



Pöyry Energy Consulting

Economics modelling CCS

Coal Research Forum Combustion Division
Imperial College

Phil Hare

17th April 2007

Introduction

- Very different views on the competitiveness of CCS
- Sensitivity to assumptions – technologies, fuel and carbon prices etc
- Need to examine end-to-end economics and optimise system across the chain
- DTI support – report available on:

<http://www.dti.gov.uk/energy/sources/sustainable/carbon-abatement-tech/page19502.html>

Key Sources of information

- International Energy Agency
- IPCC Report Carbon Dioxide Capture and Storage
- British Geological Survey

Economic assessments – a health warning

- Answers very dependent on view of “do-nothing”
 - Company investment economics likely to be based on current assets
 - Traditional currency of abatement is vs CCGT alternative
- Abatement £/tonne figures for coal plant are very sensitive to choice of counterfactual

Modelling process

Capture

- Technologies
- Performance
- Capital costs
- Operating costs
- Return on capital
- Fuel costs
- Carbon markets
- Learning curves
- Asset lifetimes



Transport

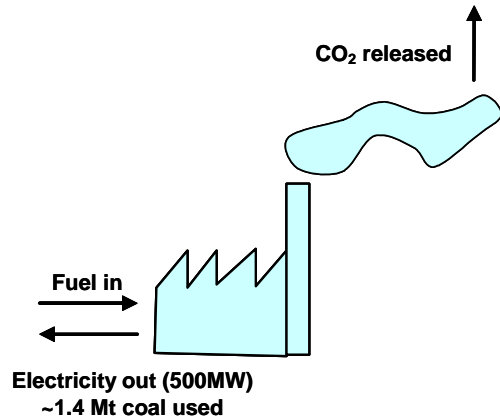
- Onshore
- Existing terminals
- Offshore
- Hub and spoke vs
- Direct connect
- Pipes
- Compressors



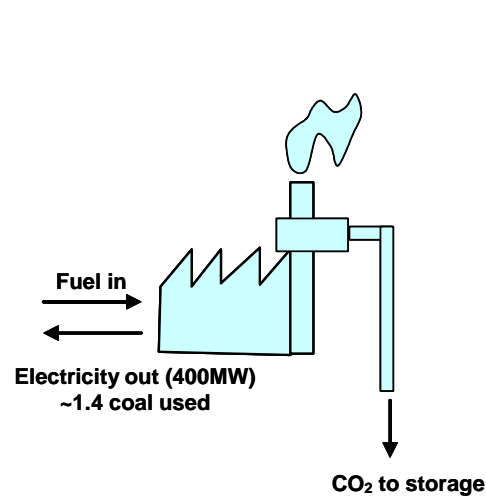
Storage

- Field Type
- EOR revenue
- Sea depth
- Reservoir size depth
- Platform costs
- Drilling costs

Abatement v capture

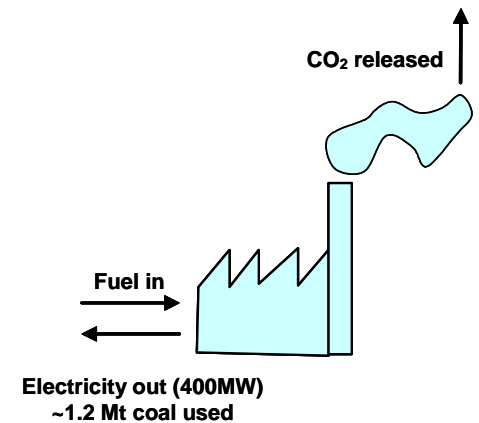


**Existing unit without CCS
releases ~3.0 Mt CO₂**



**Existing unit with CCS
releases ~ 0.4 Mt CO₂**

Uses same fuel as existing unit
but less electricity sent out

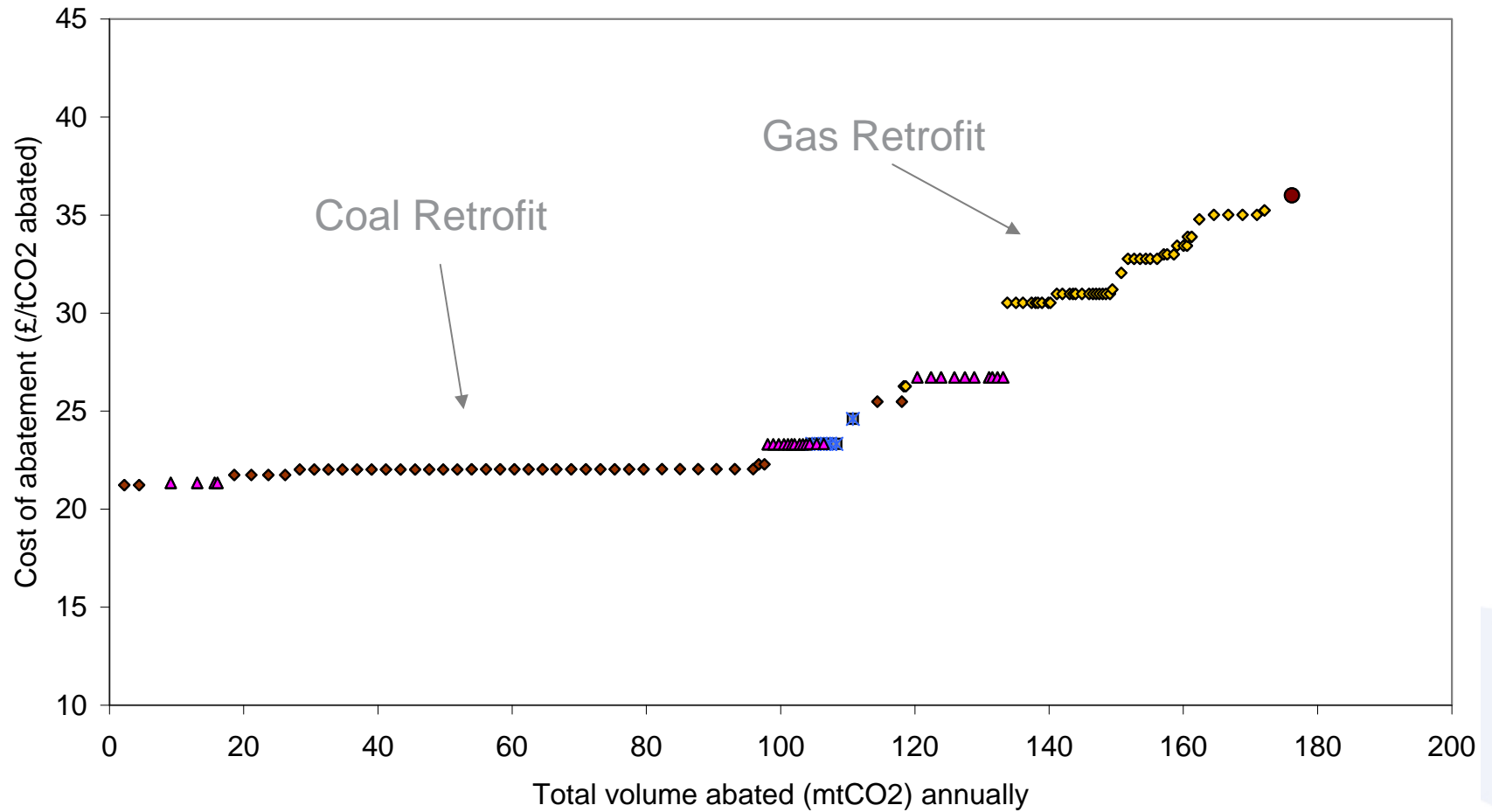


**Same fuel counterfactual
releases ~2.5 Mt CO₂**

Generates same electricity as unit with
CCS sends out but uses less fuel

- More CO₂ is captured than abated
- CO₂ captured is difference between the volume generated and released, ie 2.6 Mt
- CO₂ abated is difference between the volume counterfactual generates and that released, ie 2.1 Mt

Capture economics



Transportation....

Transport costs depend on how much steel is required and how many booster are needed.

Both of these depend on



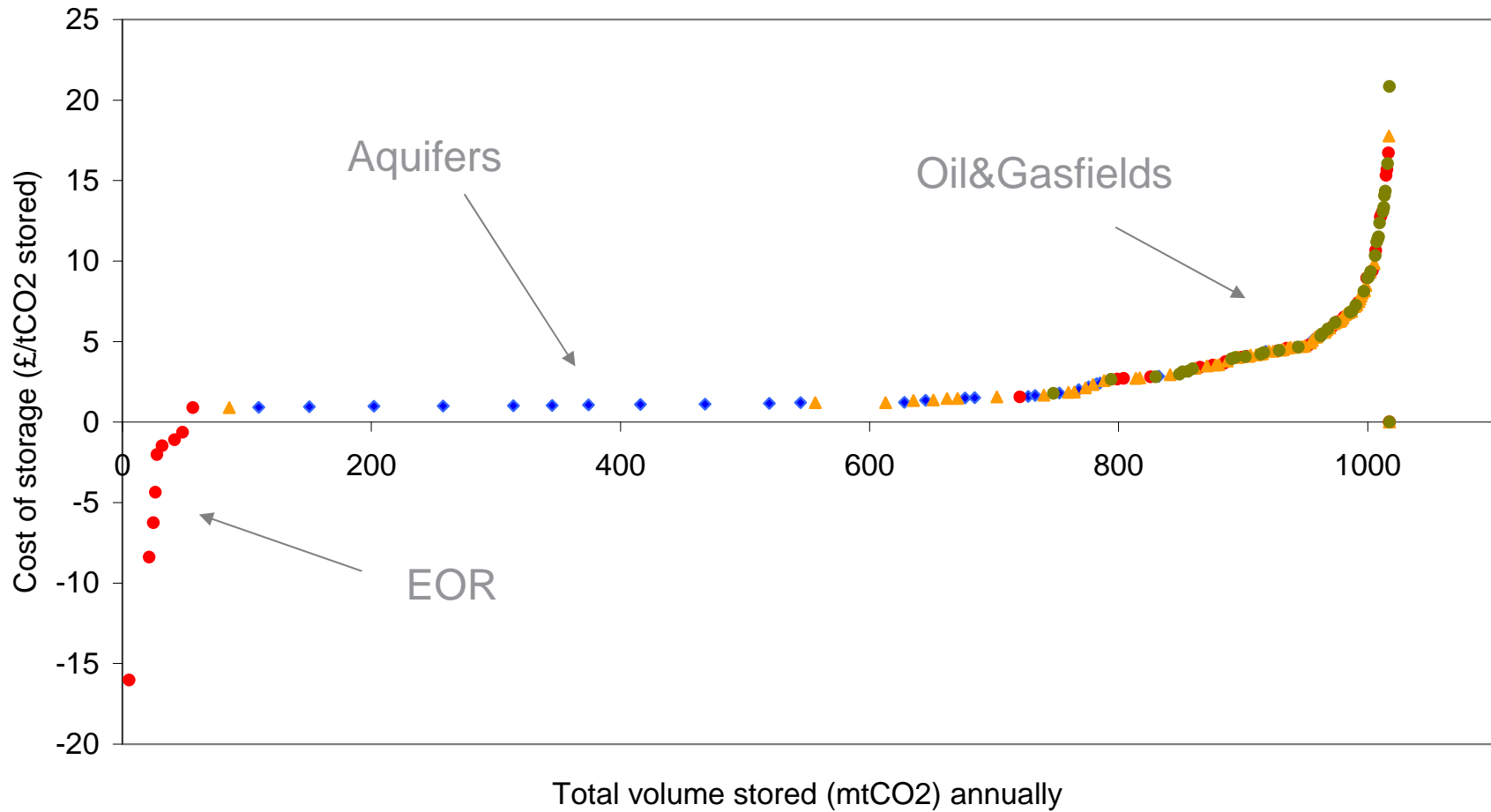
and



diameter

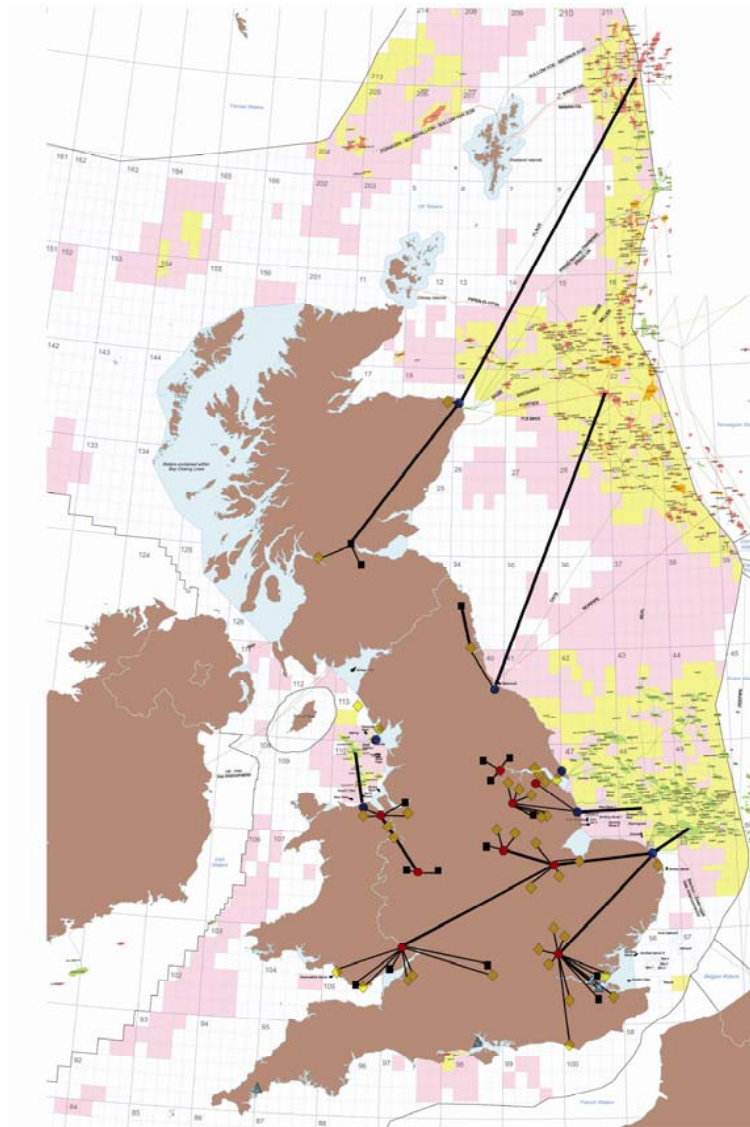
length

Storage economics

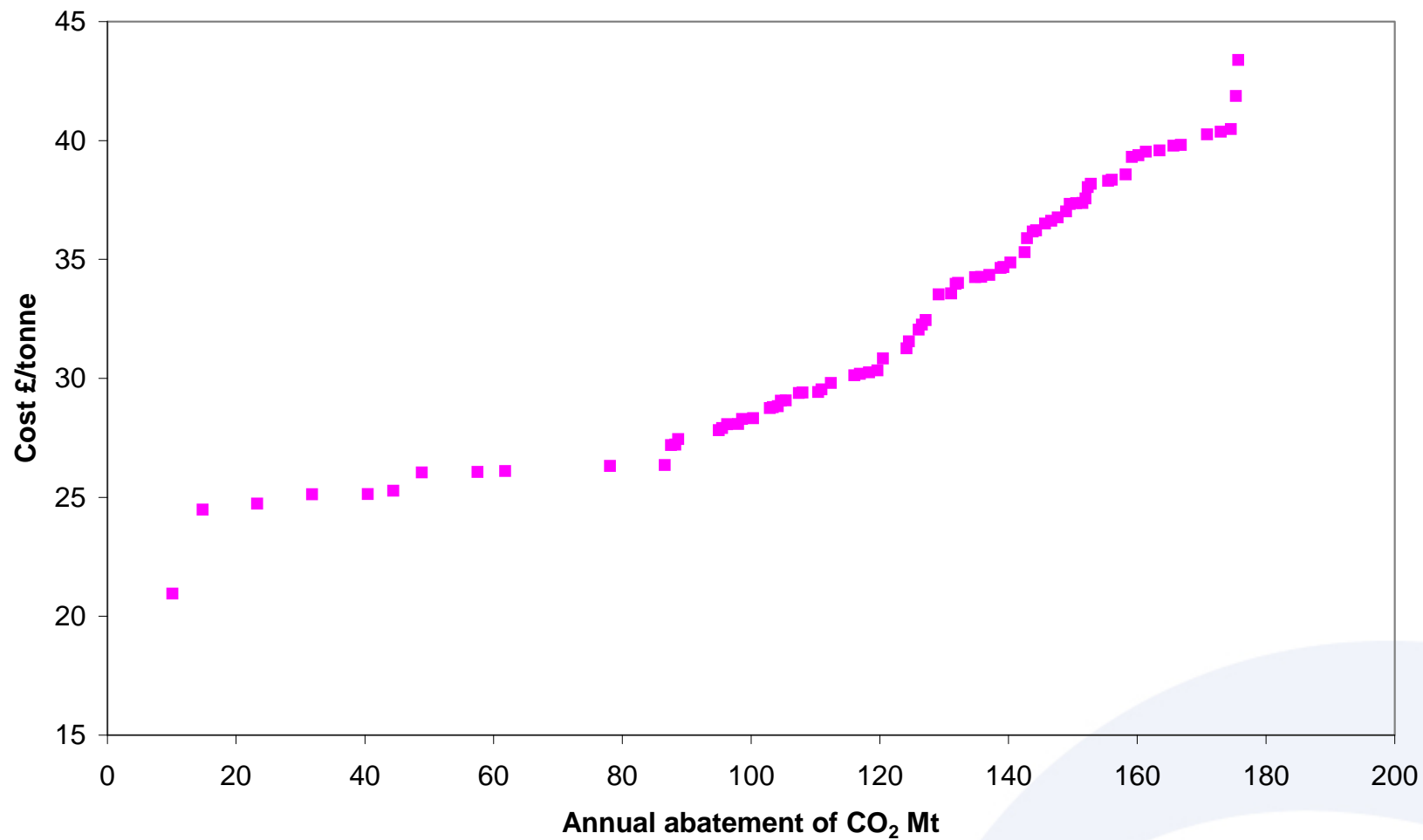


Example transport infrastructure

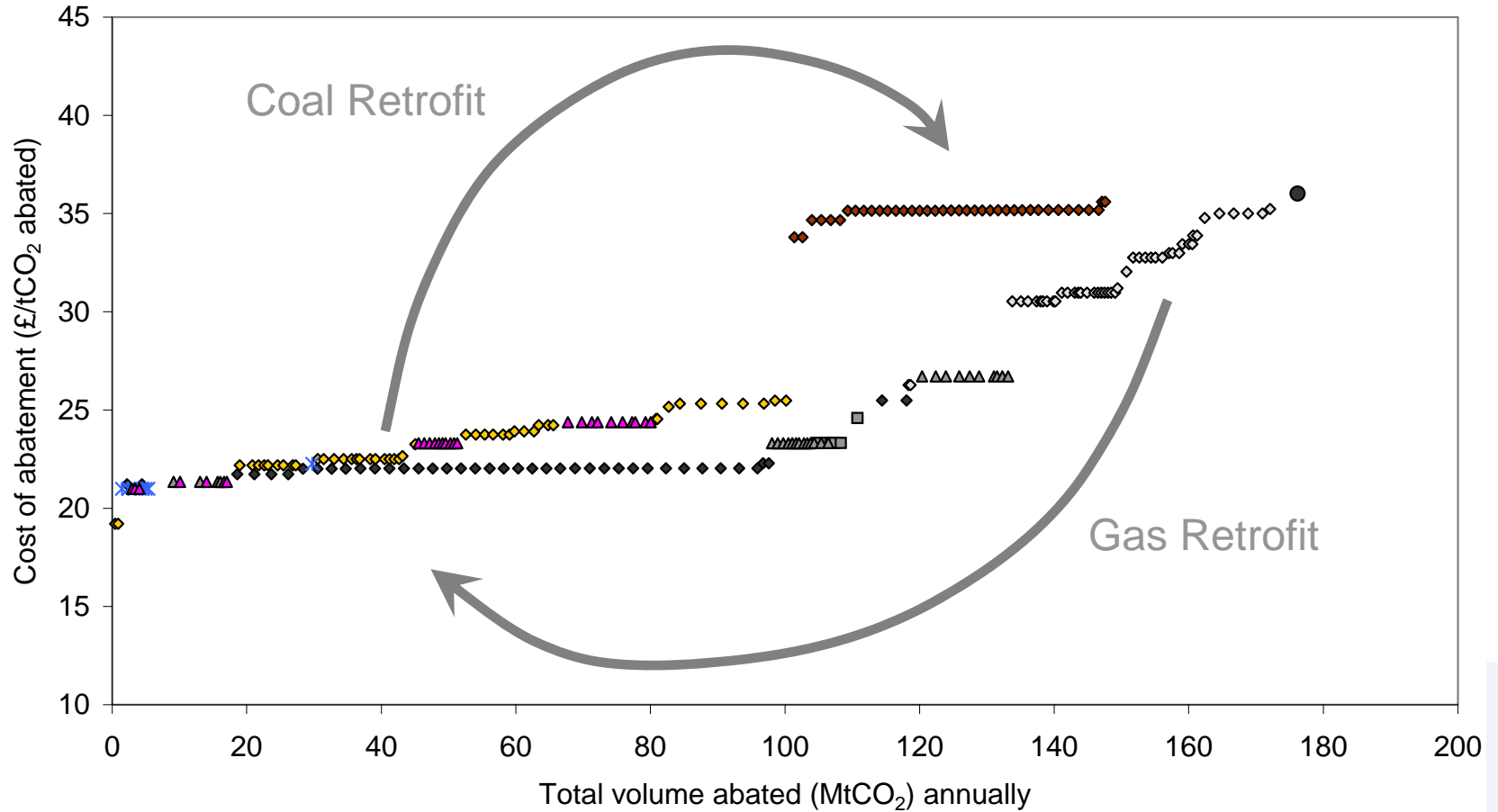
- Model can optimise transport system to lowest cost fields
- Hub and spoke vs direct connect
- Assume terminal constraint



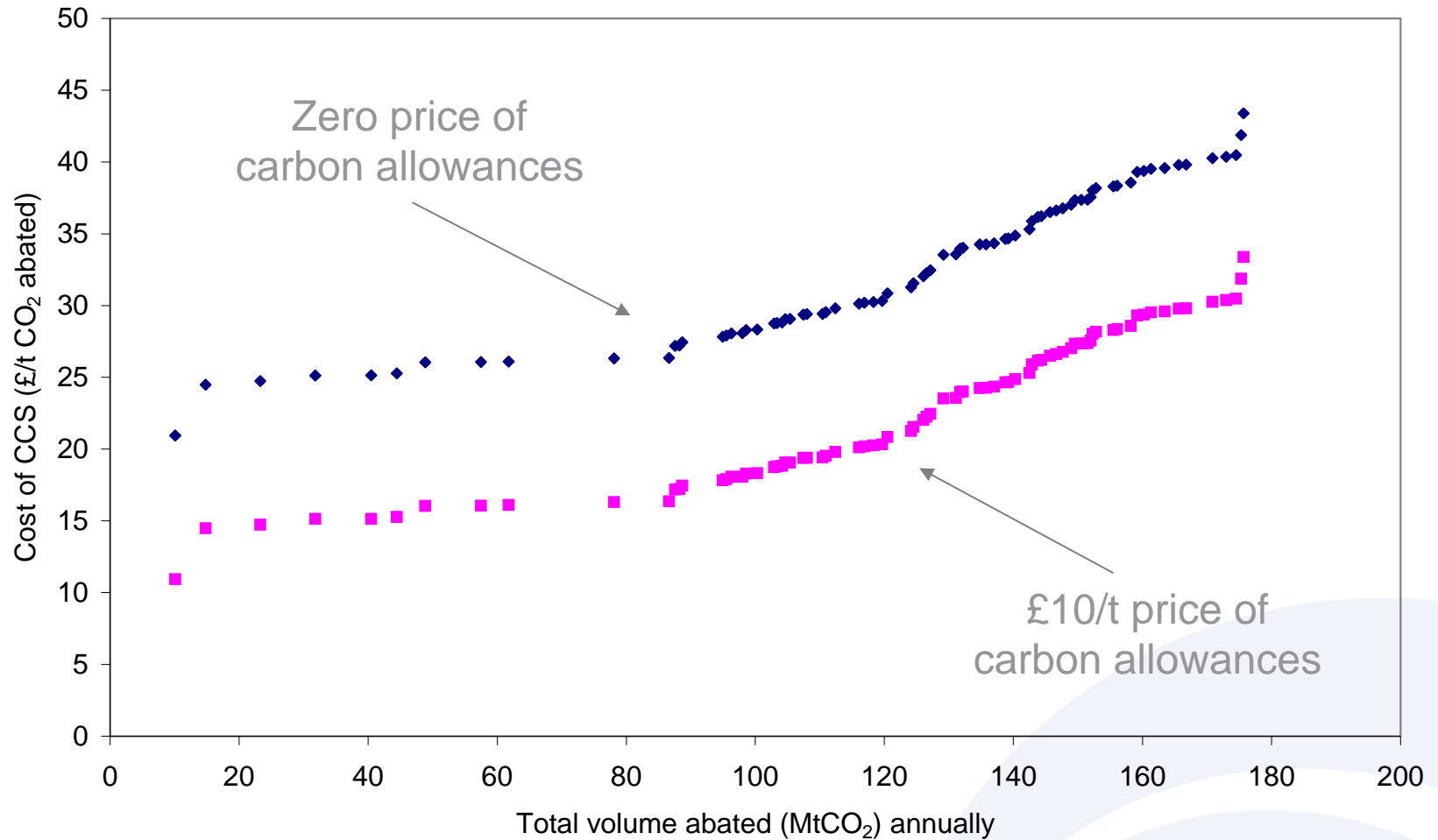
Basecase total cost curve



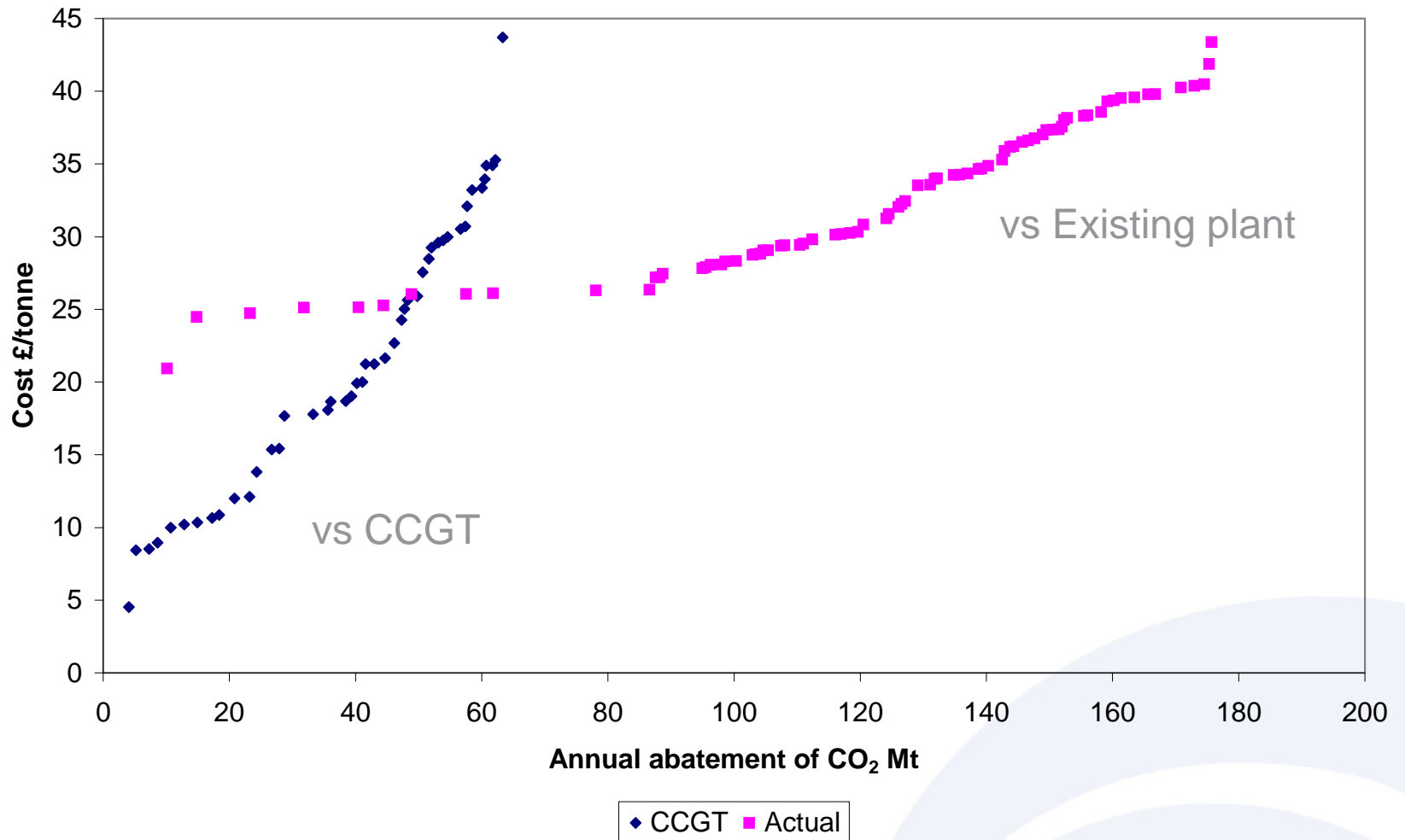
Sensitivity to Fuel Prices



Sensitivity to Carbon Prices



Counterfactual differences



Conclusions

- Significant potential for CCS at prices below £25/tonne
- Large sensitivity to inputs especially fuel
- Costs dominated by capture – UK has some very cheap carbon storage sites

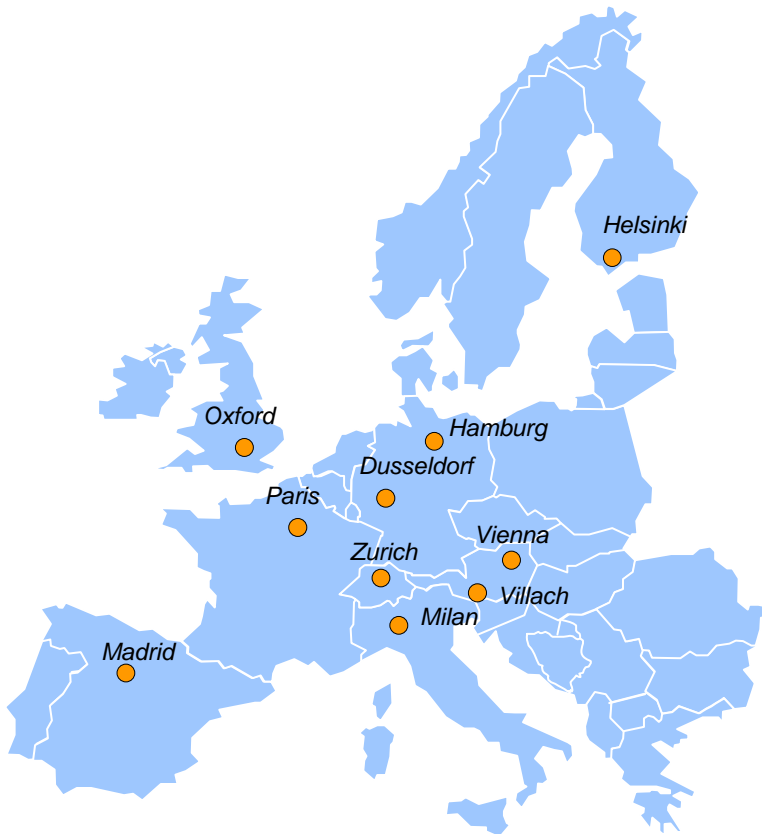
Pöyry Energy Consulting

Dr Phil Hare
+44 7770 828644
phil.hare@poyry.com

Pöyry Energy Consulting
King Charles House
Park End Street
Oxford, UK
OX1 1JD

+44 (0)1865 722660
www.poyry.com
www.illexenergy.com

Introducing Pöyry Energy Consulting



- The leading advisor to the European energy sector

- A pan-European energy consultancy formed from the merger of four highly respected consultancies



- 10 offices in Europe:
 - Oxford
 - Madrid
 - Milan
 - Paris
 - Helsinki
 - Zurich
 - Vienna
 - Hamburg
 - Villach
 - Dusseldorf
- Over 150 energy market experts



BOVBY