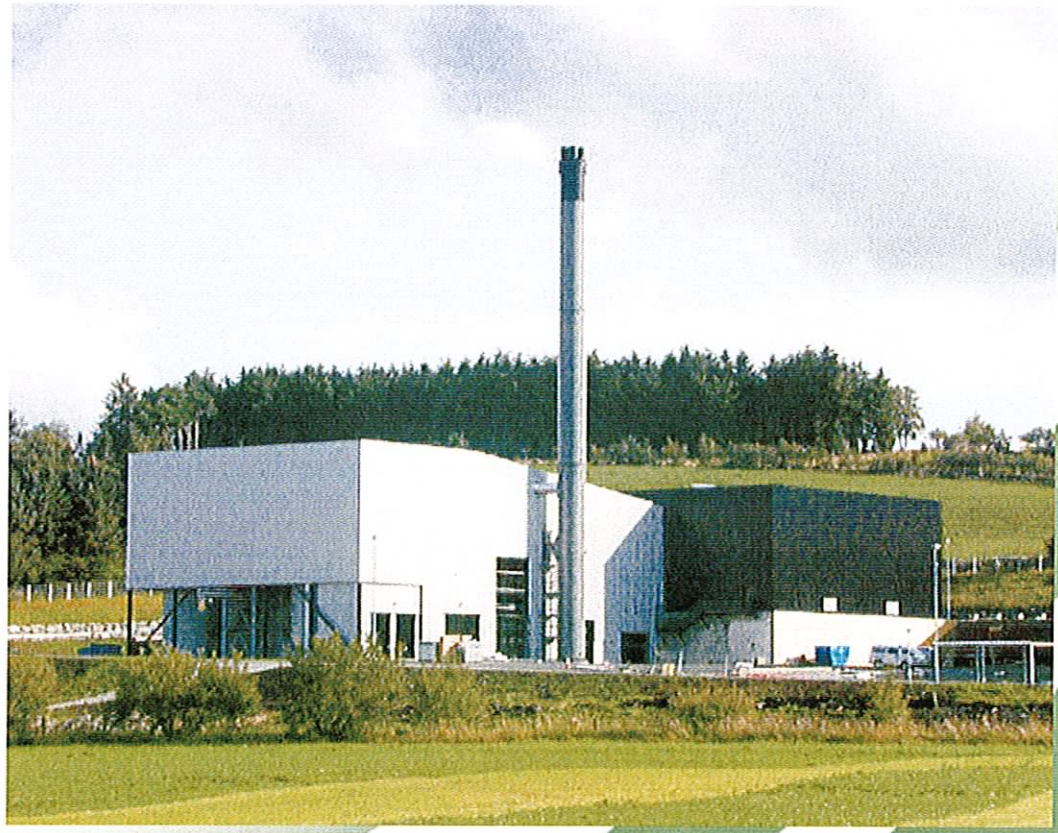
- Lyse Energi 44.5% and IVAR IKS 44.5%
  11% Westco (Com Waste Management)

Waste Contracts

- Municipal Solid Waste from IVAR IKS, a local waste collection company

Energy Contracts

- Lyse Energi AS Thermal Steam for district heating and electricity for the grid.



Sarpsborg - 2002

ENERGOS

Plant Description

- First double-line plant
- Fuel capacity: 75,000 tonnes per year
- Energy production: 190 GWh per year
- Footprint: 2100 m2
- Fuel bunker capacity: 2500 m3

Ownership & Partners

- Østfold Energi AS 100%

Waste Contracts

- Lokal municipal and industrial waste

Energy Contracts

- Borregaard Fabrikker, a large Norwegian industrial chemical firm
- Steam from the Energos plant replaces 20,000 tonnes of oil fuel

Why ENERGOS

ENERGOS

- A real alternative to traditional mass-burn incineration
  - Versatile system, can substitute mass-burn
  - Will reduce the size of plant, particularly if integrated into a waste strategy with recycling.
- Community sized – 30,000 to 120,000 tpa
  - Operating lines of 40,000 tpa capacity each
  - Smaller plant profile
  - Smaller foot print
  - Excellent emissions record

Why ENERGOS

ENERGOS

- Modular approach allows for expansion as and when (or if) required.
  - Capacity can be built to suit existing needs. Future needs can be determined in the future when the all the alternatives have been considered.
- Multiple lines
  - improve availability (always likely to be one line in operation)
  - Provide ability to cope with seasonal fluctuations (one line can be shut down if necessary in off peak seasons)
- Construction time significantly reduced
  - Number of construction workers required is much lower than alternative mass-burn construction

Why ENERGOS

ENERGOS

- Proven Track Record - it works
- Backed by ENER-G Group
  - A financially robust Company
  - A company with a positive financial track record with the City
  - A company with a track record of working with local authorities throughout the UK
  - A company with a track record of working with the major waste management companies
  - A company with a track record of working with "blue chip companies" across many industry sectors