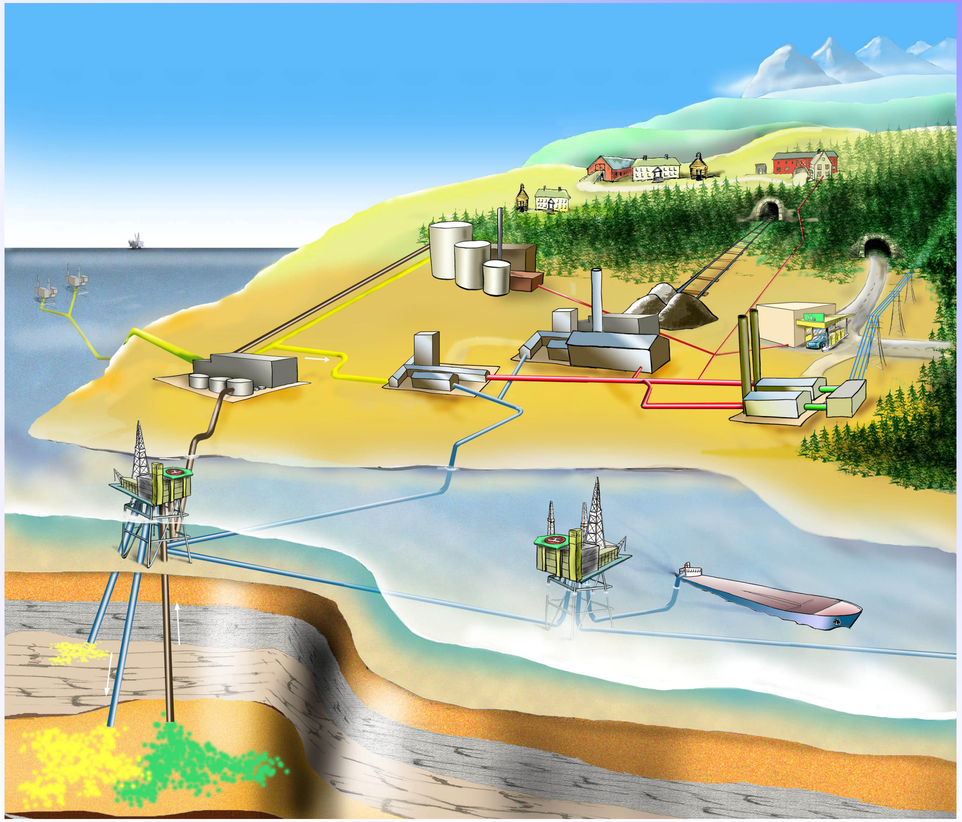
DYNAMIS

Introduction and interaction with ZEP and HFP – towards ZEP

CASTOR-ENCAP-CACHET-DYNAMIS Workshop 22-24 Jan. 2008

Nils A. Røkke – Co-ordinator - SINTEF



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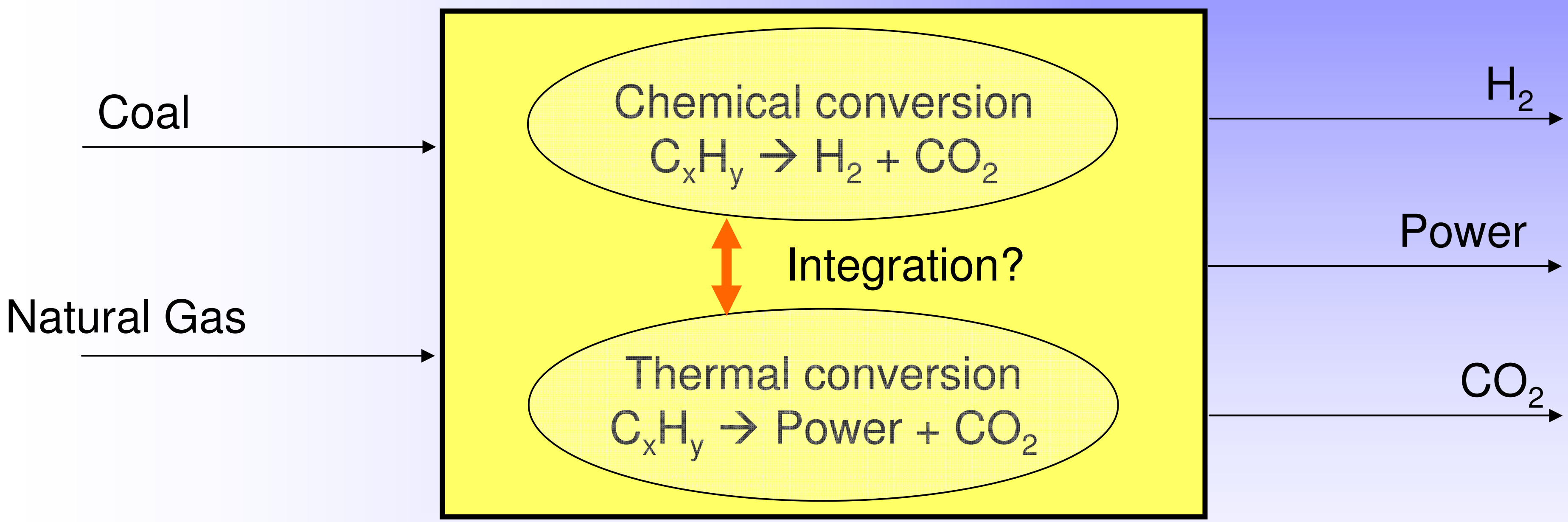
DYNAMIS scheme

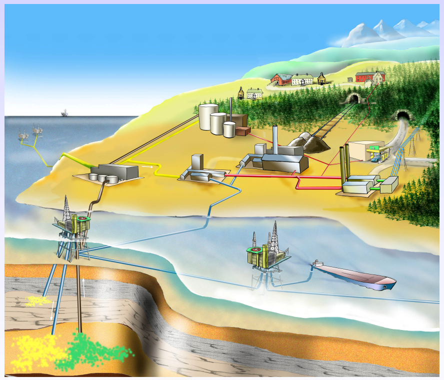


EU - DYNAMIS/HYPOGEN overall timeline & budget

• Phase 0 Feasibility Study by JRC (2004)	
• Phase 1 Measures within FP6, DYNAMIS (2006-2008)	7.5 M€
• Phase 2 Pilot Scale Demonstrations (2008-2010)	290 M€
• Phase 3 Demonstration Plant Construction (2008 – 2012)	800 M€
• Phase 4 Operation and validation (2012-2015)	200 M€
SUM	**~1300 M€**

Pic. Siemens

Pic. Vattenfall



Ill. Statoil

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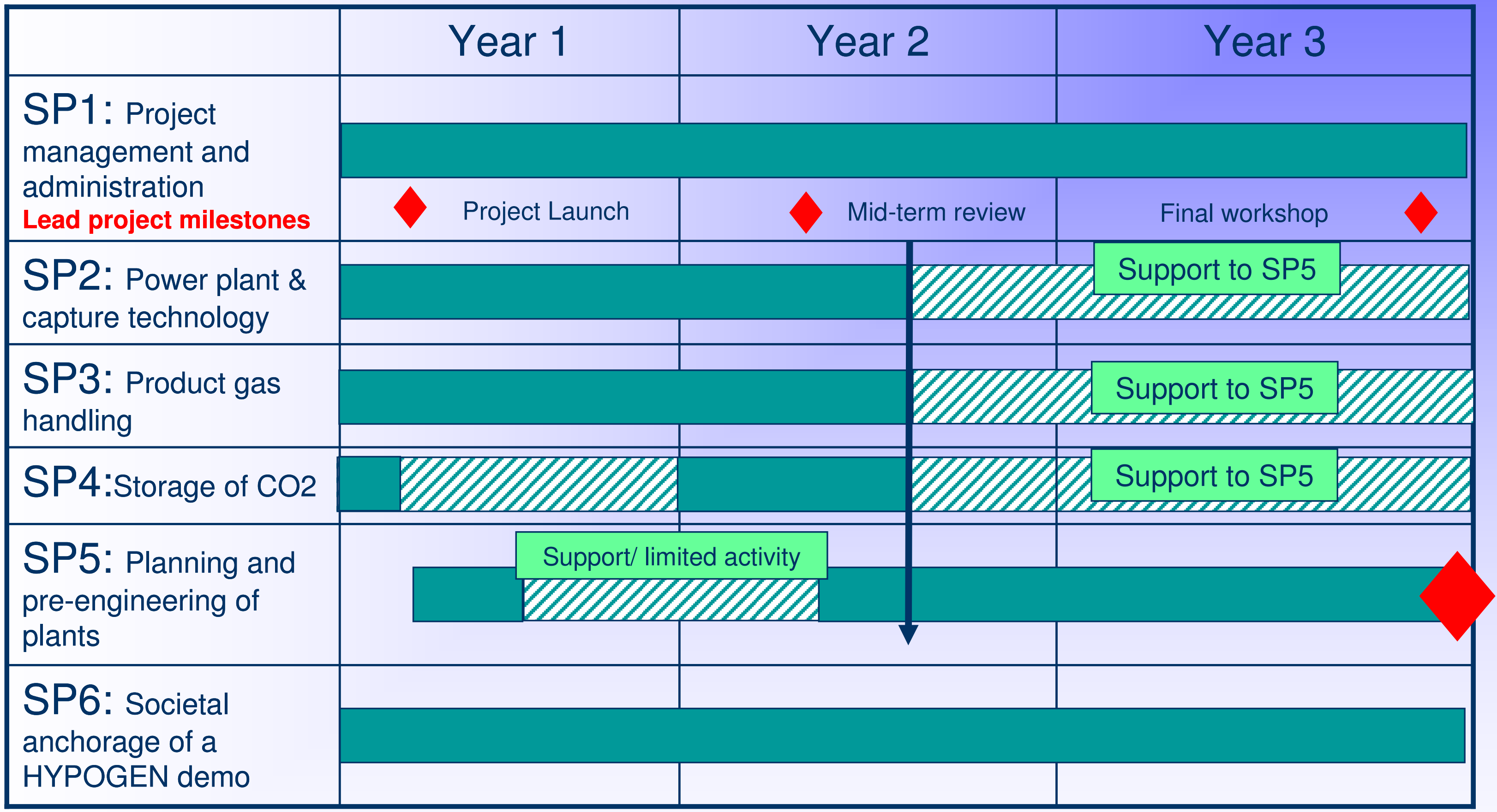
Overall Project Schedule



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Criteria for selection (typical)

- Geographic aspects
  - Site specifics
  - Fuels availability
  - Power and heat sales
  - CO_2 conditioning and storage
  - Hydrogen demand
- Technical issues
  - Overall 90% CO_2 extraction, 400 MW_e and 0-50 MW H_2 export
  - Methane/Coal reforming/gasiifcation technology
  - Syngas Separation and Conditioning
  - GT's and train configuration(SIEMENS V94.2K, ALSTOM GT13E)
- Financial Issues
  - CAPEX, OPEX
  - Financial risk(Technical, Financial (loans and interest, bankability),EIB role)
- Political & Legal
  - Framework
  - Concensus and joint undertakings
  - Storage risk and acceptance

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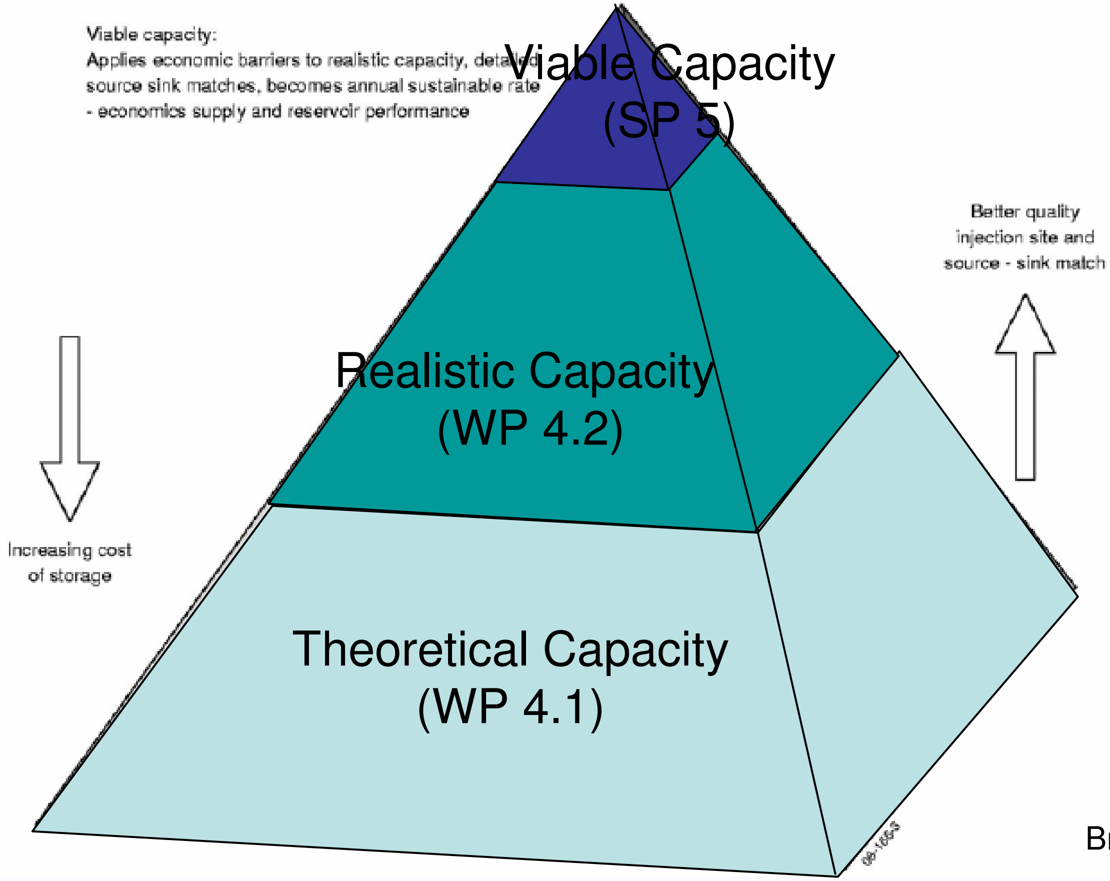
Critical criterion - CO_2 storage

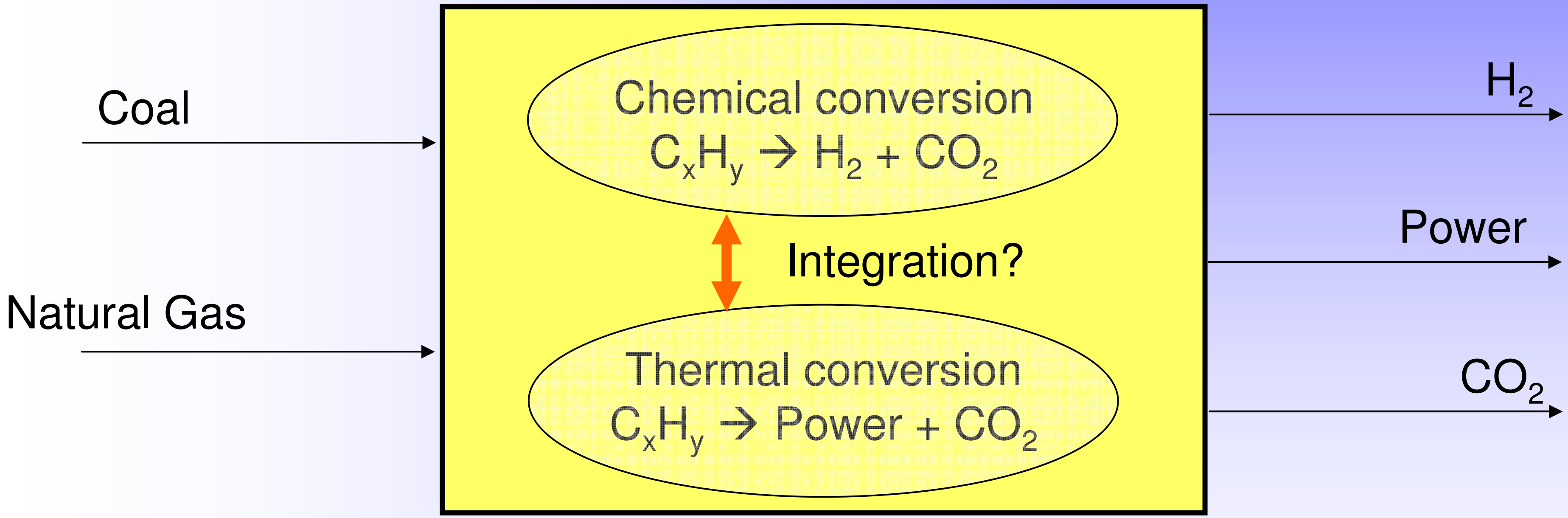


Bradshaw et al, 2006

Criteria list

- Depth > 800 m or P-init > 80 bar or Supercritical CO_2
- Total storage capacity > 60 Mt CO2
- Injectivity > 2.0 Mt CO_2 per year or permeability > 200 mD
- Integrity of seal in terms of thickness, faults etc.
- Location of site compared to Power/Hydrogen Market
- Geographical representation of sites
- Availability of geological data
- Availability of site by 2012
- Variety of geological conditions
- Variety of storage types

Technology Selection - reminder



Power plant and capture technologies – cases studied

6 NG cases	3 NG cases	GT26, Post-C, SMR, Pre-C – integration GT13E2, ASU, ATR, Pre-C – integration GT13E2, ATR, Pre-C - integration
6 Coal cases	3 Coal cases	Shell gasifier Siemens/Future Energy gasifier GE/Texaco gasifier All cases: GT13E2, Selexol
x Lignite cases	3 Lignite cases	TBD – in progress – 3 cases initially HTW gasifier included, instead of GE/Texaco

Technology selection

- Natural Gas with Pre-C capture
- Natural Gas with Post-C capture and NG reforming of H2
- Coal and/or lignite with Pre-C – (ZE)IGCC

- Coal/lignite with parallell H_2 production and CO_2 capture (oxy-fu or Post-C) not pursued due to efficiency and thus cost issues

Decision of the EB Sept 07

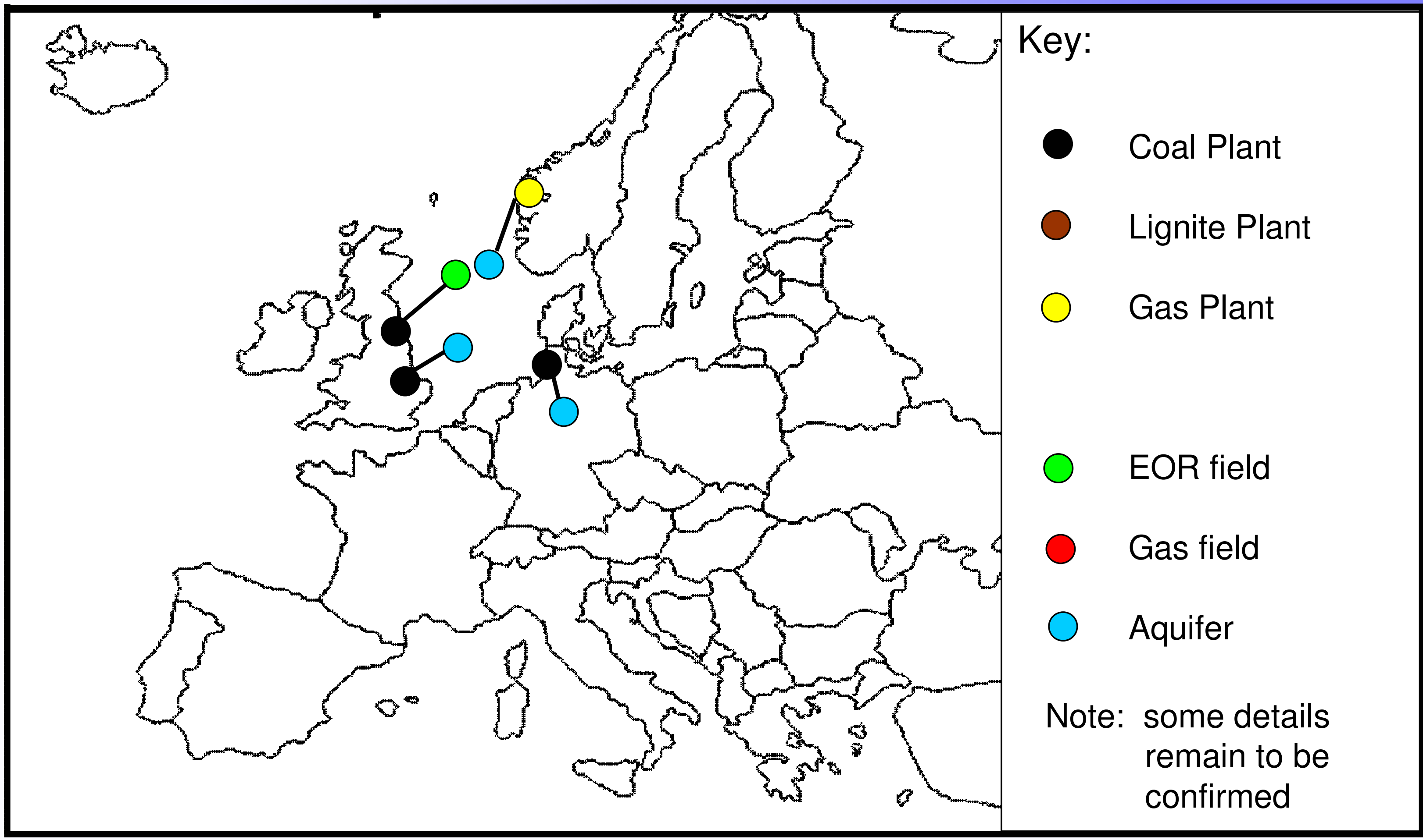
Using the DYNAMIS requirements of cost efficient production of H2, electricity and CO2 storage, 4 sites are recommended for further studies in the second phase of DYNAMIS:

- **Mongstad, Norway**, suggested by Statoil: Natural gas based plant with offshore CO_2 storage.
- **Hamburg region, Germany**, suggested by Vattenfall; Bituminous coal based plant with onshore or offshore CO_2 storage
- **East Midlands, England**, suggested by E.ON UK; Bituminous coal based plant with offshore CO_2 storage
- **North East UK**, suggested by PEL; Bituminous coal based plant with offshore CO_2 storage

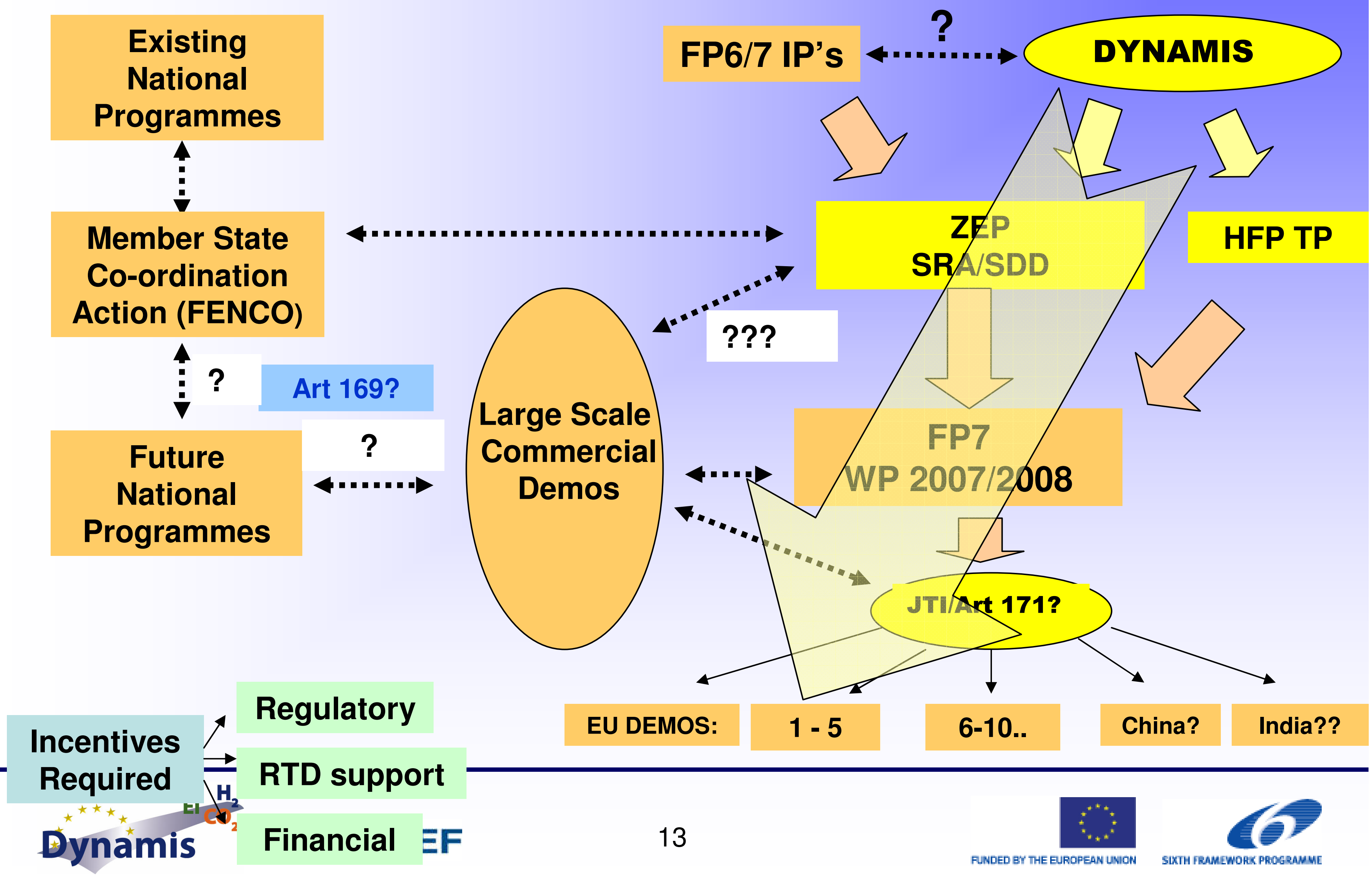
These plants represent a reasonable spread of fuel types, storage types and location and hydrogen utilisation/export possibilities

Hydrogen use and off-take as stated in the DYNAMIS mandate is hard to accomplish in most cases

Shortlist of plants- HYPOGEN



How does everything fit together?



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Summary and conclusions

- 4 sites have been identified as candidate plants for the HYPOGEN initiative- these have all been proposed by an industrial partner.
- Further work will involve to further develop these cases with pre-engineering studies and preparatory measures (EIAS,..)
- Target is to have developed these cases to ready for project launch by the end of DYNAMIS, i.e. March 2009.
- Much is now dependent upon the industrial commitment and support of the specific sites.

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Thank you for your attention

Dynamis SINTEF

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Screening results – traffic light method

GREEN – This should be used to represent a condition where the site is considered very close to optimal for purpose. For example if the site is of sufficient size to house the necessary plant components in an ideal layout then this criterion should be given a green, or if the storage location has sufficient capacity to store the CO_2 captured throughout the entire plant life safely then this criterion should be given a green weighting.

AMBER – This should be used to represent a hurdle which is not desirable, but one which could be overcome. For example a site plot which forces a site / plant layout which would not be considered ideal, or a compartmentalised storage location which may present additional engineering challenges.

RED – A red traffic light should be used to represent a negative factor which is considered financially or technologically prohibitive to overcome. For example, if a site was not of sufficient physical size to house the necessary plant equipment it would be deemed a red, or if the CO_2 compression requirement in order to utilise a particular storage location was so high as to compromise the project viability. The sites proposed as case studies for the DYNAMIS project should not have any critical criteria scored as red.