



Liquid Innovations
Hydrogen, CO₂, LNG and bio fuels
in Energy Port Rotterdam

ROTTERDAM.**CLIMATE**.INITIATIVE

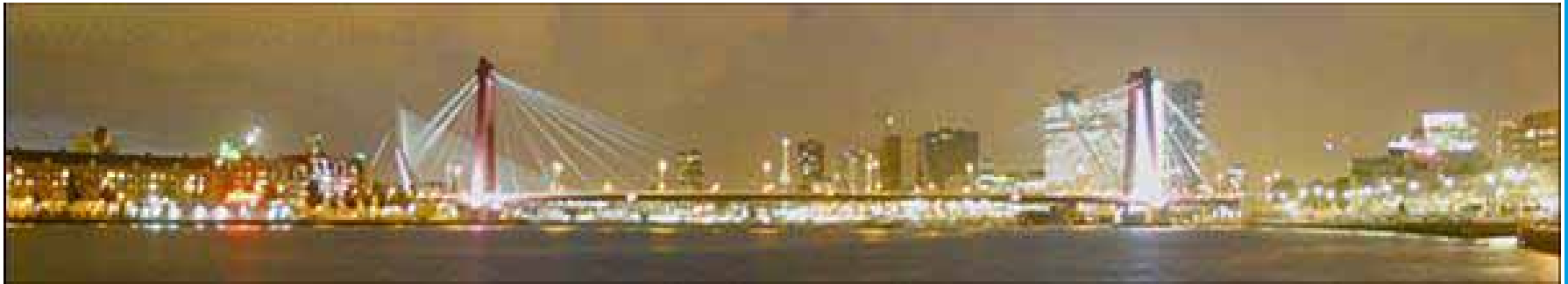
December 11, 2008
Gerrit J. van Tongeren

Liquid Innovations

- Rotterdam Energy Port
- Rotterdam Climate Initiative
- Hydrogen: Actions and Ambitions
- Connections between hydrogen, CCS, LNG and bio fuels



Rotterdam Energy Port



Rotterdam region 1.2 mln residents, 10.500 ha port area.

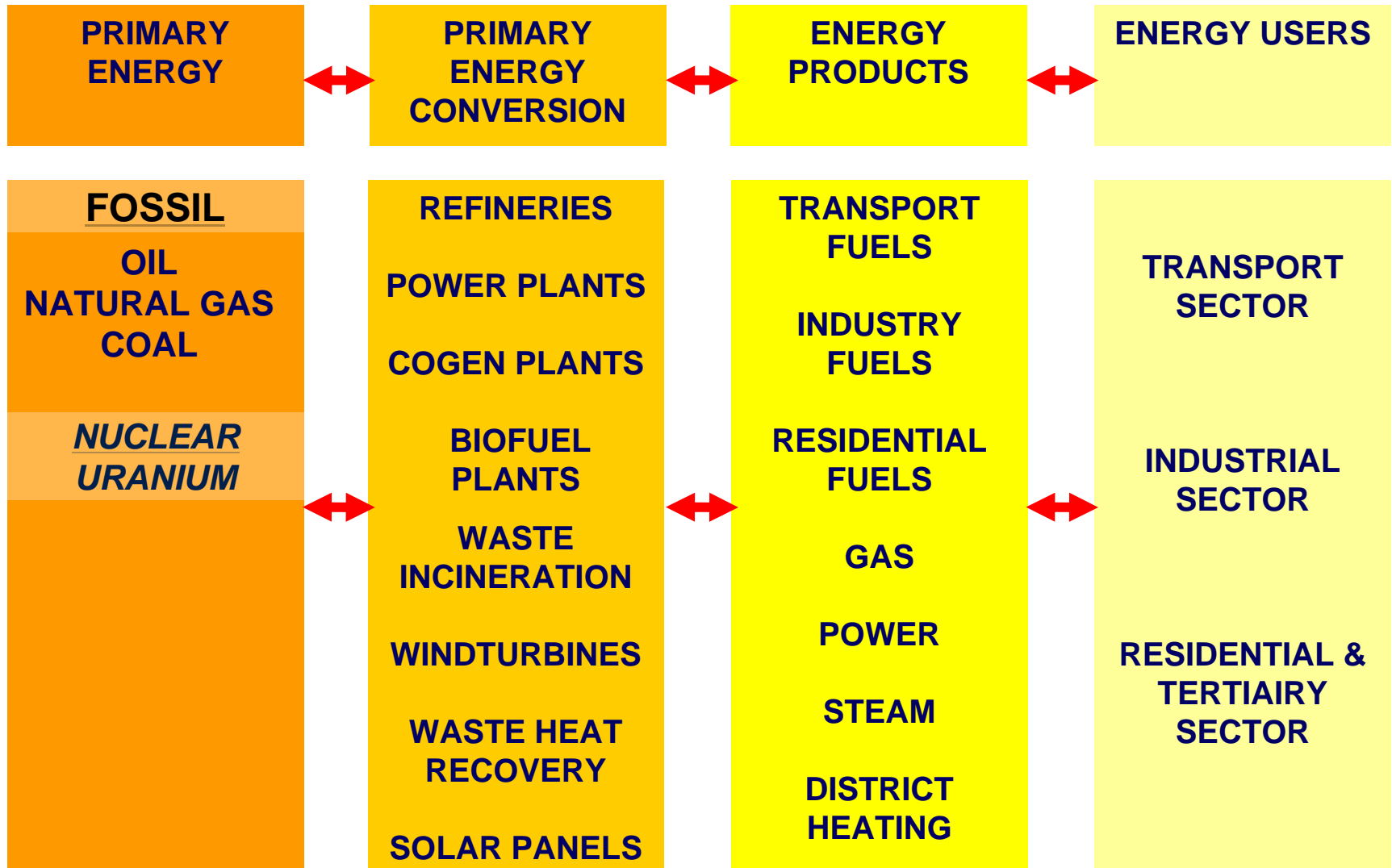
Throughput Port of Rotterdam 2007: 407 mln tons
(import 299 mln tons, export 107 mln tons)

For example

Iron-ore:	40 mln tons
Coal:	28 mln tons
Crude oil:	97 mln tons
Mineral oil:	57 mln tons
Containers:	105 mln tons (10,8 mln TEU containers)



Energy Chain



CO2

Rotterdam Climate Initiative

Ambition:

50% reduction of CO₂ emissions in 2025, as compared with 1990



Rotterdam Climate Initiative

The three chapters:

- Saving Energy
- Sustainable Energy
- Carbon Capture and Storage (CCS)



Rotterdam Climate Initiative

The five programmes:

- Sustainable City
- Energy Port
- Sustainable Mobility
- Energizing City
- Innovation Lab



Hydrogen Actions and Ambitions

Why hydrogen in Rotterdam?

- Production facilities: 1.000 tons a day (1 million households or 2 million hydrogen cell vehicles)
- Industrial corporations (Air Products, Shell, ExxonMobil and AKZO)
- The urgency of reducing CO₂ reduction and improving air quality
- Infrastructure for hydrogen: 50 km to the west (Zwijndrecht) and 150 km to the south (Antwerp)



Hydrogen Actions and Ambitions

Hydrogen Projects in Rotterdam

- Transport: H₂-ICE buses (Shell, MAN, Connexxion, AP)
- Maritime: feasibility studies and for propulsion and on shore power supply.
- Stationary: CHP pipelines
- Industrial utilization: use of off-gas hydrogen (Nedstack, AKZO)
- Mobility (small scale): Formula Zero



Hydrogen: Perspective on 2018

Hydrogen Drivers

- Developments in energy (price of oil, storage facilities)
- Technological developments (plug & play, commercial applications)
- Range of infrastructural options
- Supporting governmental policies



Hydrogen: Perspective on 2018

Production

Rotterdam as main producer and hub of climate neutral hydrogen in Europe

- Zero Emission Power Plants
- Green Production of Hydrogen
- Rotterdam International Distribution Point



Hydrogen: Perspective on 2018

Three stages

- Current H₂ production: natural gas based
→ not climate neutral
- Green H₂: steam reforming of biomass/biogas, electrolysis with green electricity
- Climate neutral H₂: steam reforming of gas with CCS → opportunities for CCS in Rotterdam



Hydrogen: Perspective on 2018

Storage and Distribution

- Filling stations: alongside roads and on shore
- Supply: pipeline and transport of LH₂
- Hydrogen highway



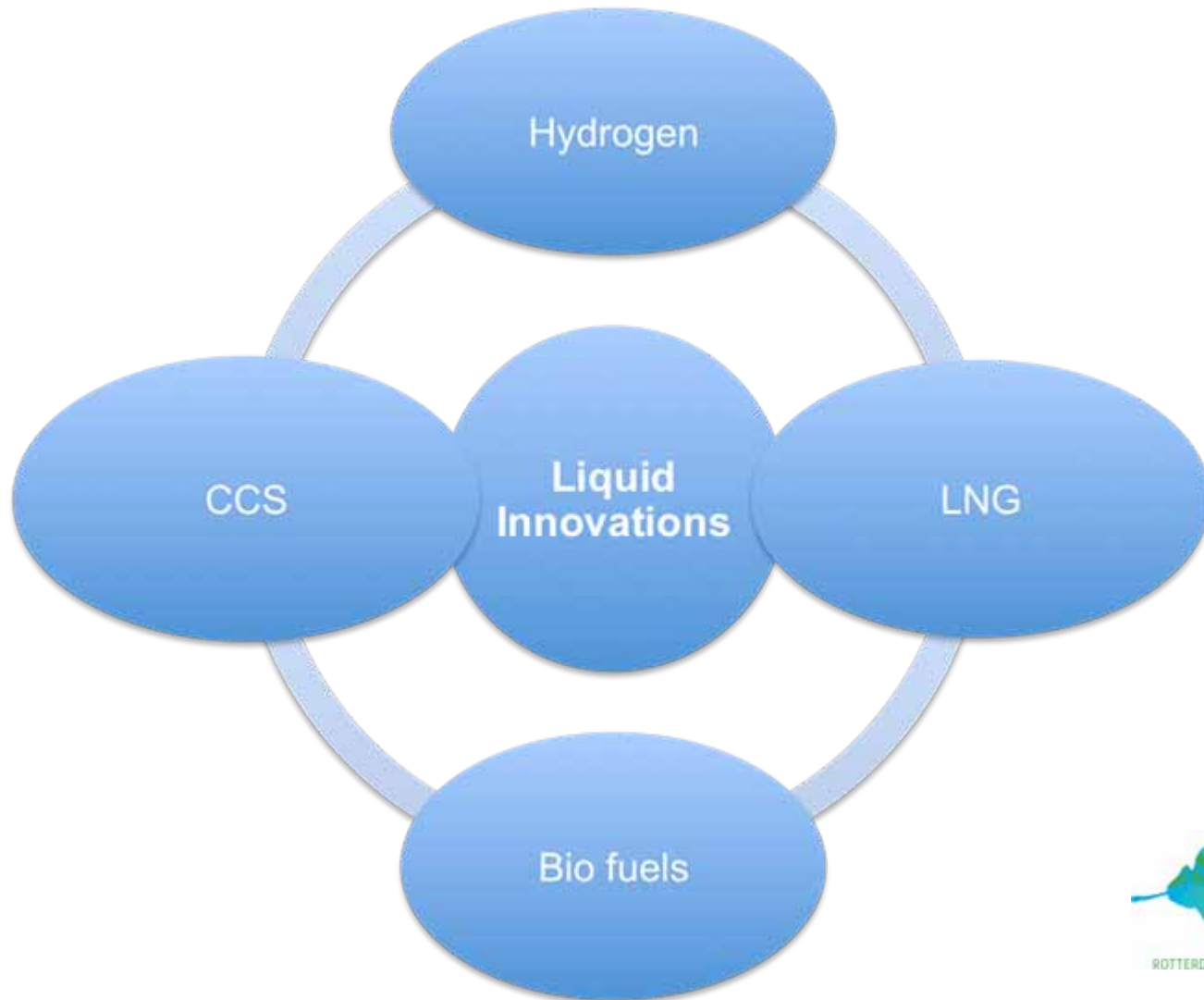
Hydrogen: Perspective on 2018

Use

- > 50 interprovincial H₂ buses
- > 500 H₂ vehicles for distribution of goods in cities
- Green port equipment: > 1.000 H₂ forklift trucks
- H₂ in residential area
- Maritime functions: on shore power supply and internal navigation



Liquid Innovations



Worldwide Liquid Innovations

