Answers to the biofuel debate

The CHOREN BTL process
status – progress – future prospects

Bruxelles, 15.09.2008

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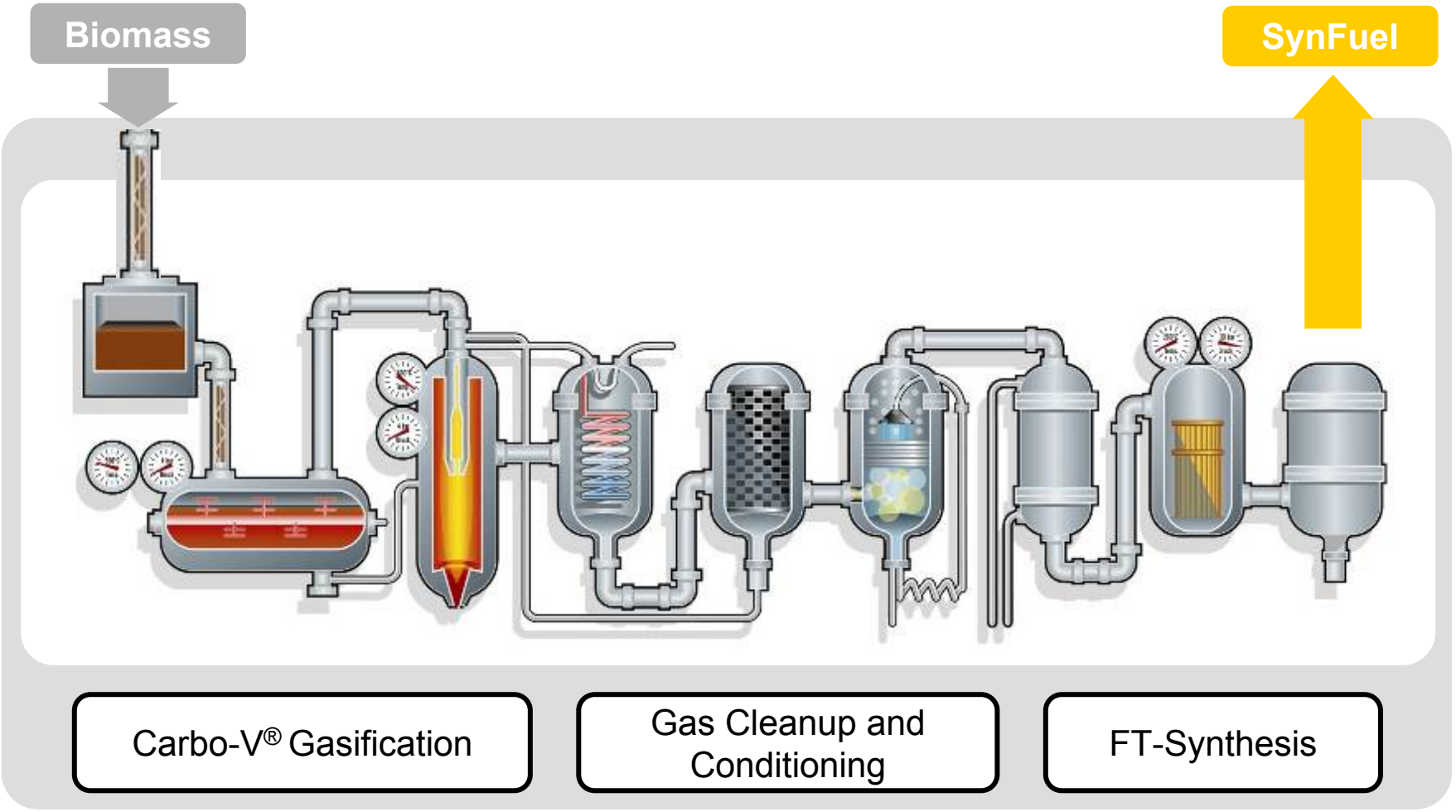
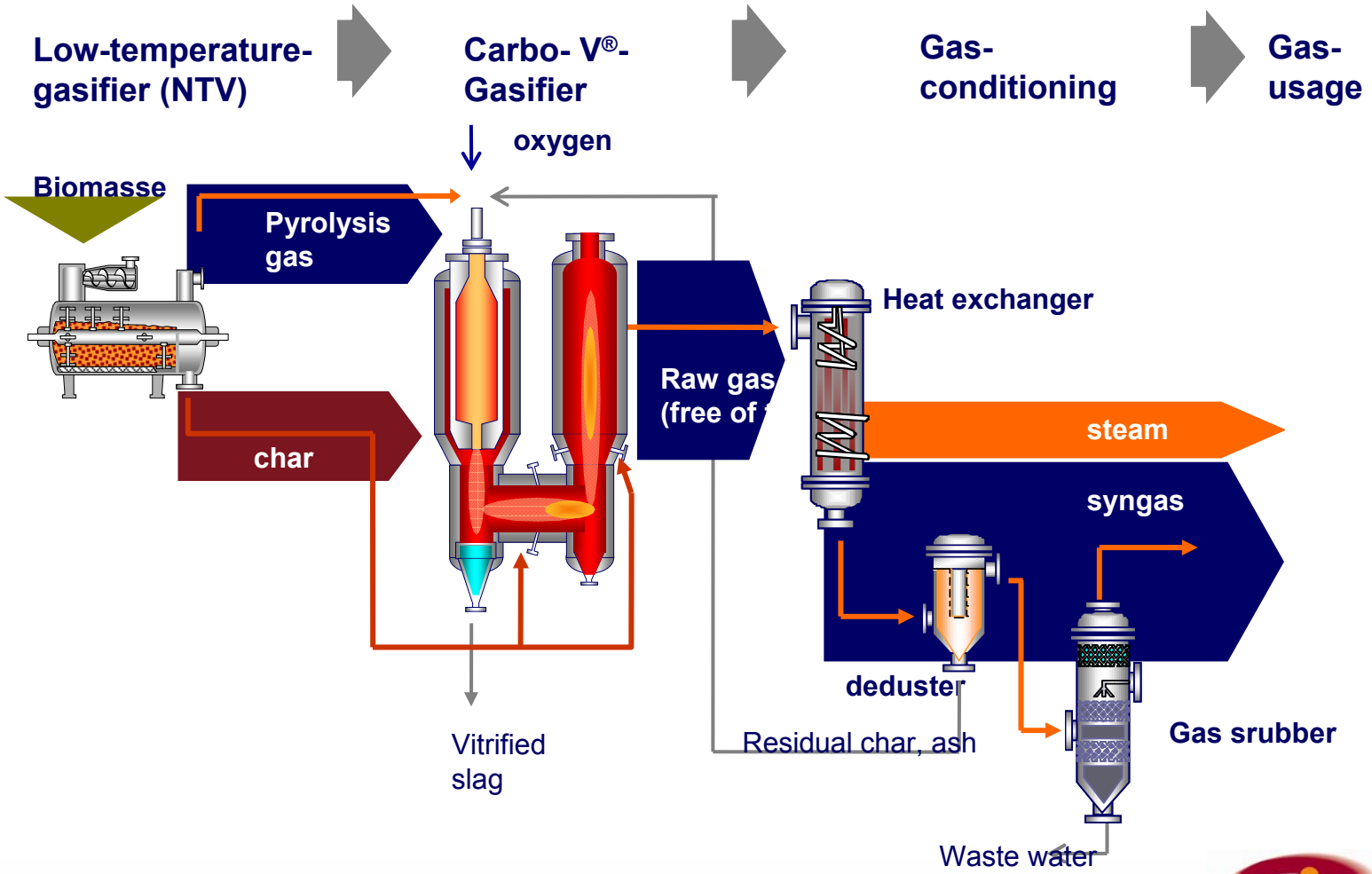
Biomass-to-Liquids (BtL) production process



RENEW conclusions

- Main drivers for BTL production costs are
  - Biomass costs
  - Process efficiency
- High process efficiency requires
  - High biomass gasification efficiency: Carbo-V- gasification
  - High efficiency of the synthesis: Shell SMDS FT-synthesis
  - High integration

The Carbo-V®
biomass gasification process



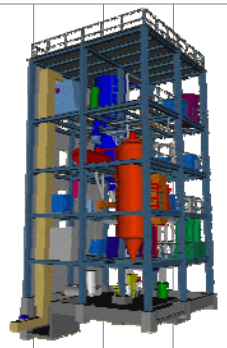
Advantages of Carbo-V® Gasification

- High **performance for** synthesis application
  - cold gas efficiency > 80%
  - Low methane content
  - => low inerts = high efficiency in synthesis unit
- Absolute **tar-free combustion or synthesis gases** (no catalytic gas cleaning required!)
- High **flexibility in feedstock** (all dry and carbon-containing feedstock possible)
- Conversion of ash to **slag** (granules suitable as a construction material)
- More than **20,000 operation hours** (by end of 2006) in the alpha plant

FT-Synthesis

- Shell SMDS FT-Synthesis in Bintulu / Malaysia in commercial operation since 1993
- One of very few FT-plants worldwide
- Highly integrated Co-based fixed bed technology
- Development of new FT-processes not recommended (> 10..20 years, difficult IP environment)
- Other synthesis processes for exisiting engines that are under discussion are actually not commercially available

Development stages at CHOREN



Pilot plant with
air blown gasifier

Alpha ♦ 1 MW O_2

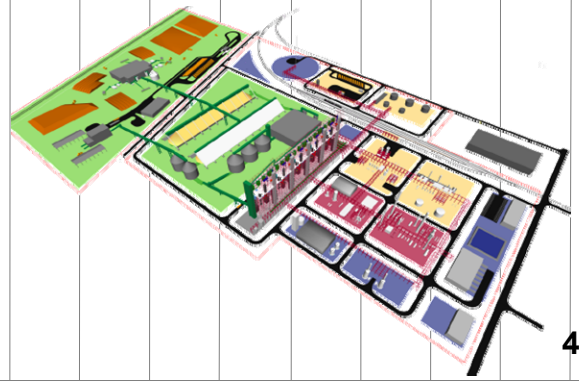
Scaleup * 45 (one line)

BETA Freiberg
First commercial BTL plant
45 MW

Beta: 15 ktpa

15 MW air ♦ 30 MW O_2 ♦ 45 MW O_2 HTV

Scaleup * 4 (multiple lines)



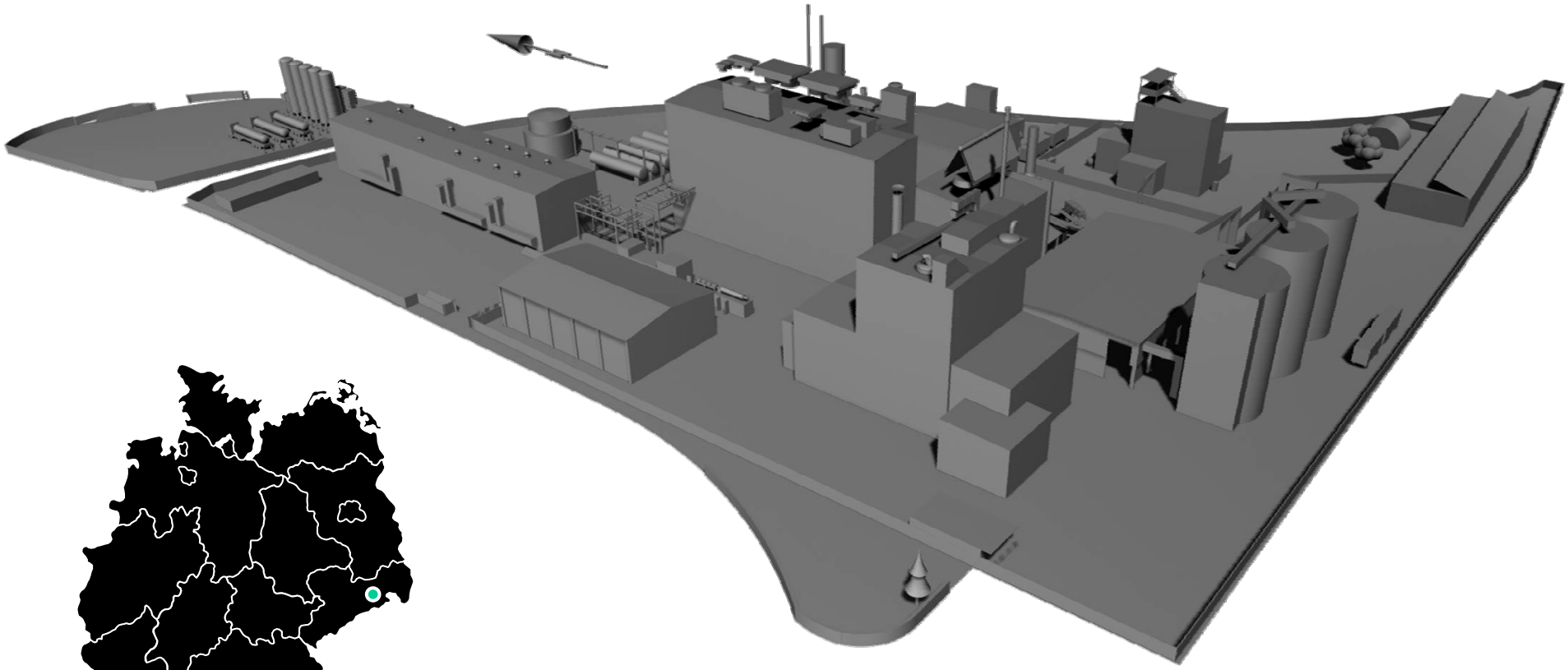
Sigma plant 640 MW
4 parallel gasifiers á 160 MW

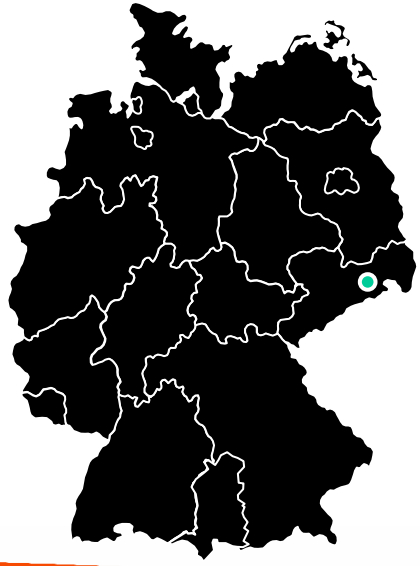
BTL Sigma: 200 ktpa

Scouting
FED 1- 3
FID
Execution
Operation

1990 1995 2000 2005 2010 2015

CHOREN BTL site Freiberg - Overview





UET/CHOREN Alpha-plant

•2001
•First BtL from bio-syngas in laboratory scale

•13 April 2003:
First liquids (methanol) from wood produced

•6 May 2003:
After the production of 11,000 liters, the R&D program for methanol was finished

•June 2003:
First production of FT-liquids from wood

•2004:
Process and product optimization in the EU 6th frame program (RENEW)

•2005
•Continues operation (> 3.000 h)

CHOREN site Freiberg
45 MW Carbo-V® Gasifier – June 2005

Test campaigns in the Beta-plant gasifier (2004)

CHOREN site Freiberg
45 MW Carbo-V® Gasifier – June 2005

CHOREN site Freiberg
45 MW Carbo-V® Gasifier – October 2007

Beta-Plant Freiberg:
BTL Production in Semi-Industrial Scale

renew

1 Biomass conditioning | 2 Biomass storage | 3 Biomass dryer | 4 Carbo-V® gasifier | 5 Power station

6 Gas conditioning & Fischer-Tropsch synthesis | 7 Storage for offsite & utility gases

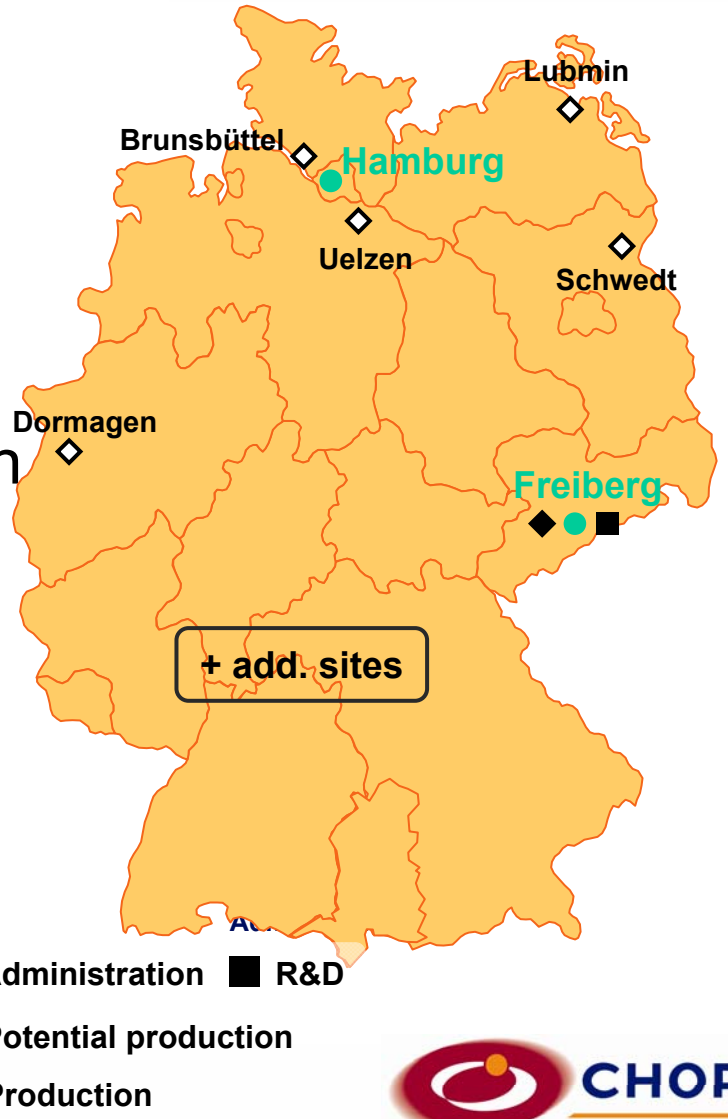
- 45 MW thermal
- 65,000 t_{DM}/a feedstock
- 18 Million Liter BTL

CHOREN

Start of Commissioning – April 17th 2008

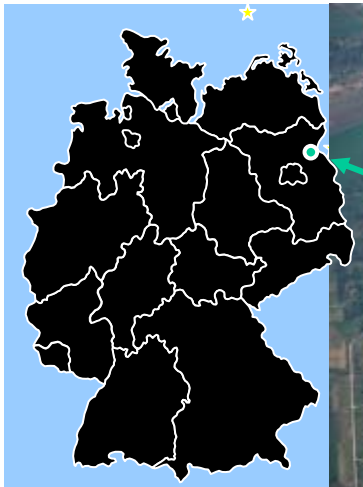
Company development and Σ-site evaluation

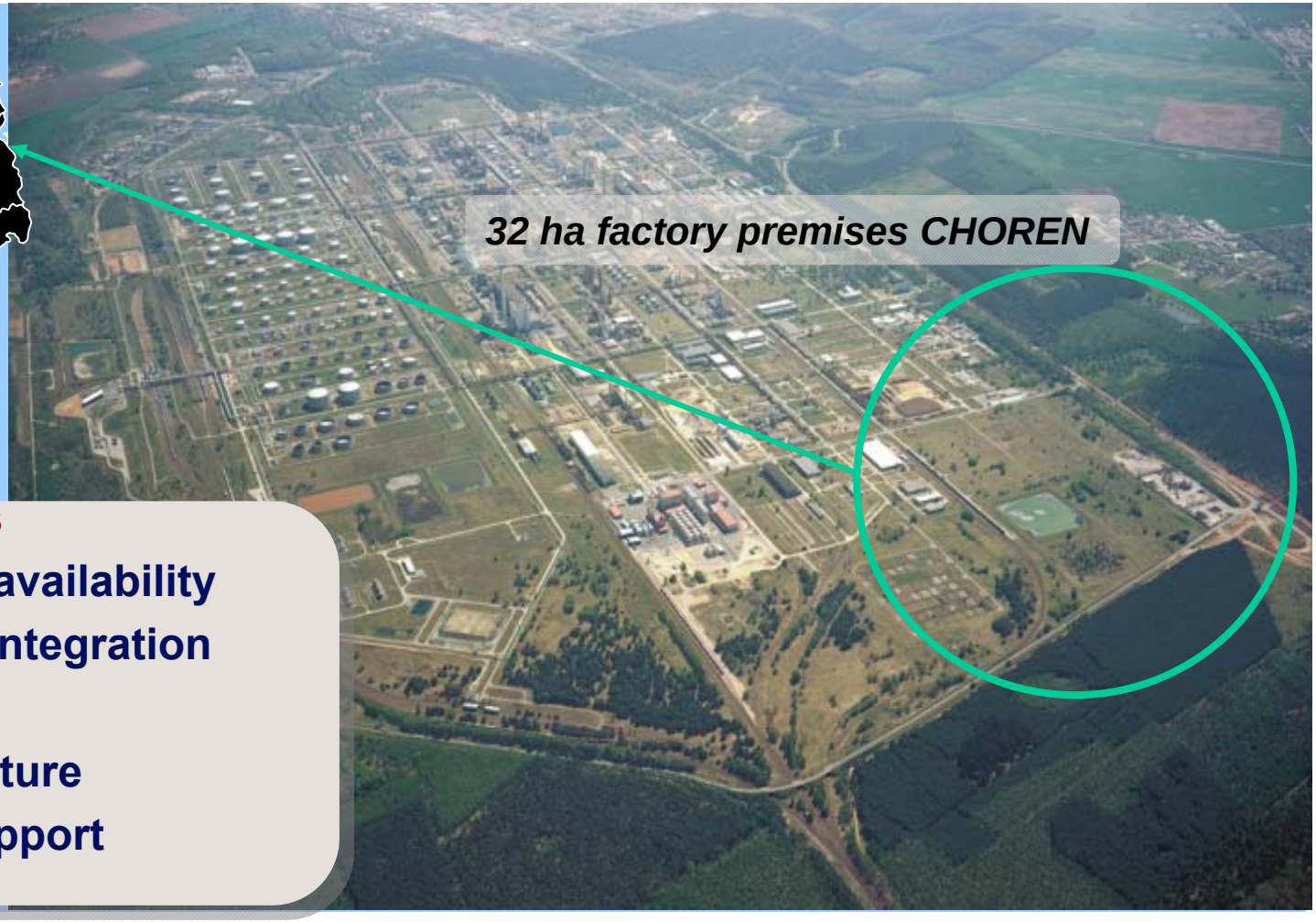
- Preparation of 200,000 t/a BTL plant (Σ-plant)
- Further plants in this unit size are on preparation
- 20 suitible locations identified in Germany
- 6 excellent locations



Σ1 Schwedt – FID in 2009

- 640 MW_{th}
- 1.000.000 t/a bio-mass
- 200.000 t/a BTL

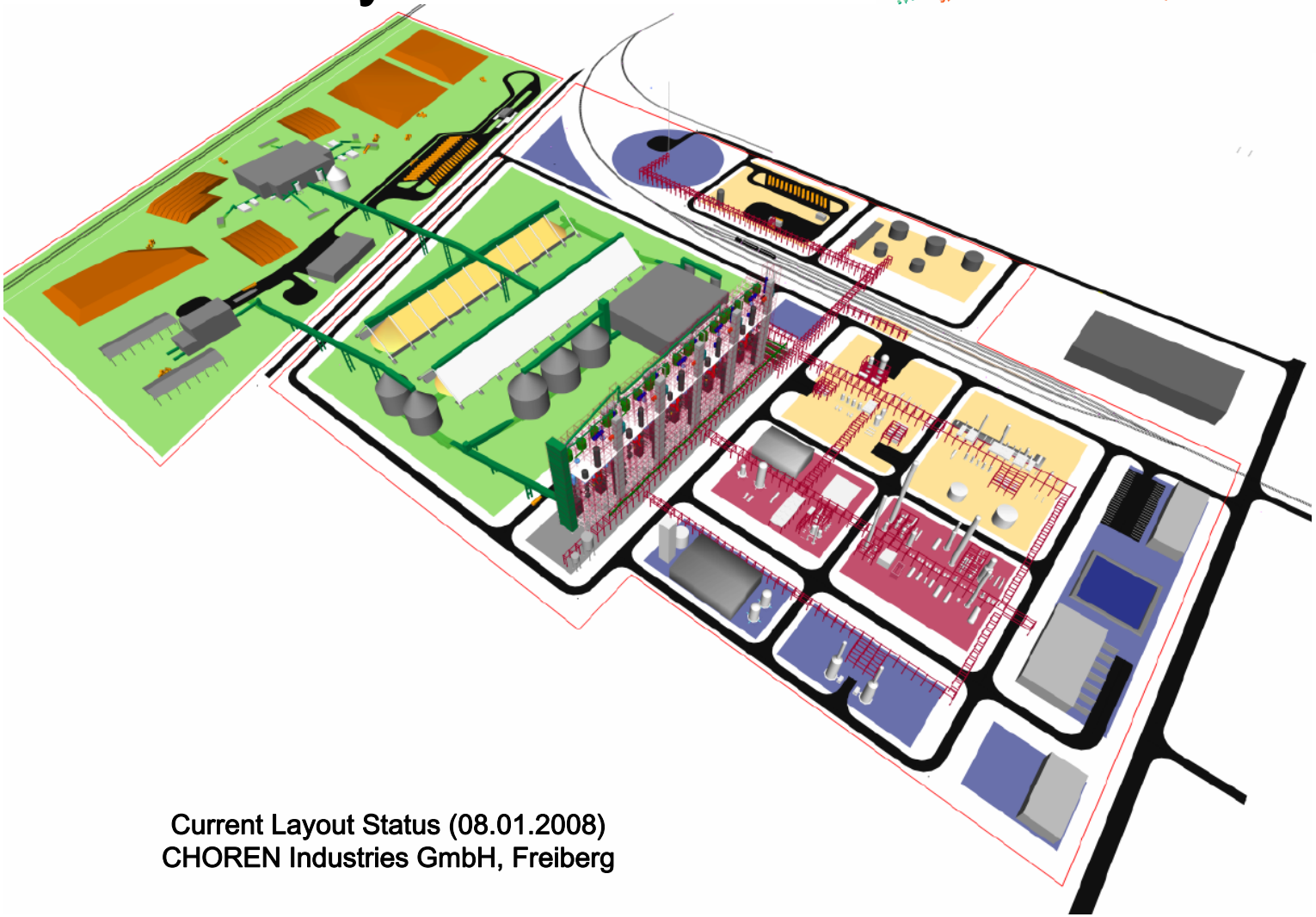




Advantages

- Biomass availability
- Refinery integration
- Logistics
- Infrastructure
- Public support

Σ1 Schwedt – Layout



Current Layout Status (08.01.2008)
CHOREN Industries GmbH, Freiberg

Key Figures Σ1 Schwedt

• Fuel production	200.000 t/a BTL = 5.000 BOPD = 270.000.000 Liter BTL
• Gasifier power	4 x 160 MW_{th} Parallel = 640 MW_{th}
• Biomasse demand	ca. 1 Mio. t_{TS}/a
◆ Turnover from biomass purchase	60 – 80 Mio. €/a
• Extention of the area	32 ha,
– facility:	11 ha
– Biomasse store:	9 bis 27 ha
– Tank farm and utilities:	6 bis 12 ha
• Jobs (primary)	850
– Biomasse supply:	600 - 700
– Production:	200
• Investment	> 800 Mio. €
• Green house gas reduction	650.000 t CO_2 / a

Preconditions for BTL market implementation

- Construction of a first industrial reference plant (500 MW-size) asap
- Risk share between all stakeholders
- Public support via subsidies, loan guaranties and reliable framework (tax advantage)

C	=	**Carbon**
H	=	**Hydrogen**
O	=	**Oxygen**
REN	=	**Renewable**

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