

C.GEN's North Killingholme IGCC Project



C.GEN

- C.GEN NV established early 2007 :
 - ◆ Linked with Cobelfret:
 - Long and short haul ship transport:
 - coal, ore,
 - cars, containers
 - Terminals in Europe, for instance Rotterdam, Flushing, Killingholme
 - ◆ Realize sustainable energy projects and energy projects with low CO2 emission;
 - ◆ Interesting synergies: coal supply, CO2 transport by ship, nautical experience, presence in major ports.

Key Requirements C.GEN's Projects

- ❑ CO2 capture & solid fuel firing plants with low ecological footprint (public acceptance)
- ❑ Robustness in changing economic and legislative environment, flexibility, opportunities
 - ◆ Fuel flexibility: preference to non-conventional steam coal for lower OPEX
 - ◆ Balancing Efficiency vs CAPEX
 - ◆ Delivery of pure hydrogen to third parties:
 - bridge towards H2 economy
 - arbitrage between electricity and hydrogen
 - ◆ Keeping several doors open for CO2 disposal: phased construction – possibility for natural gas as feedstock
- ❑ High availability
- ❑ Proven technology

Project Definition

- ❑ Conceptual feasibility study completed by Foster Wheeler in April 2008
- ❑ Base concept: coal gasification and combined cycle plant
- ❑ Twelve scenarios: several technologies, with and without carbon capturing, poly-generation (electricity plus ...), combination of gasifier and GT technologies

- Conclusions Conceptual Feasibility Study:
 - ◆ IGCC technology sufficiently proven
 - ◆ IGCC plants with CO₂ capture economically feasible under certain conditions,
 - ◆ Importance of flexibility
 - ◆ Hydrogen/electricity arbitration opportunities
 - ◆ Secure and reliable CO₂-offtake is essential

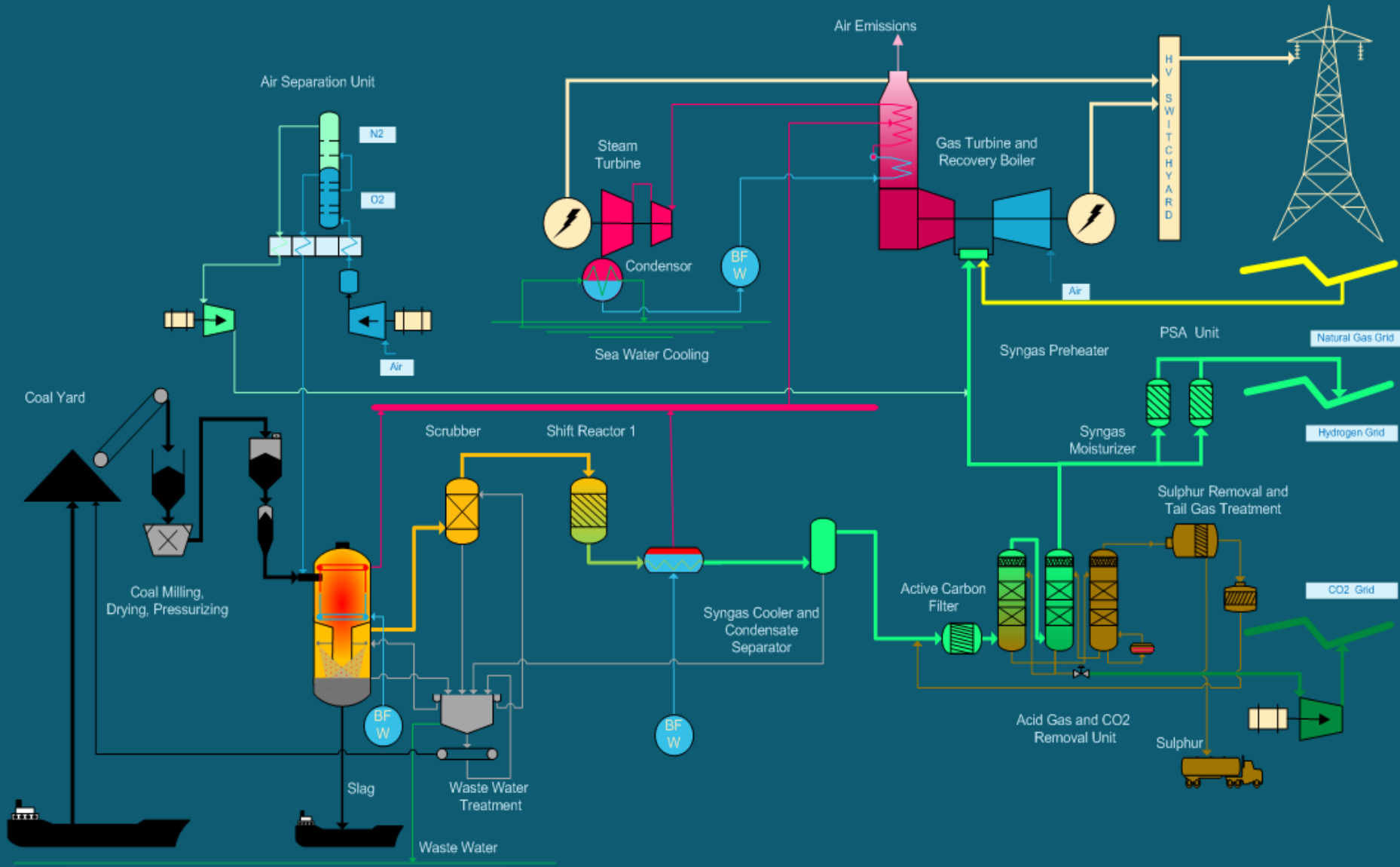
Project Definition

- ❑ Detailed Feasibility Study” started July 2008 – technology ranking (including “addenda”) finalized end March 2011
- ❑ Technical-economic results definitely in favor of water quench gasifiers:
 - ◆ Higher fuel flexibility
 - ◆ Lower capex
 - ◆ Higher availability
- ❑ Feasibility phased construction investigated (in case CO₂ transport/storage not timely available or CCS not commercially viable)

Project Definition

- ❑ Opportunities for integration of IGCC project in existing industrial network (hydrogen & industrial gas supply)
- ❑ Similar projects on locations in the Netherlands and UK: modular approach

IGCC Plant



Project Definition: Main Parameters of Single Module

- ❑ IGCC Plant with a capacity of up to 520 MW net + possibly 5 - 7 t/h pure H₂
- ❑ Fuels:
 - Unconventional hard coal (low AFT, ...)
 - Petcoke (up to 30% co-combustion)
 - Sustainable biomass (woodchips, up to 30% co-combustion)
- ❑ Up to 5000 tpd hard coal (without additional H₂)
- ❑ Coal unloaded from ships or barges on site, or transported from neighboring port, storage on C.GEN's coal yard;
- ❑ Potential CO₂ capture capacity: 10.000 tpd
- ❑ Evacuation CO₂ by pipeline or ship
- ❑ HRSG with SCR
- ❑ Exchange of heat with neighboring plants possible

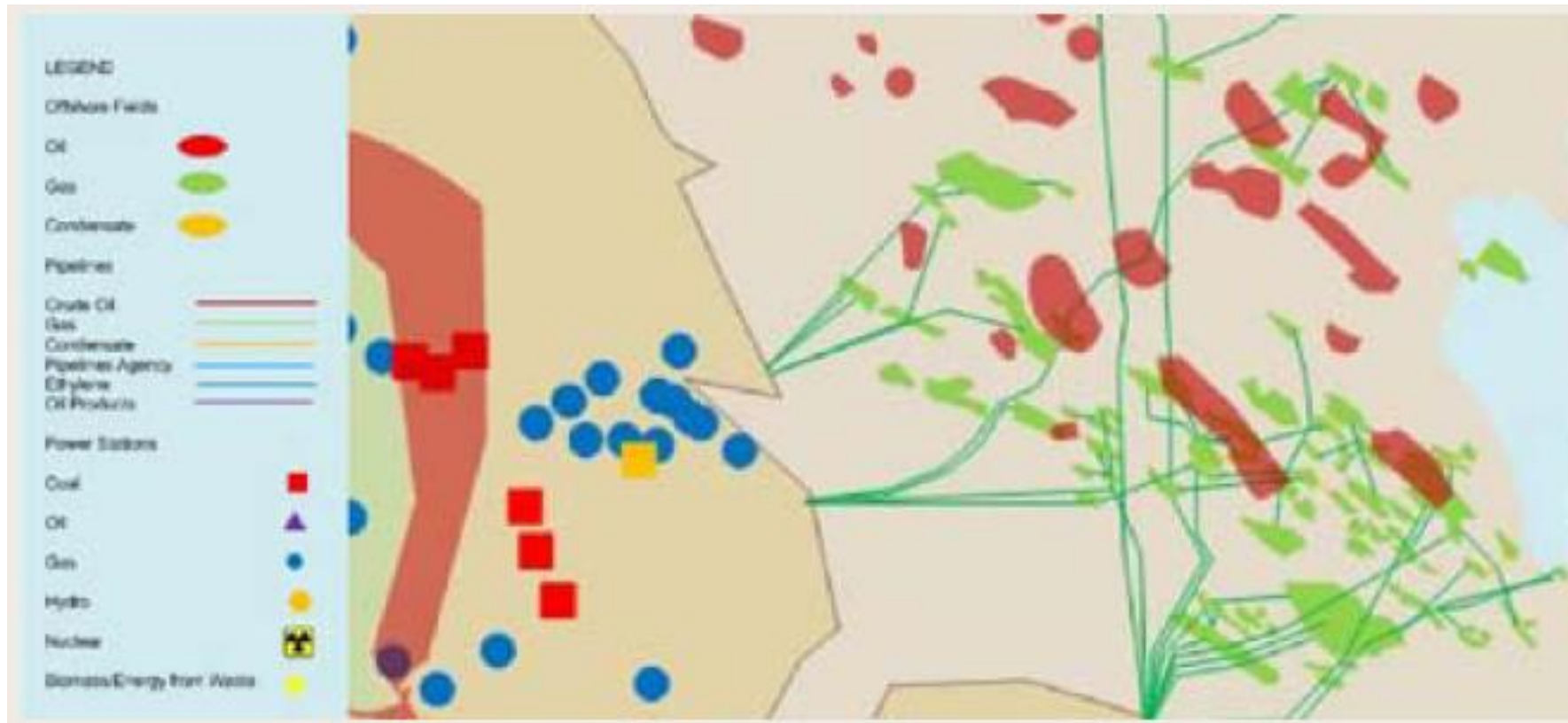
C.GEN's land in Killingholme



Location Killingholme

- ❑ Start with one module up to 520 – 570 MW net
- ❑ Harbor facilities and railroad connection present
- ❑ Industrial environment:
 - Potential H₂ and heat off-takers
 - Potential supply of waste fuels
- ❑ Close to off-shore CO₂ storage area
- ❑ HV connections nearby
- ❑ Cooling water available – cooling towers probably necessary

Emitters and storage possibilities in the Humber



With courtesey "Yorkshire Forward"

Timeline Killingholme

- ◆ Parsons-Brinkerhof started permitting procedure 2010
- ◆ Scoping document will be issued soon
- ◆ NER application filed February 2011
- ◆ Commercial operation: 2015-2016
- ◆ Phased Construction if CCS not economically viable yet

