



# Hydrogen chains in Rotterdam

*Prepared for: 8th National Hydrogen and Fuel Cell conference*

Rotterdam, 9 December, 2010

- Operating **56** HyCO Manufacturing Units & **24** H<sub>2</sub> purification units

- ✓ *Syngas, hydrogen and/or carbon monoxide production*
- ✓ *24 of the HyCO units equipped with CO<sub>2</sub> capture*

- Operating **85** CO<sub>2</sub> purification/liquefaction plants worldwide: capacity of 2-750 tpd

- ✓ *4 units Capture CO<sub>2</sub> from flue gas (50-80 tpd)*

- Operating **355** Air Separation Units

- Operating **18** Cogeneration Trains

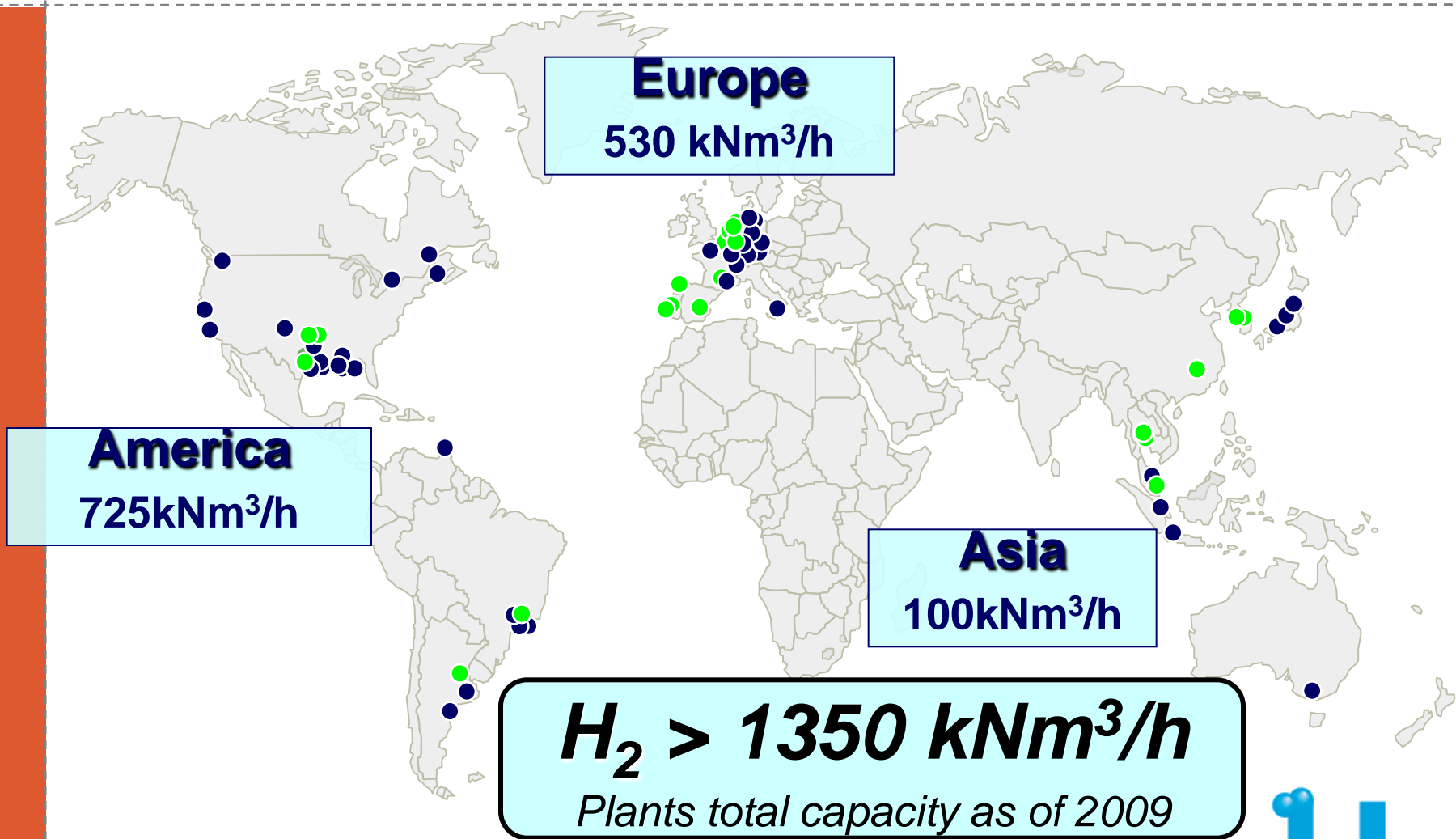
- ✓ *Steam and electricity production*

- Operating more than **8500 km** of pipelines worldwide across **39 countries**

- ✓ *More than **45 years** of experience in network operations*
- ✓ *All products : O<sub>2</sub>, N<sub>2</sub>, H<sub>2</sub>, CO, CO<sub>2</sub>, Syngas, Steam,*



# Worldwide Hydrogen Operations



- H<sub>2</sub> Production/Purification Unit
- H<sub>2</sub> and HyCO Units with CO<sub>2</sub> capture



# Large Industries H<sub>2</sub>/CO Customers

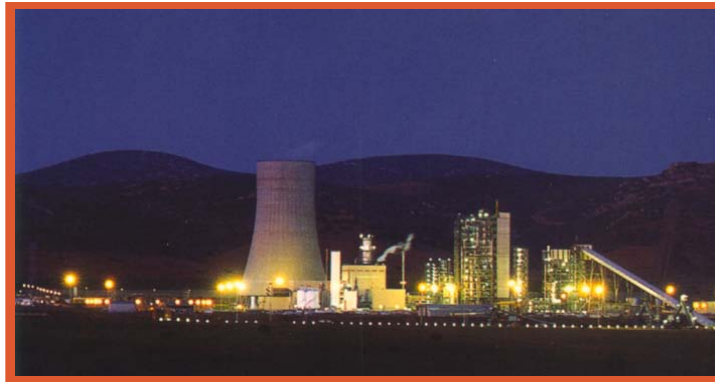
*The Chemical  
and  
Petrochemical  
Industry*  
*H<sub>2</sub>, CO, Syngas*



*The Metals industry*  
*H<sub>2</sub>*

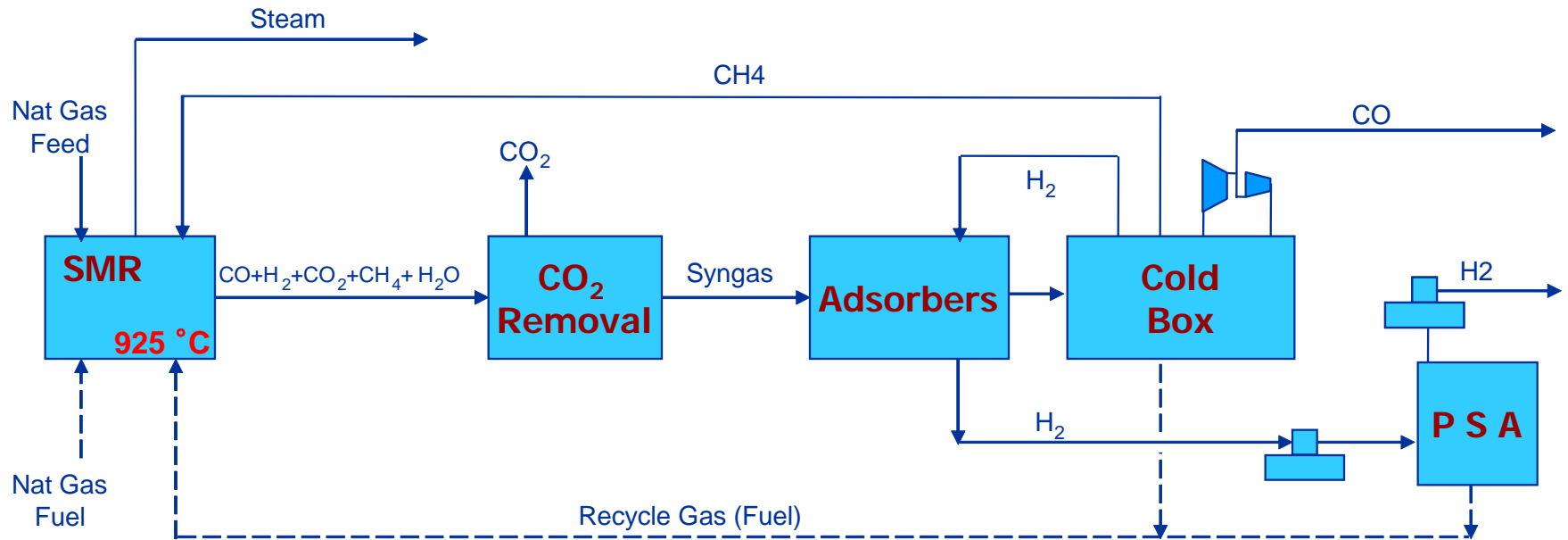


*The Oil & Gas industry*  
*H<sub>2</sub>*



*The Energy  
Conversion  
Industry*  
*Supply of H<sub>2</sub> or  
Syngas*

# Simplified scheme H<sub>2</sub>/CO plant



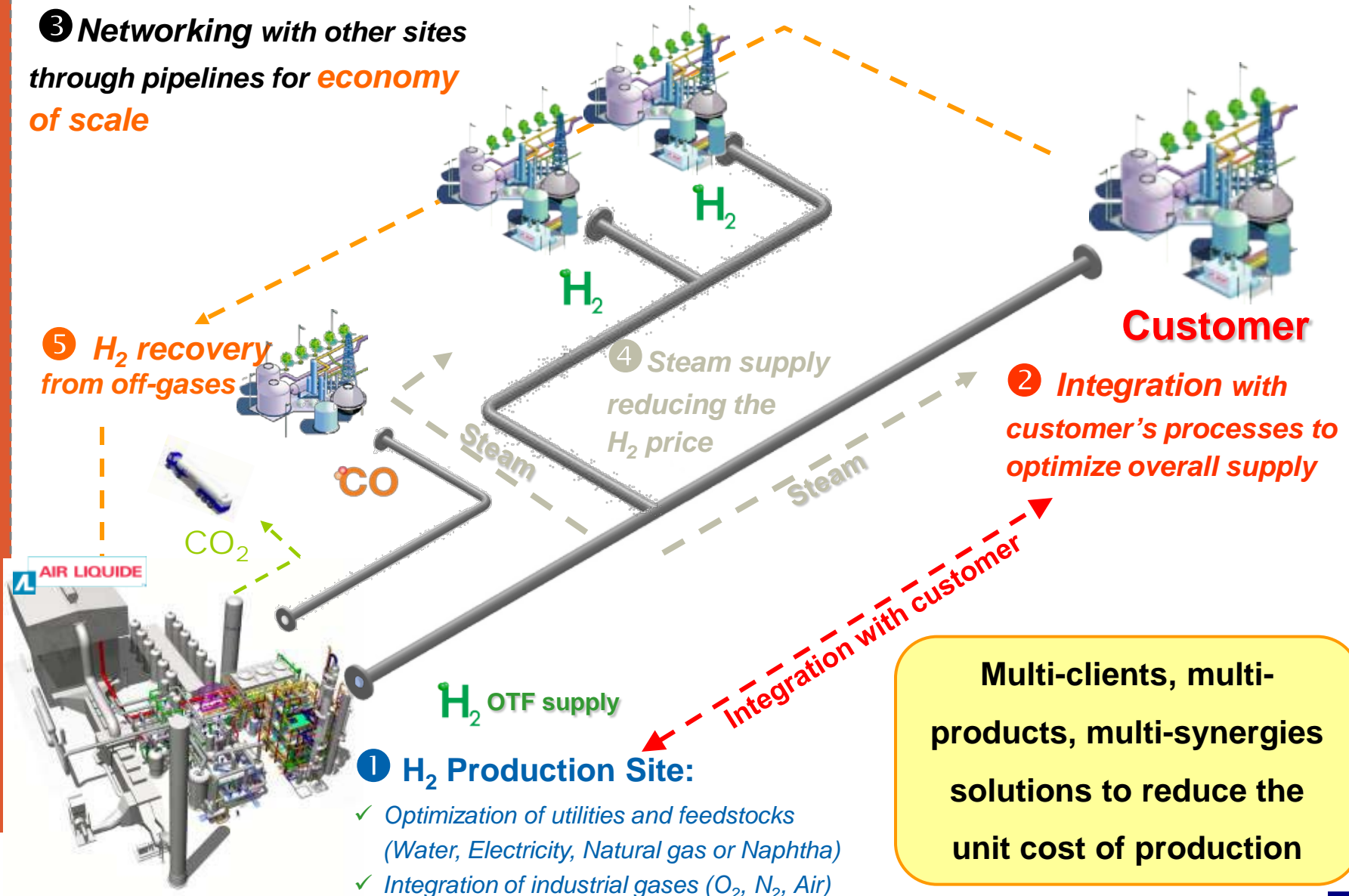
# Air Liquide H<sub>2</sub> Basin Approach

**3** Networking with other sites through pipelines for **economy of scale**

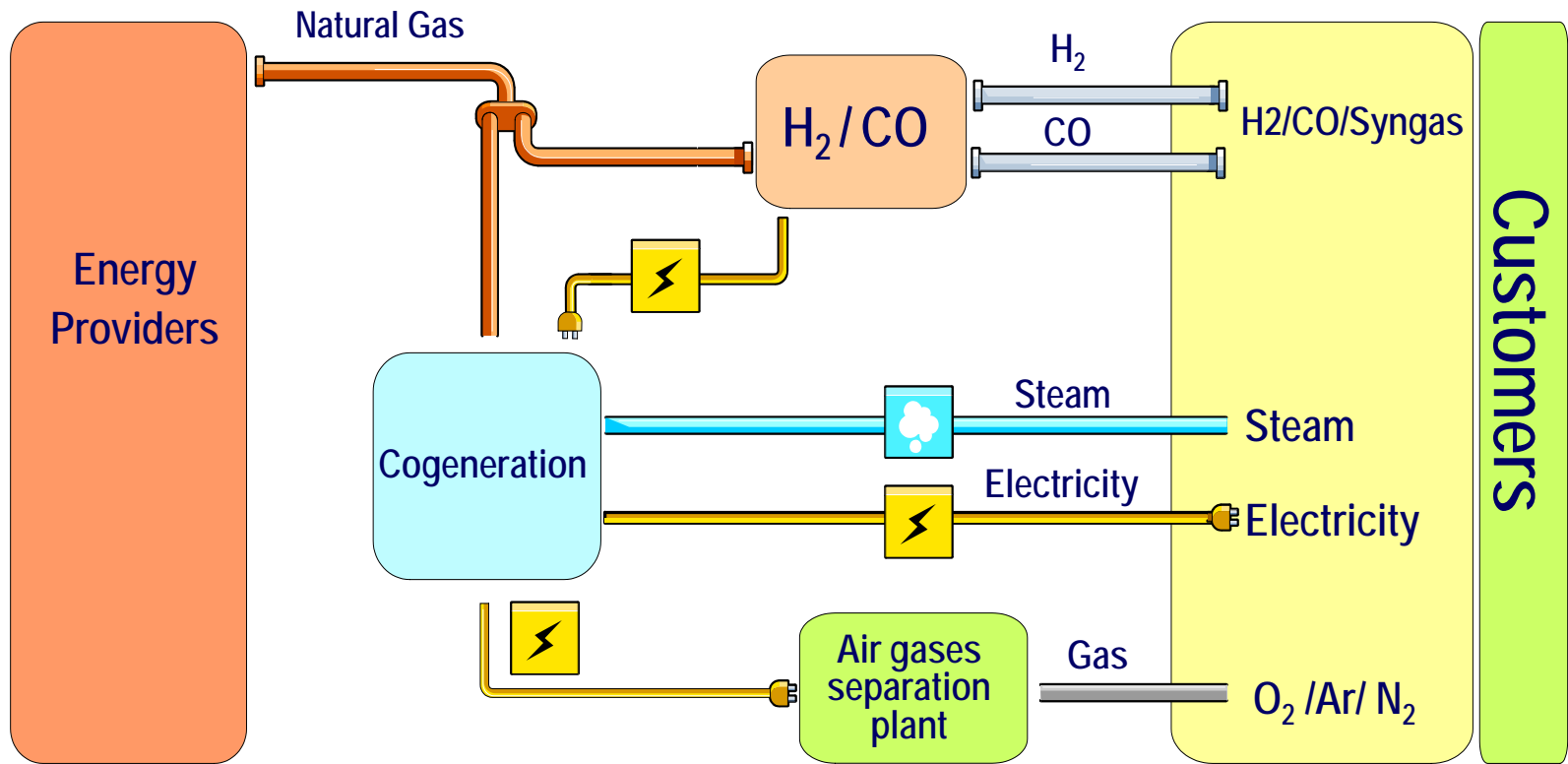
**5** H<sub>2</sub> recovery from off-gases

**4** Steam supply reducing the H<sub>2</sub> price

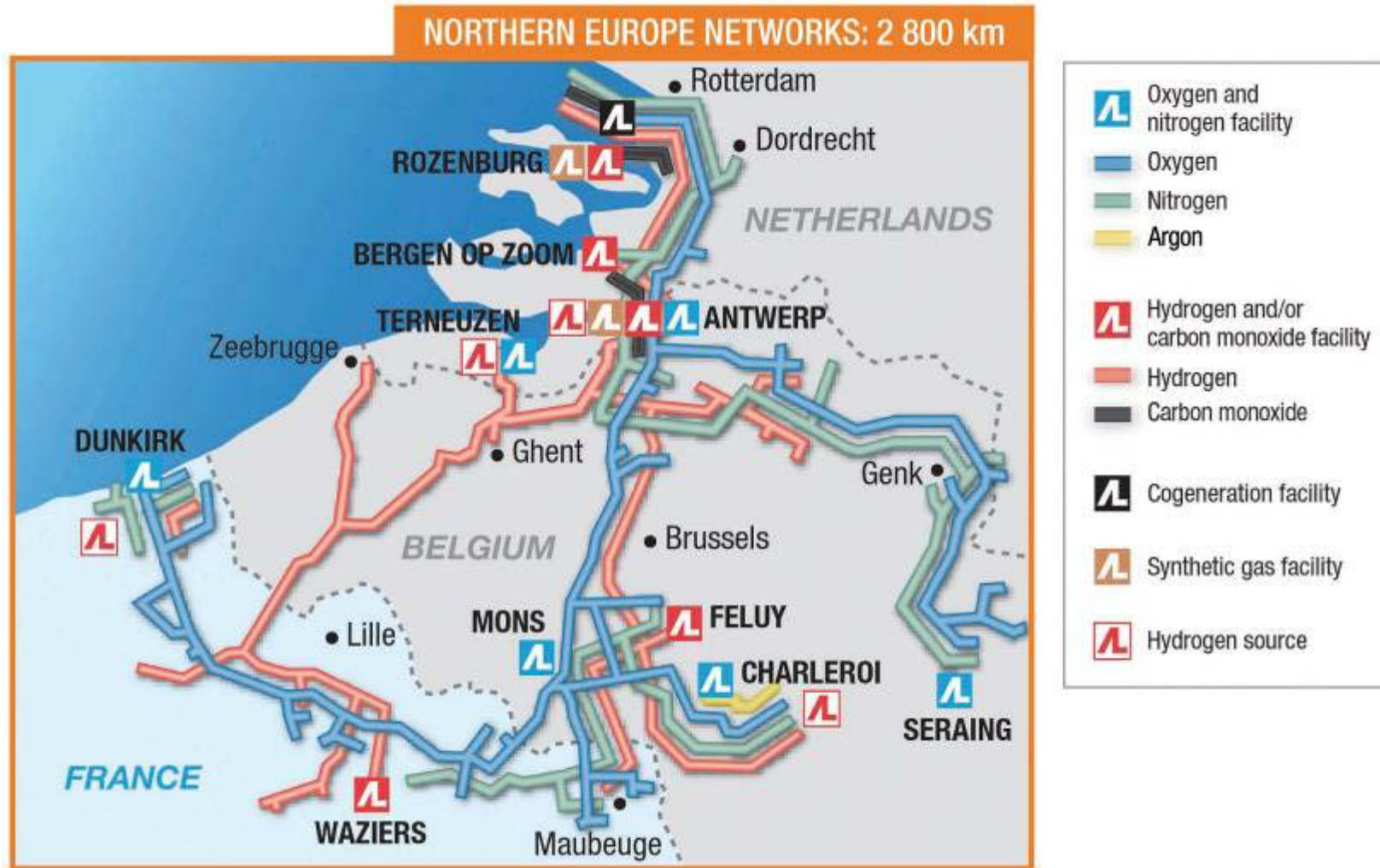
**2** Integration with customer's processes to optimize overall supply



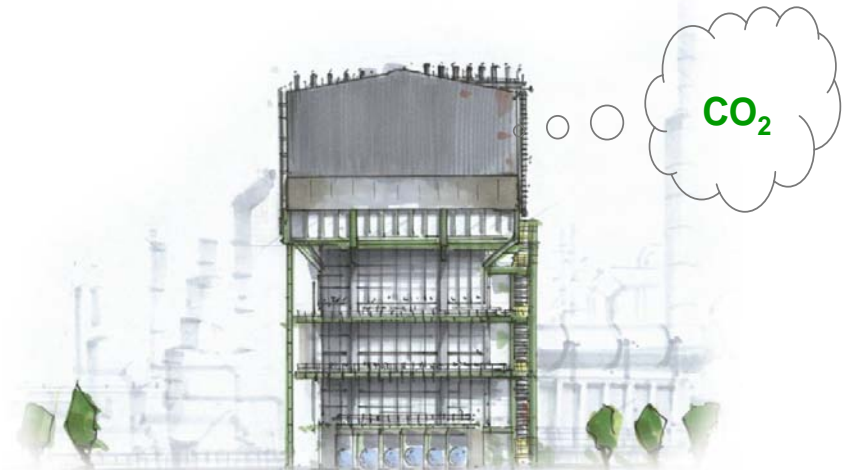
# Thermal and energy integration



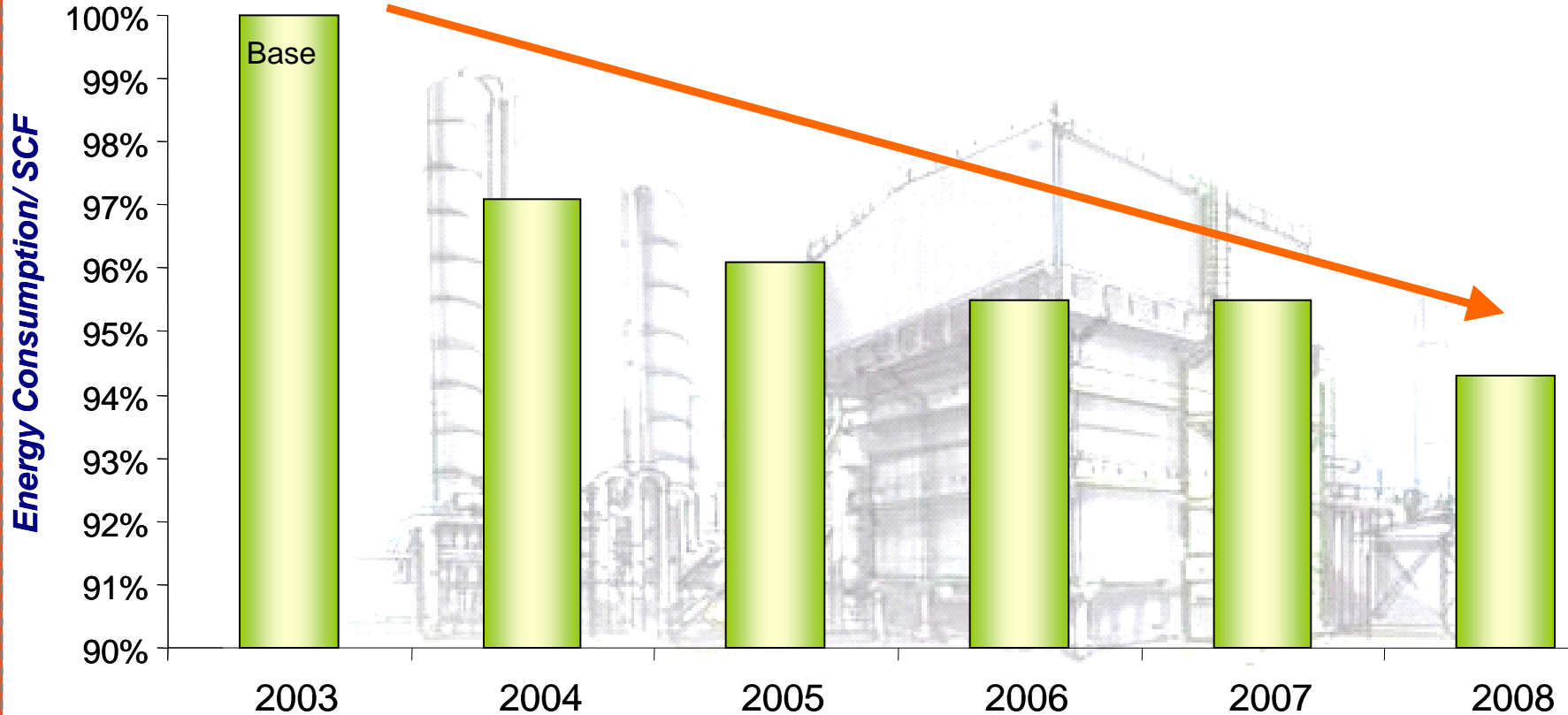
# The Northern France and Benelux Networks



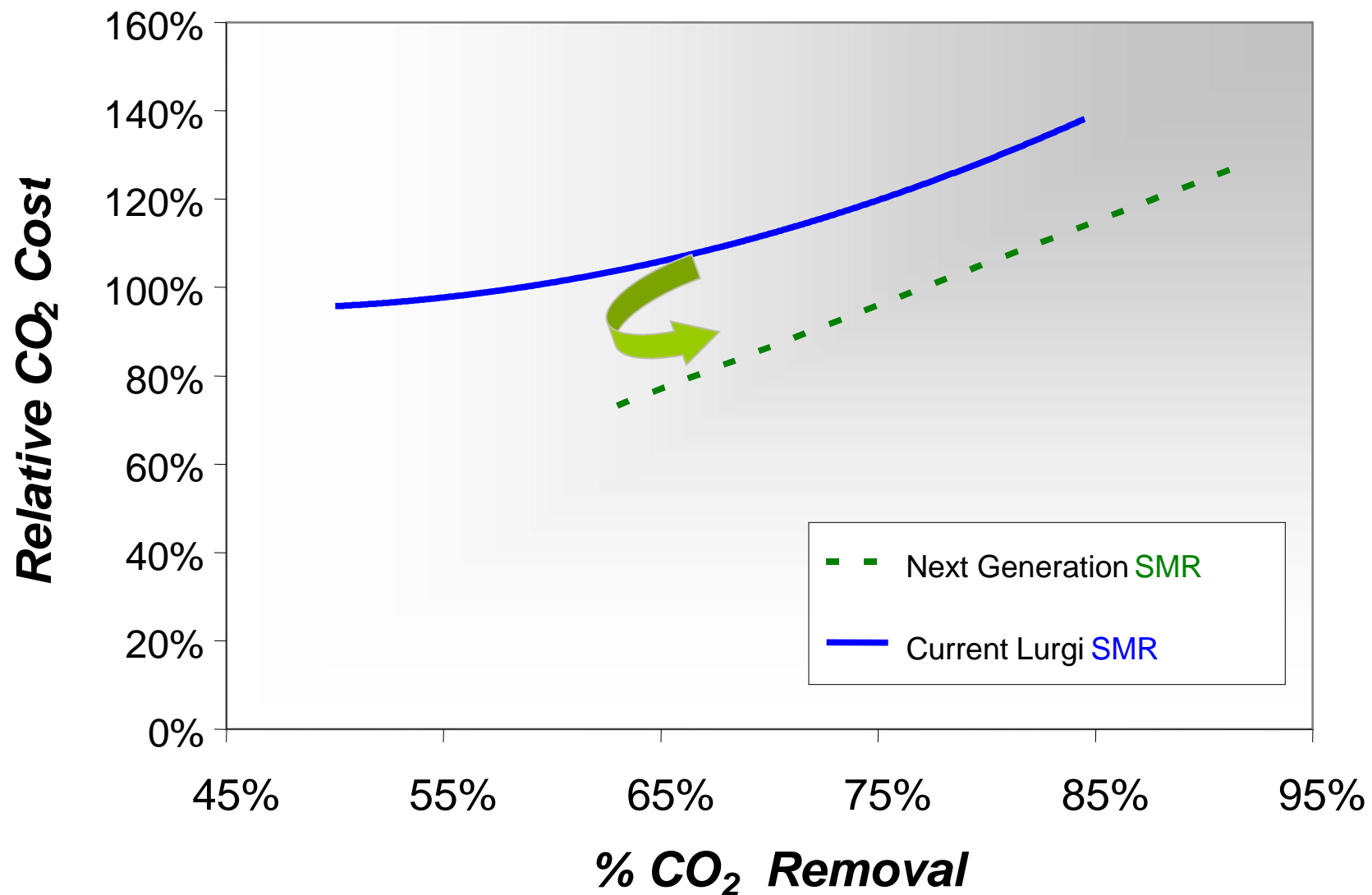
- Optimizing performance to reduce CO2 emissions
  - ✓ Air Liquide hydrogen plants linked to Industrial Management System
  - ✓ Efficiency optimization
  - ✓ Ensure feedback to Engineering and Operations, close the loop
  - ✓ Focus on **Reliability** and **Availability**
  - ✓ Actions to prevent incidents
- Developing CO<sub>2</sub> capture on SMR's
  - ✓ Reduce emissions prior to capture
  - ✓ High capture rate (65 – 92%)
  - ✓ Reduce/optimize cost of capture
- Develop CCS
  - ✓ Partnerships, example: CINTRA
  - ✓ Involved in value chain



# Air Liquide Worldwide HyCO Plant Efficiency

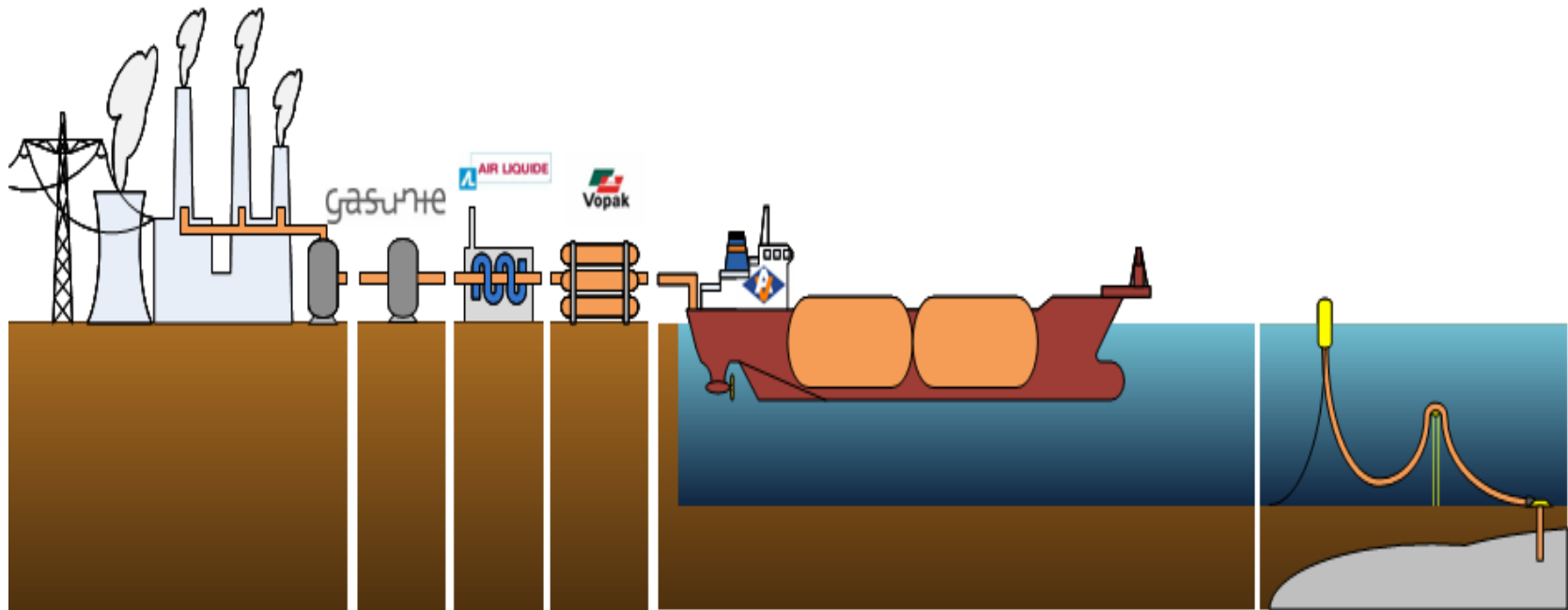


# Reducing Cost of CO<sub>2</sub> Capture/Drying/Compression



# CINTRA: JV for CCS logistics

- One stop shop for CO2 emitters



- Value chain: Possible supply of CO2 for EOR, Oil Field Fracturing, food, beverage, water treatment and many other uses

## ■ Refining

- ✓ Desulfurization of fuels, due to more severe specifications of a.o. marine fuels
- ✓ Conversion of residues to lighter products

## ■ Chemicals

- ✓ Debottlenecking and new plant investments

## ■ Energy conversion

- ✓ IGCC/CCS as a future source of H2/syngas

- H2 generation through windpower ( electrolysis)
  - ✓ Prince Edward Island and Nunavut projects- clean power generation for off-grid, remote communities in Canada (wind –hydrogen solutions)
  - ✓ H2 next to biodiesel used as fuel in absence/ insufficient wind
  
- H2 generation through hydropower (electrolysis)
  - ✓ H2 (fuel cell) powered forklifts: sustainable refrigerated distribution centre of Wal-Mart Canada



**Thank You**