

National Grid's CCS Industry Event

**Proposal to Re-use Gas Assets for CO<sub>2</sub> Transportation**

Monday 11<sup>th</sup> May 2009

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# Morning agenda

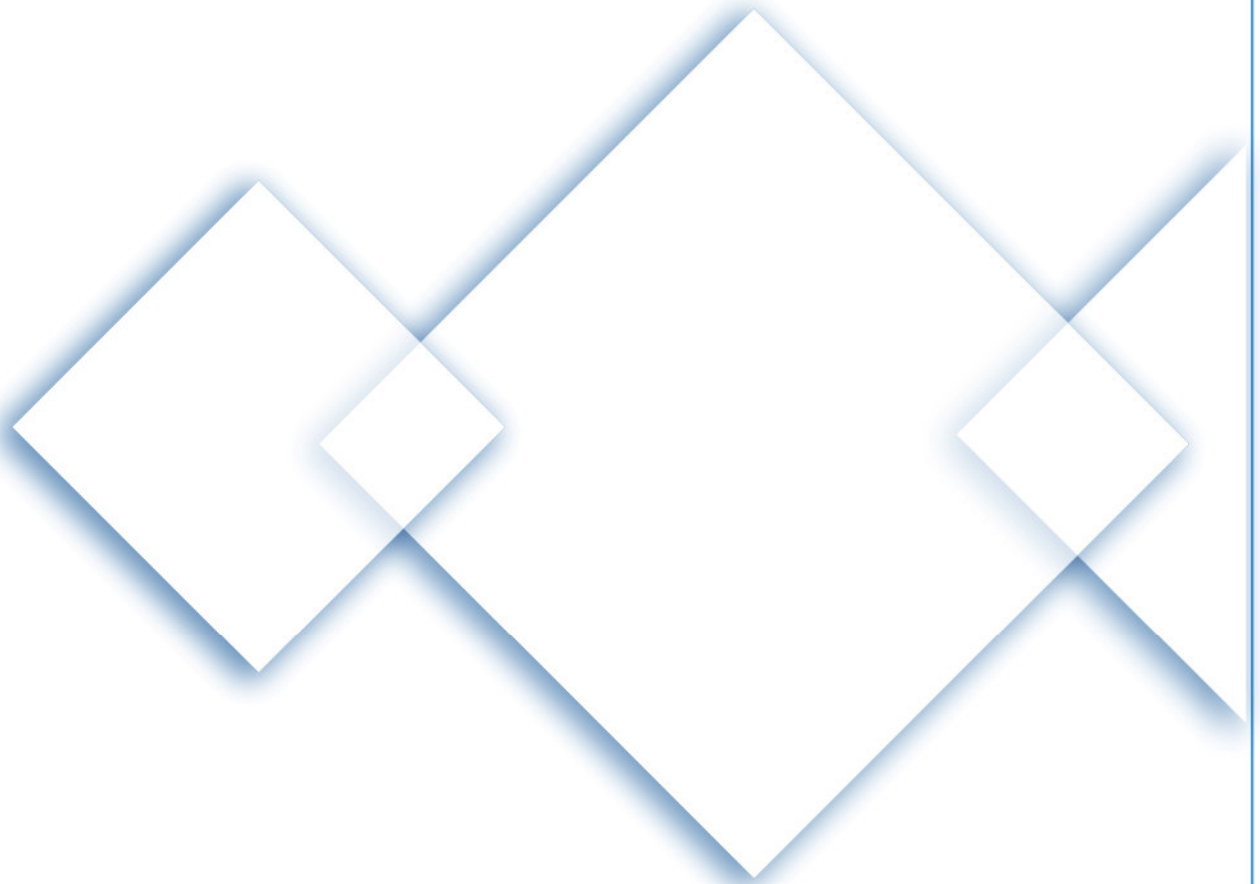
## Agenda & speakers

10:00	Opening remarks	Jeff Chapman, Chief Executive (CCSA)
10:10	CCS in future energy mix	Phil Lawton, Network Capacity Project Manager (National Grid)
10:30	National Grid's involvement in CCS	Jim Ward, CCS Project Manager (National Grid)
10:45	Proposal to re-use assets for CCS	Jim Ward, CCS Project Manager (National Grid)
11:25	Break	
11:40	Ofgem's consultation process	Bogdan Kowalewicz, Gas Transmission Snr Mgr (Ofgem)
11:50	Q&A session Panel members:	Jeff Chapman, CCSA Phil Lawton Jim Ward Bogdan Kowalewicz Russell Cooper, National Grid, Asset Management Oliver Highway, National Grid, Gas Operations
12:20	Closing remarks	Jeff Chapman, CCSA
12:30	Lunch	

# Afternoon agenda

## Agenda & speakers

14:00	Opening remarks	Jeff Chapman, Chief Executive (CCSA)
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14:30	National Grid's involvement in CCS	Jim Ward, CCS Project Manager (National Grid)
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16:20	Closing remarks	Jeff Chapman
16:30	Close	



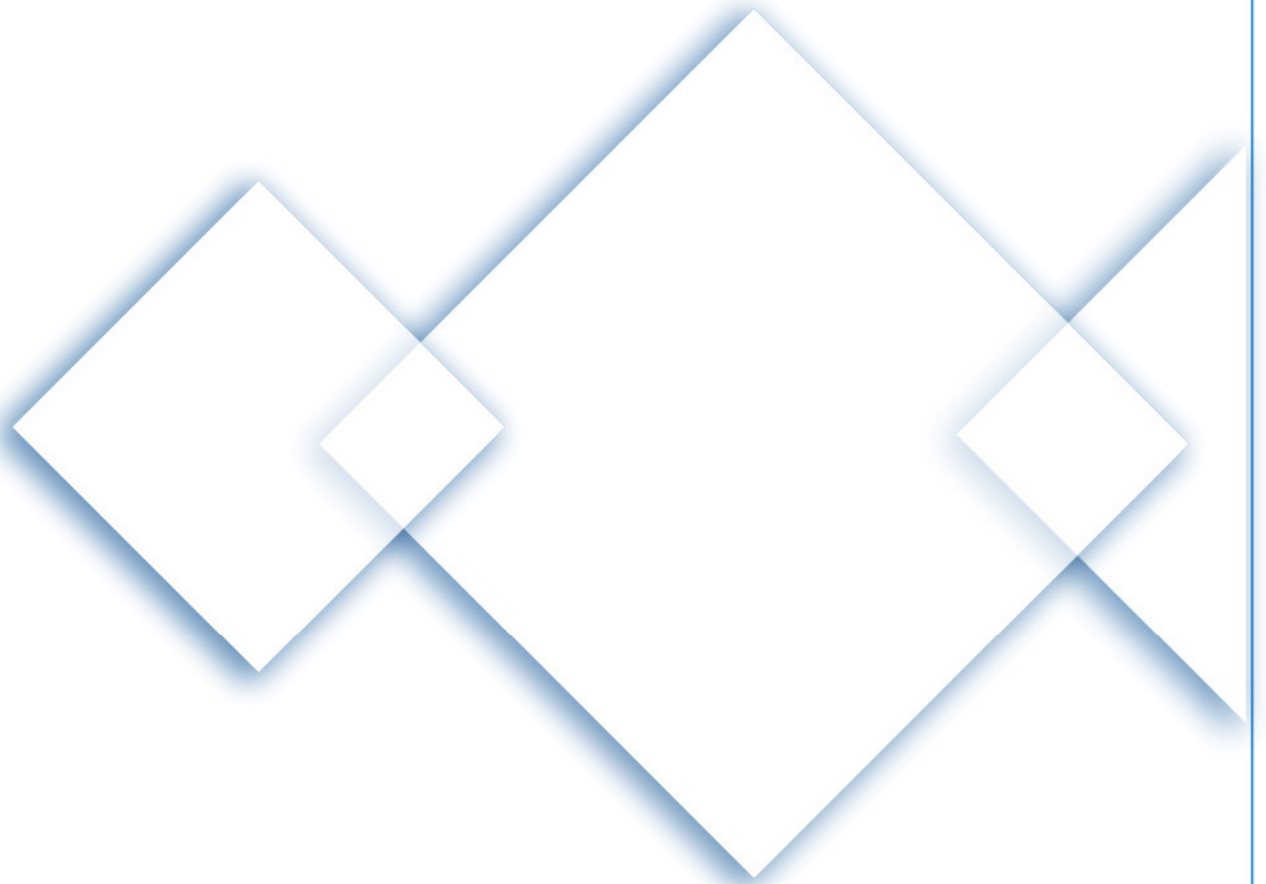
## Jeff Chapman

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Chief Executive,  
Carbon Capture & Storage Association (CCSA)

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## CCS in the future energy mix

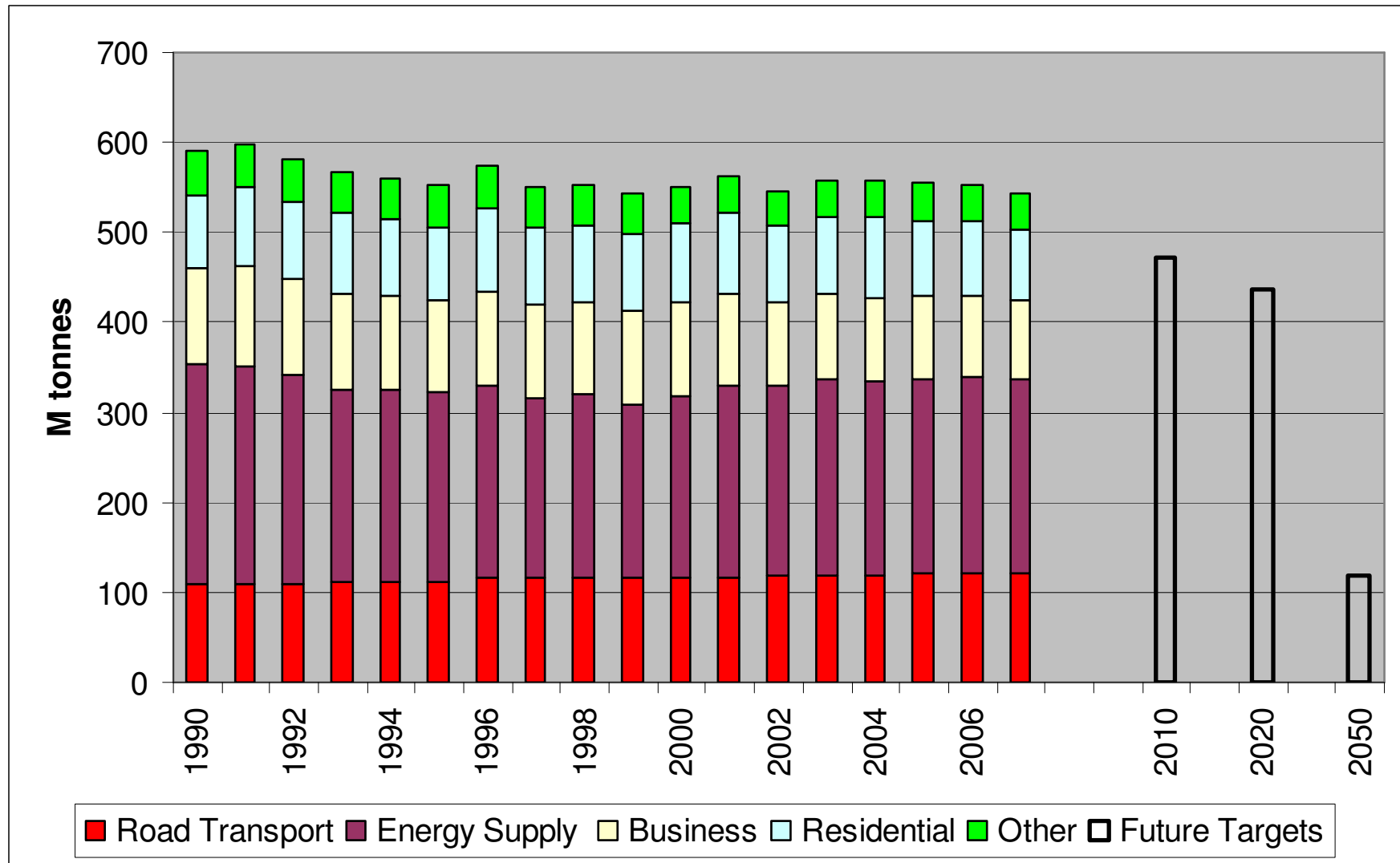
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Phil Lawton, National Grid Network Capacity Project

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## The Targets vs. Progress to Date



# Other factors making it harder (1)

## Demand Side

- ◆ Population is predicted to rise:
  - 2006: 60,600,000 (government data)
  - 2031: 71,100,000 (government forecast)
  - 2050: 79,000,000 (extrapolated from above)
  - 30% increase 2006 to 2050
  
- ◆ Number of households expected to rise:
  - 2008: 25 million
  - 2050: 35 million
  - 40% increase 2006 to 2050

## Other factors making it harder (2)

### Supply Side

- ◆ Gas: as UKCS production falls, greater use will be made of remote sources and LNG. The energy associated with moving the gas or liquefying it impacts on its carbon intensity.
  - Pipeline gas (1000km) upstream losses 5.3%
  - Pipeline gas (4000km) upstream losses 12% (assumed for 2050)
  - LNG gas upstream losses 23%
- ◆ Oil: as oil reserves are depleted, it becomes more energy intensive to extract the oil. For example Canadian Oil Sands will be 15-20% more energy intensive than current oil reserves. Study assumes no change in “cost” of oil extraction.



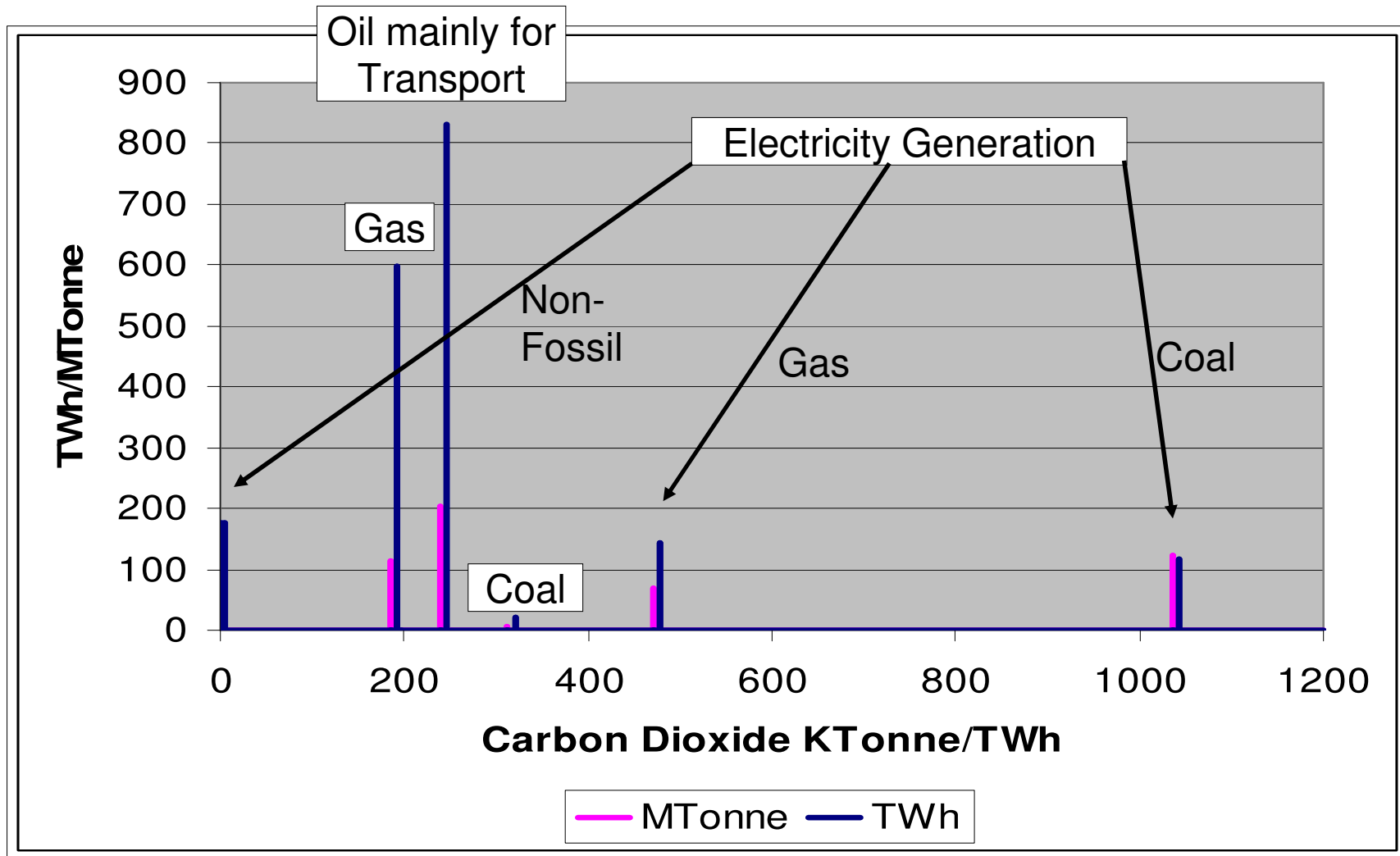
## A possible scenario for 2050...

	Electricity	Heat	Transport
<b>Efficiency</b>	~30%	~30%	~0%
<b>Today's Technology</b>	Nuclear (0kg/MWh) CCGT (400kg/MWh) Coal (1000kg/MWh)	Gas (225kg/MWh) Oil (315kg/MWh)	Oil (1300kg/MWh)
<b>2050 Technology?</b>	Nuclear (0kg/MWh) Renewable (0Kg/MWh) CCS Gas (40Kg/MWh) CCS Coal (90kg/MWh)	Gas (243kg/MWh) Biogas/Renewable (0kg/MWh) Electricity (100kg/MWh) Heat Pumps (30kg/MWh)	Electric Vehicles (140kg/MWh) Hydrogen (75kg/MWh)

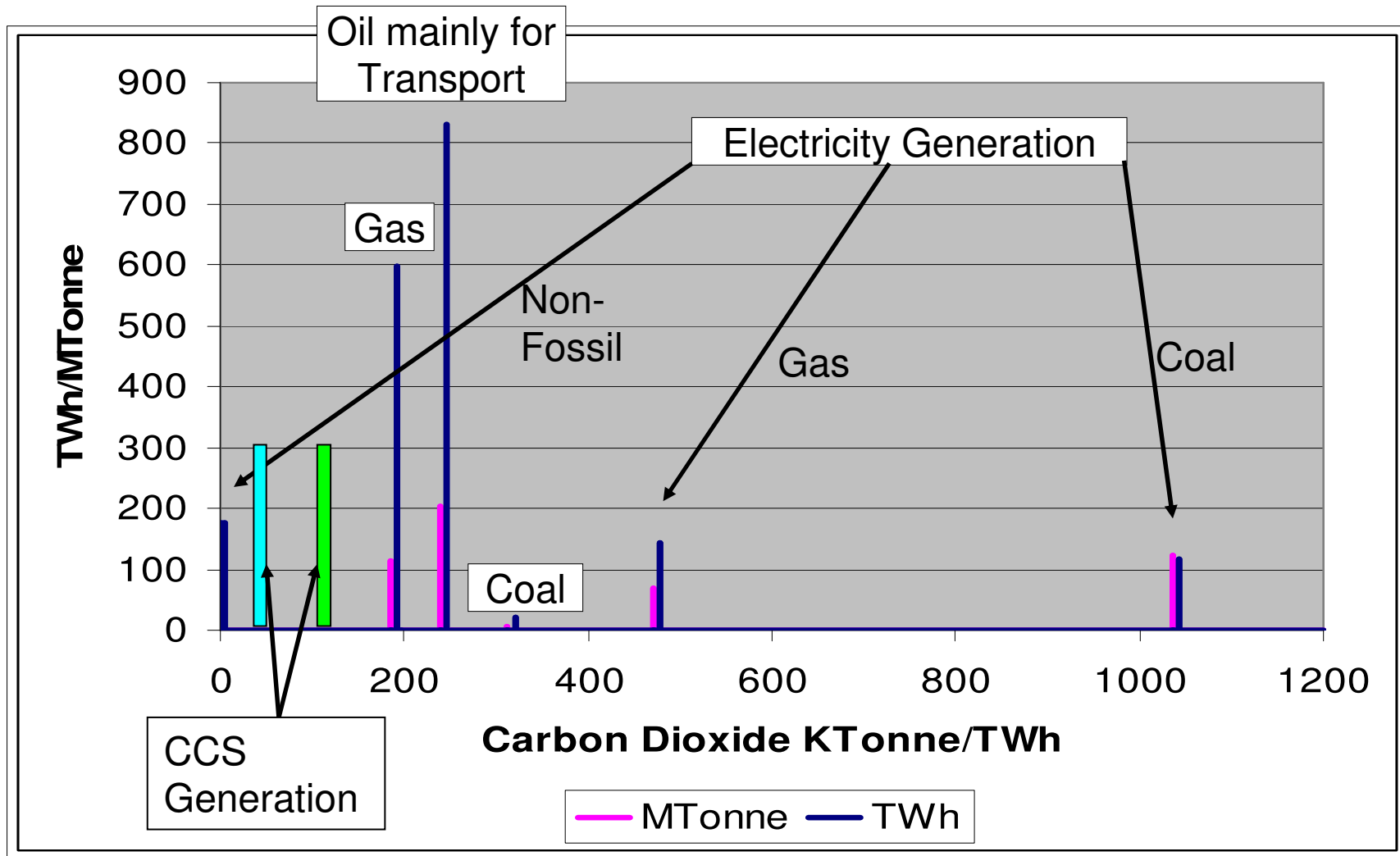
## A possible scenario for 2050 without CCS

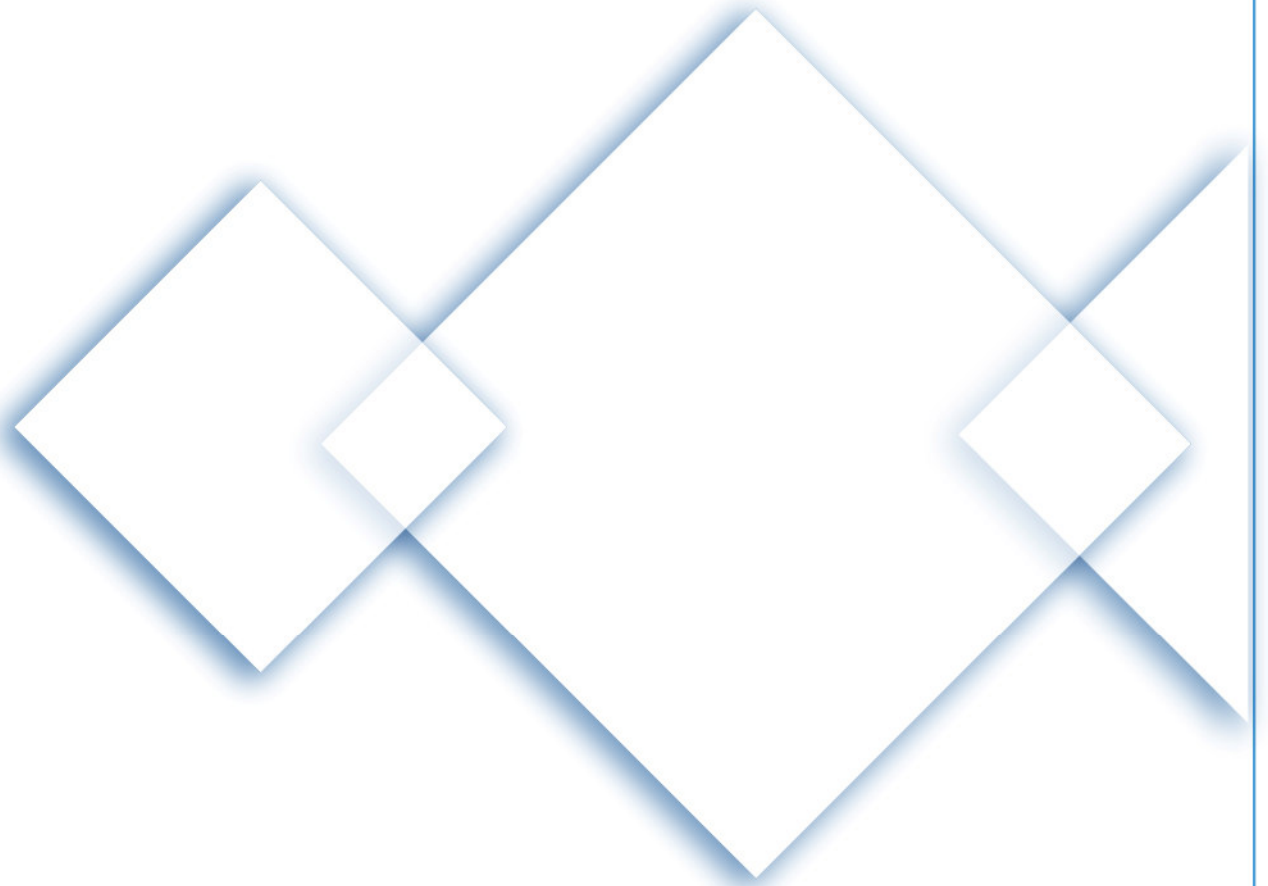
	Electricity	Heat	Transport
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# UK Energy Carbon Spectrum 2007 plus CCS Coal



# UK Energy Carbon Spectrum 2007 plus CCS Coal





# National Grid's involvement in CCS

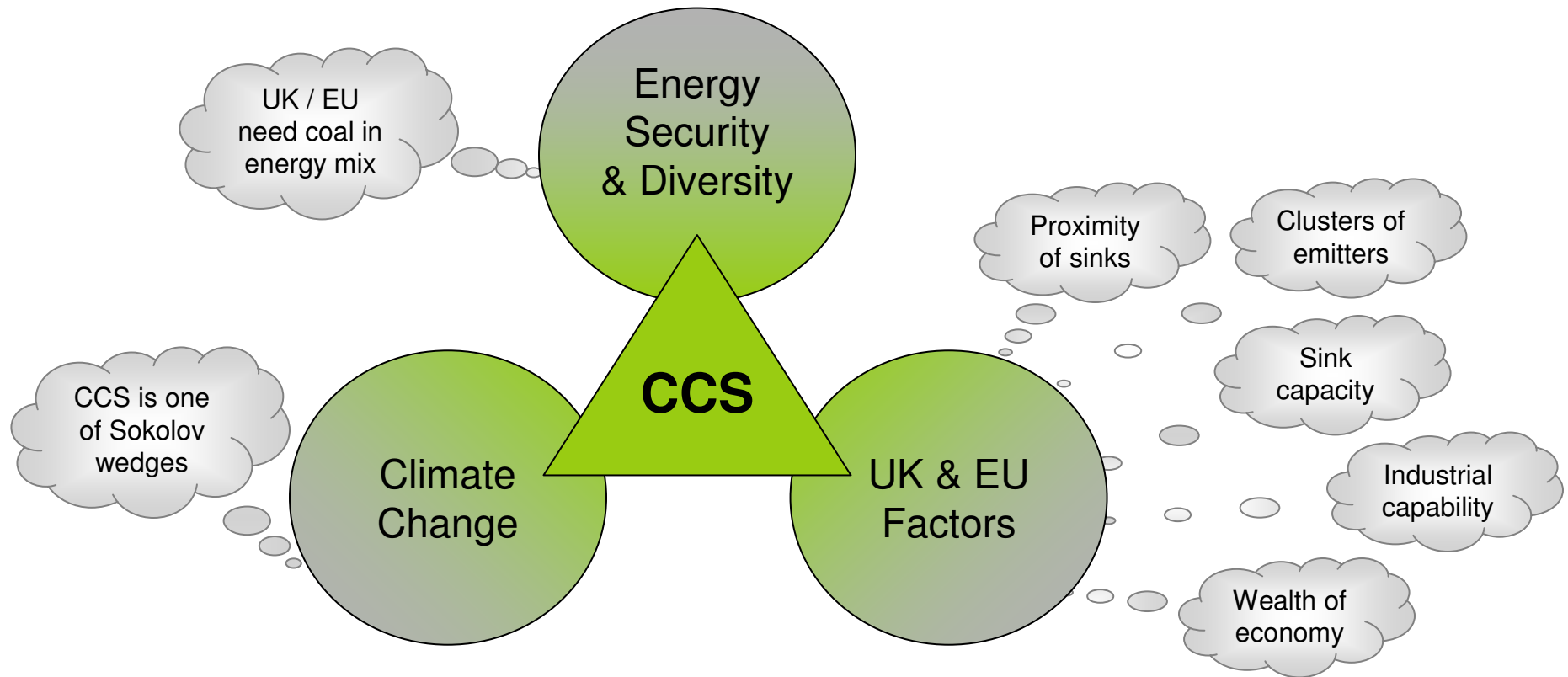
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Jim Ward, National Grid CCS Projects

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# Why we think CCS is important....



- UK has key clusters of emitters with close proximity to depleted fields
- 2050 analysis suggests 32GW of thermal generation could be enabled by CCS

# Why we want to be involved

## **We are committed to being an innovative leader in energy management and to safeguarding our global environment for future generations**

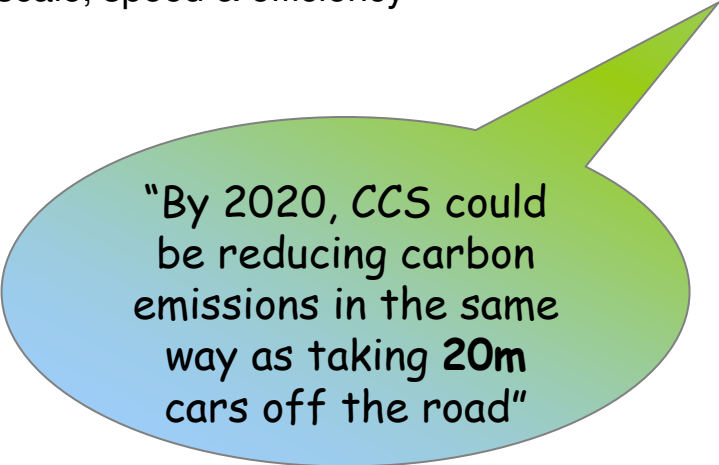
- CCS in the UK would reduce our CO<sub>2</sub> emissions, and place us at the forefront of EU strategy
- Reliability of Coal + CCS could underpin our continued way of life

## **CO<sub>2</sub> transportation is a complex issue and requires specific skills and experience**

- We are experts in network design, investment and operation, and managing associated risks within an HSE framework
- National Grid can enable coordinated CCS deployment at scale, speed & efficiency

## **CCS supports our government policy**

- Strengthens UK security of supply (fuel mix, system operation and coal reserves)
- UK / EU CO<sub>2</sub> emissions reduction targets – 20% by 2020



"By 2020, CCS could be reducing carbon emissions in the same way as taking 20m cars off the road"

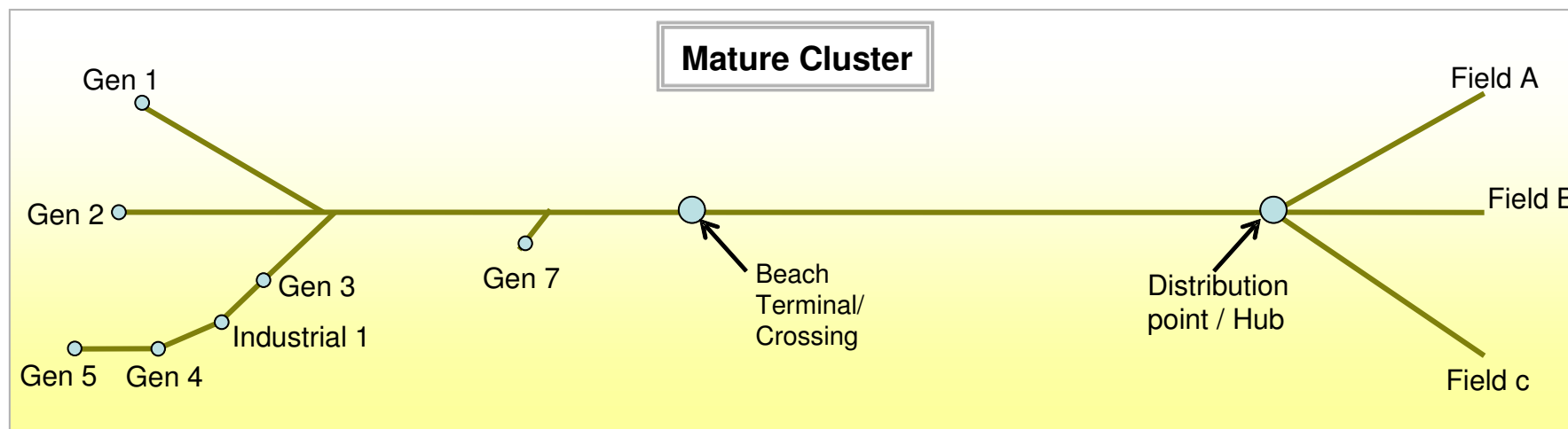
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# Long term view - clusters to networks?

## Network advantages:

- ◆ Efficiency of investment and operation
- ◆ Increased reliability through optimised design
- ◆ All parties access regime
- ◆ Better commercial arrangements for all parties



**The development of networks requires a collaborative approach from industry and government**


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# Importance of EU demonstration projects

## EU: 12 Demonstration projects by 2015, funded by 300m EUAs

- ◆ UK Government funding up to 4 demonstration projects
  - Demonstration of full supply chain at scale
  - No new coal without demonstration project
  - Demonstration of pre and post combustion technologies
  - Clusters to be promoted
- ◆ Prove full supply chain at scale  


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graph LR; A[Capture] --> B[Transportation]; B --> C[Storage]
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- ◆ Create regulatory frameworks
- ◆ Improve commercial viability  


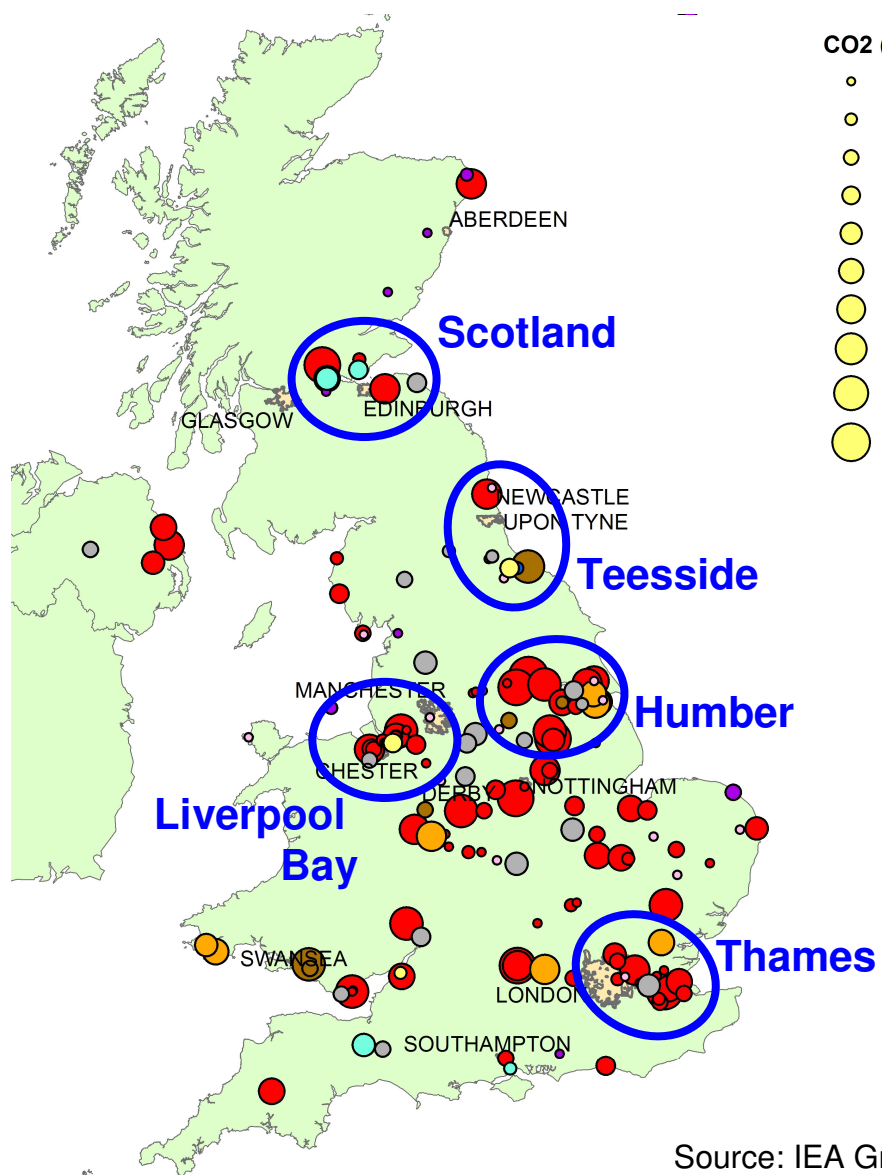
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graph LR; A[Develop technology] --> B[Improve efficiency and cost]; B --> C[Increase industry participation]
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- ◆ Legislate for CCS

**The UK is extremely well placed to be at the forefront  
of CCS development in the EU**

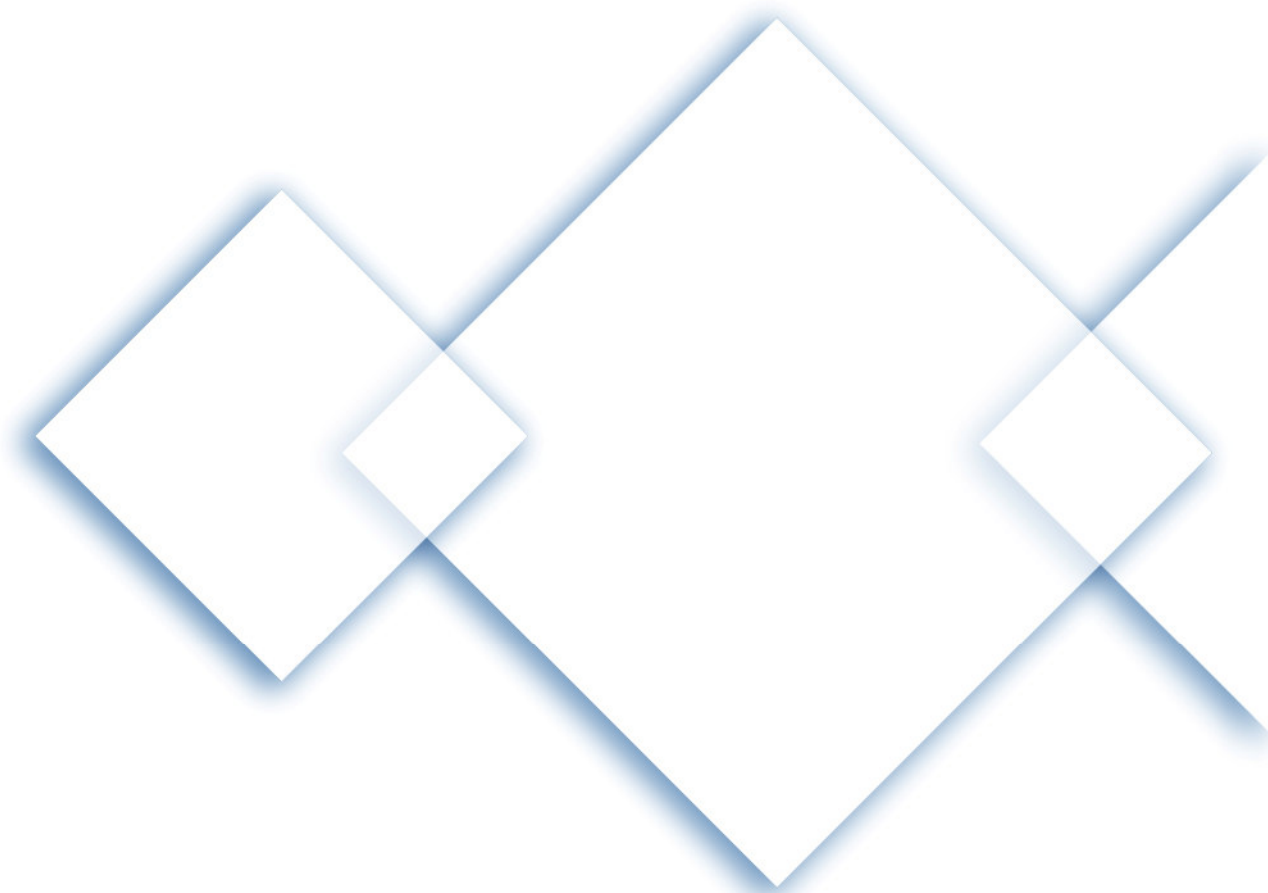
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# UK emitters and clustering potential



Cluster Region	CO <sub>2</sub> volume
Scotland	18Mt
Teesside	11Mt
Humber	60Mt
Liverpool Bay*	10Mt
Thames	28Mt



## Our proposal to re-use assets for CCS

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Jim Ward, National Grid CCS Projects

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# High-level points of the re-use proposal

**We have developed this proposal in a way that we believe is:**

- ◆ Consistent with UK and EU policy
- ◆ Consistent with consumer interests
- ◆ Consistent with regulatory view of maximising asset utilisation and being innovative
- ◆ Consistent with National Grid's vision and strategy

**We acknowledge that the issues may be seen through multiple lenses – we hope the consultation draws out a balance of views**

# Agenda item contents

**This section will focus on Ofgem's consultation, published 8<sup>th</sup> April 2009**

- ◆ Background and context of National Grid's outline proposal
- ◆ Potential for Scottish feeder availability, post-2013
- ◆ St Fergus capability work to date
- ◆ Gas operations and incentive management
- ◆ Other network considerations
- ◆ Valuation of assets
- ◆ Proposed commercial options for gas shippers
- ◆ Next steps

# Background to National Grid's proposal

## Why are we exploring re-use of gas assets?

- Government CCS policy and DECC competition opportunity
- Unique circumstances – Scottish infrastructure and supply patterns
- Lower cost option for CCS demonstration and reduced environmental impact
- Maximise value to consumers
- If we wait until 2014/15, re-use opportunity will probably be gone

## How did this become an Ofgem consultation?

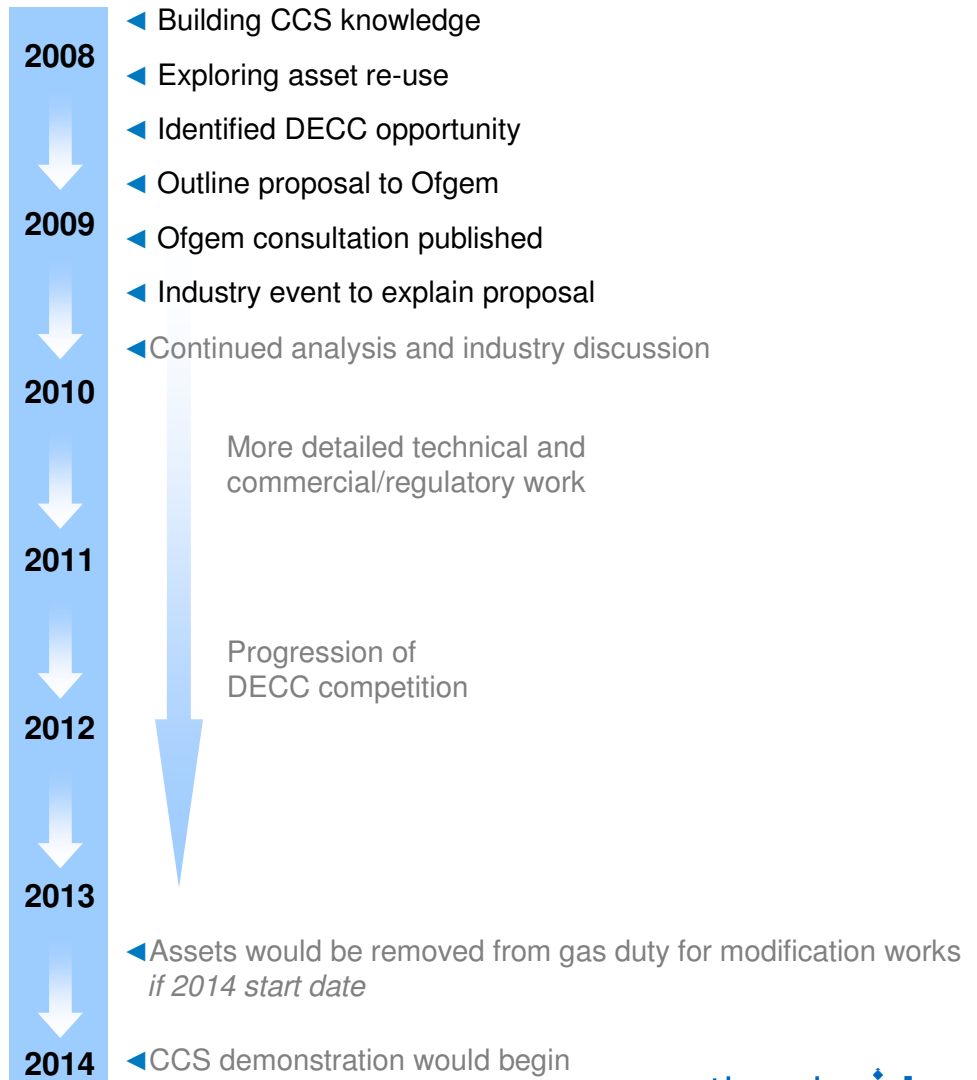
- Disposal of assets requires formal GEMA<sup>1</sup> consent, as per gas transporters' licence
- Internal discussions + initial analysis for outline proposal.....  
.....complex issues now need wider participation
- Asset re-use for CCS has implications beyond the gas network, ie UK plc
- Our responsibility is to explore this, so outline proposal developed

<sup>1</sup> Gas and Electricity Markets Authority

# Context to National Grid's proposal

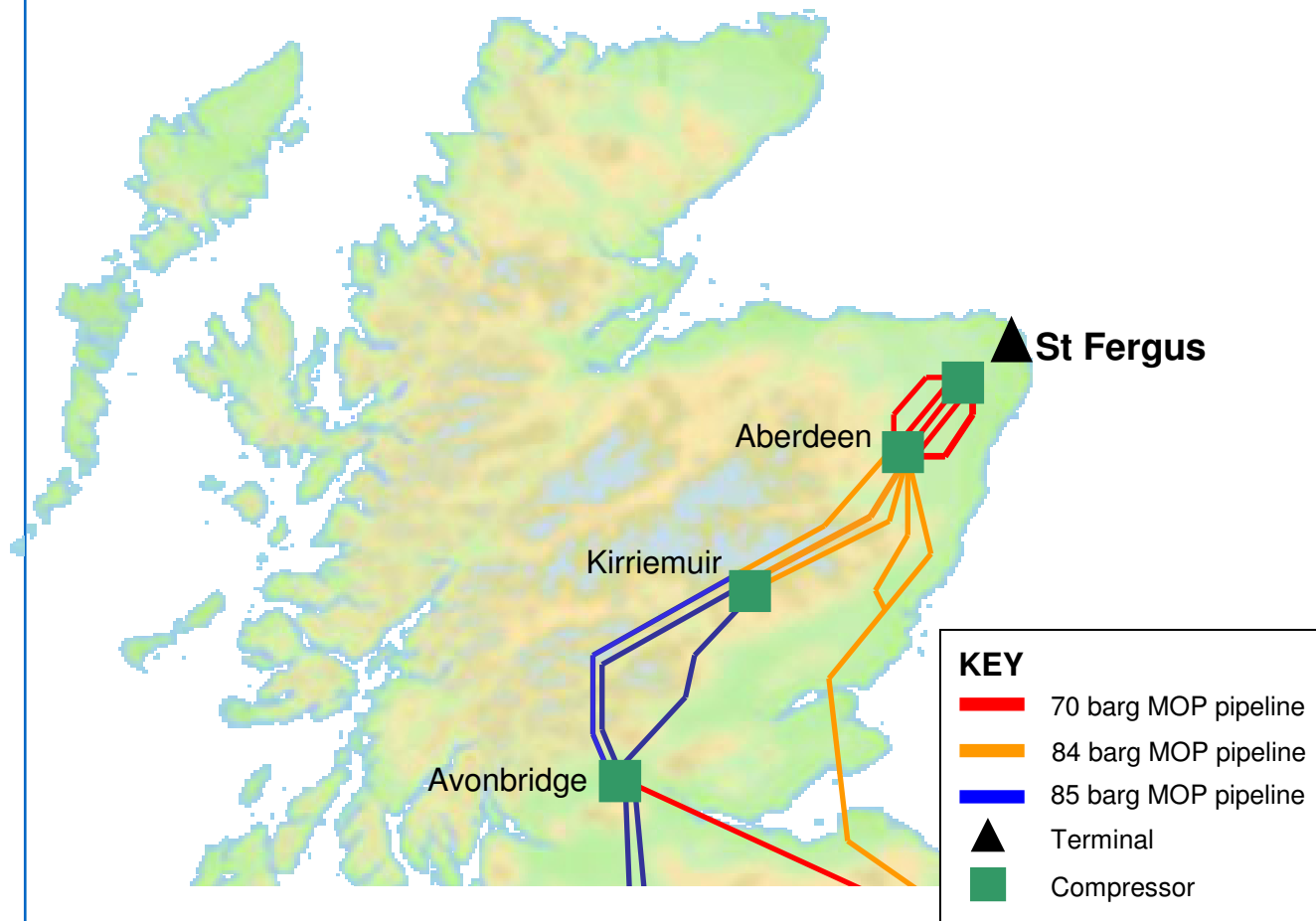
## Key points:

- DECC competition requires end-to-end demonstration in 2014
- Assets will be nearing full depreciation by time of disposal
- St Fergus supply forecasts and entry capacity bookings suggest future availability
- Technical feasibility of re-use established
- Potential for value from re-use for gas shippers/consumers



# Existing Scottish feeders considered for re-use

## Schematic showing National Transmission System (NTS) infrastructure in Scotland



### Key points:

- Proposal to re-use one route from Avonbridge to St Fergus
- Total length of assets for re-use ~300km
- Current operating pressure 70-85 bar
- Diameter 36"



# How are these feeders considered available?

## To determine the availability of any feeders we have considered:

- Time of proposed removal from gas duty
- Historic and future gas supplies to St Fergus:
  - UK Continental Shelf (UKCS)
  - Norway
  - West of Shetland
- Capability of remaining gas infrastructure
- Other network considerations

## In addition we need to ensure:

- Ability to meet Safety Case requirements
- Ability to satisfy Licence obligations
- Protection of gas consumers and shippers
- Regulated industry not exposed to undue risk

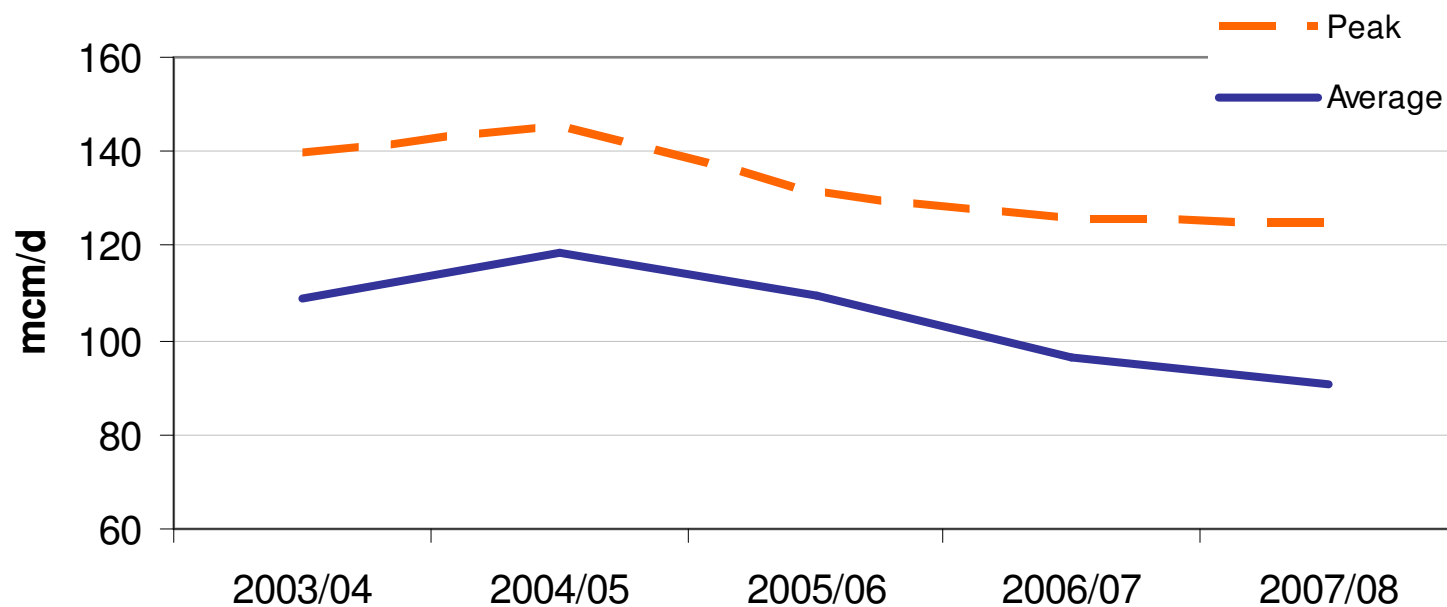
Current indications  
are that these  
factors can be  
managed.....  
... but more work  
to do and an  
on-going process

# Historic gas supplies to St Fergus

**Supplies to St Fergus have been declining.**

2008/9 peak flow of 120.6mcm (21<sup>st</sup> Oct).

Gas Year	Peak	Average
2003/04	139.4	108.7
2004/05	145.2	118.3
2005/06	131.1	109.3
2006/07	125.3	96.5
2007/08	124.7	90.4



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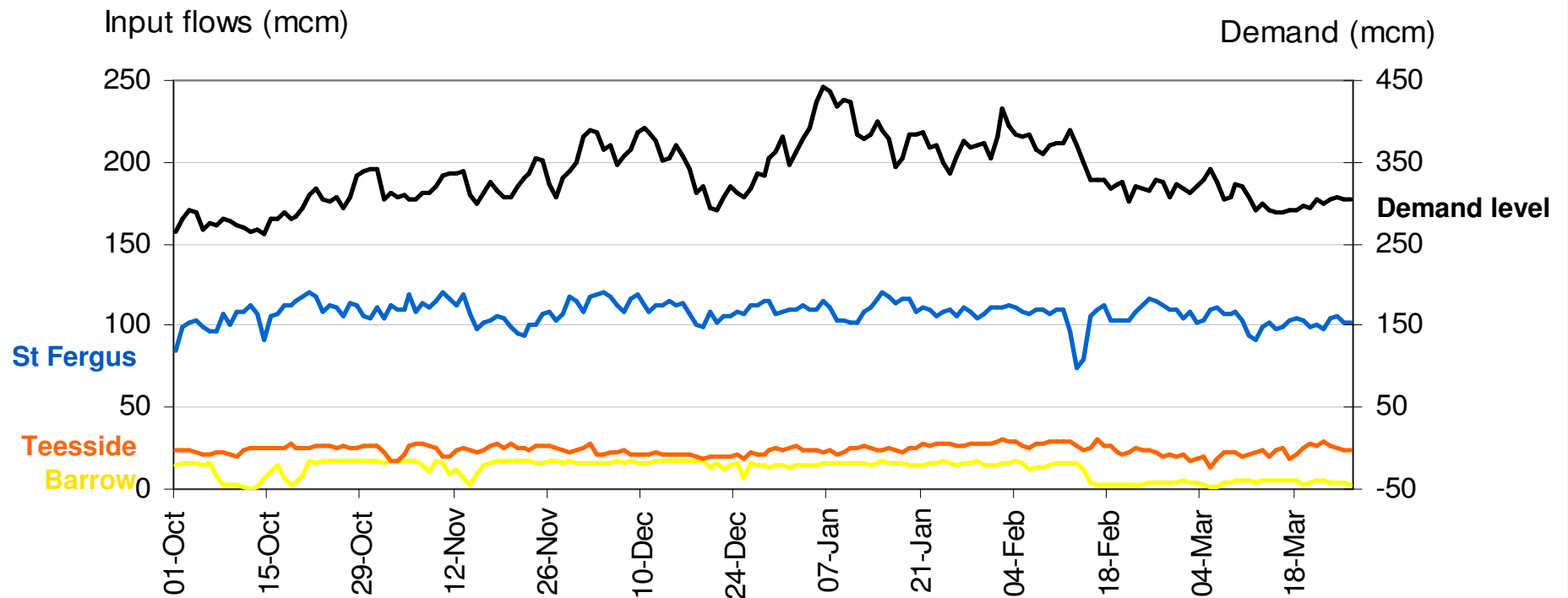
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# Northern Triangle gas supplies this winter

**2008/9 was the coldest winter for ~15 years.**

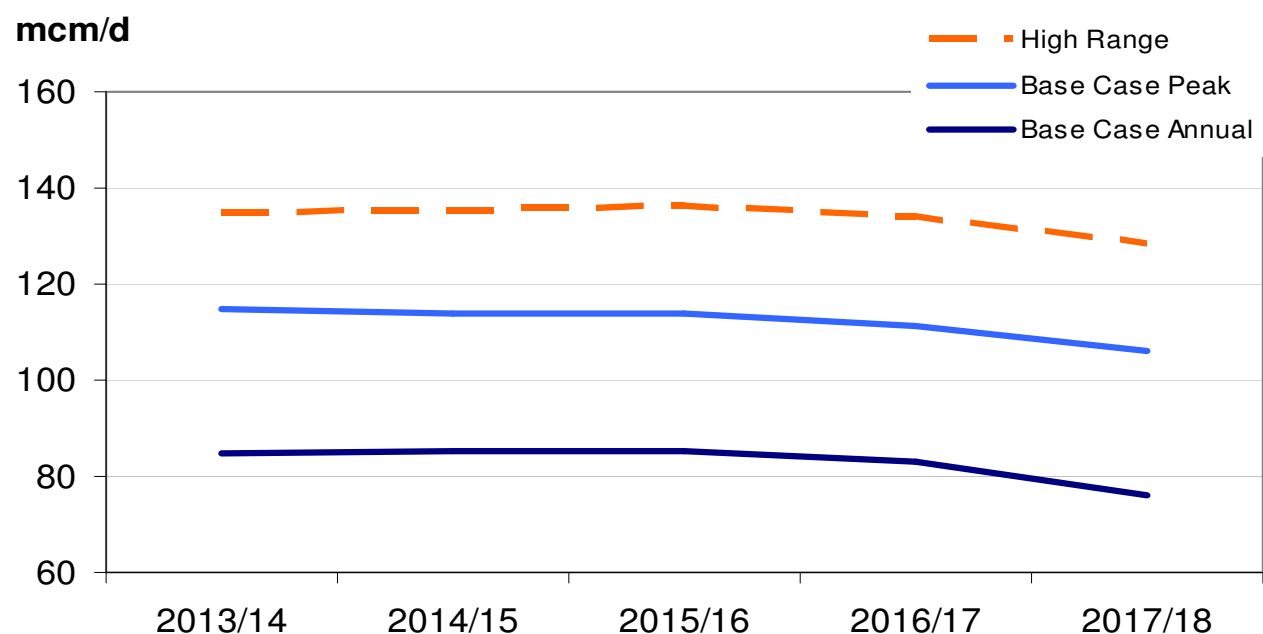
St Fergus flows remained below 121mcm alongside:

- High spot gas prices
- High demand levels
- Restricted flows from Europe



# Forecast gas supplies to St Fergus

## 2008 Ten Year Statement (TYS) supply forecast for St Fergus:



High range includes :

- 20mcm/d from West of Shetland
- 62mcm/d from Norway

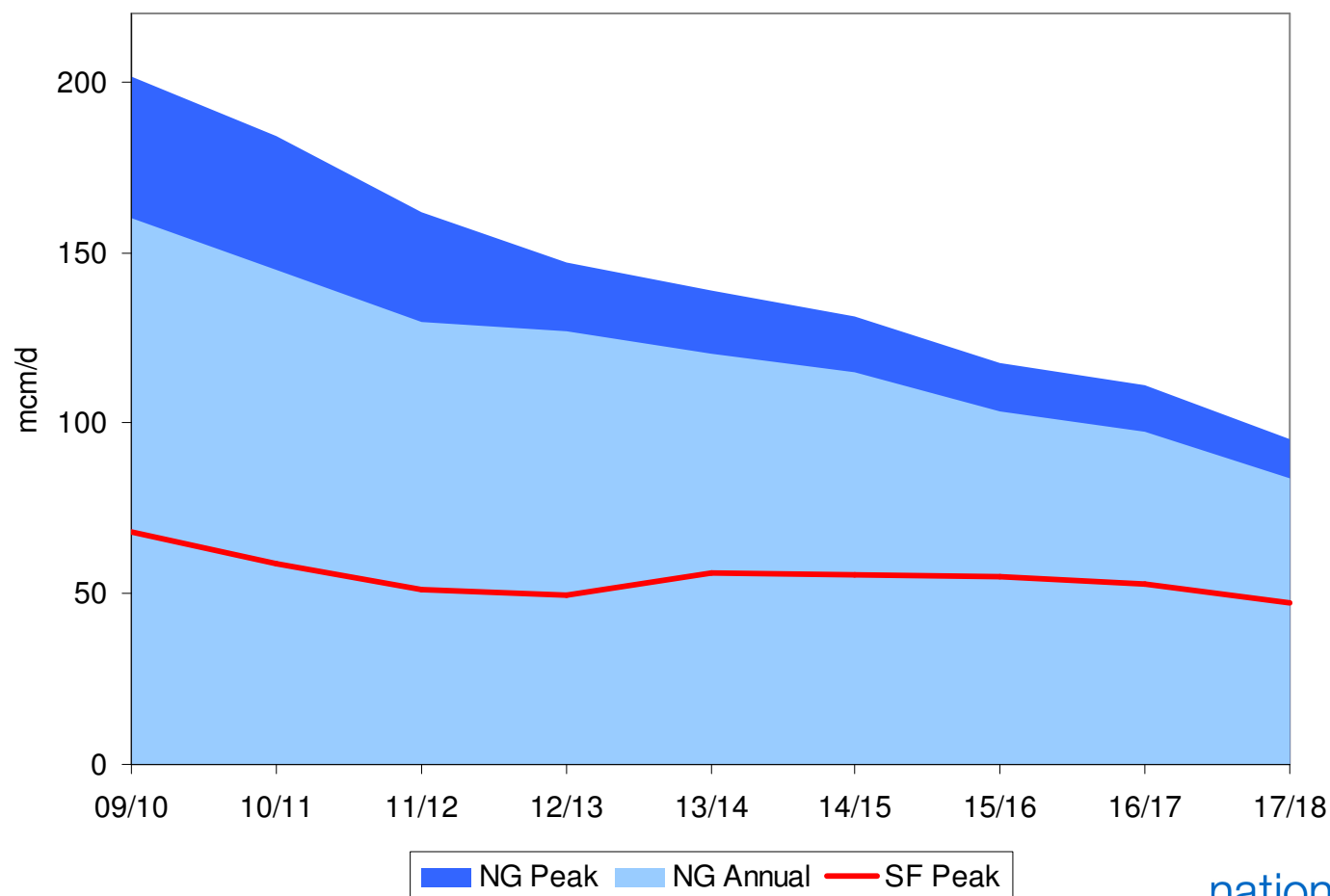
Forecast basis	2013/14	2014/15	2015/16	2016/17	2017/18
High Range	134.8	135.3	136.1	134.1	128.3
Base Case Peak	114.7	114.1	113.8	111.4	106.1
Base Case Annual	85.0	85.3	85.2	82.9	76.3

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# Declining gas supplies from UKCS

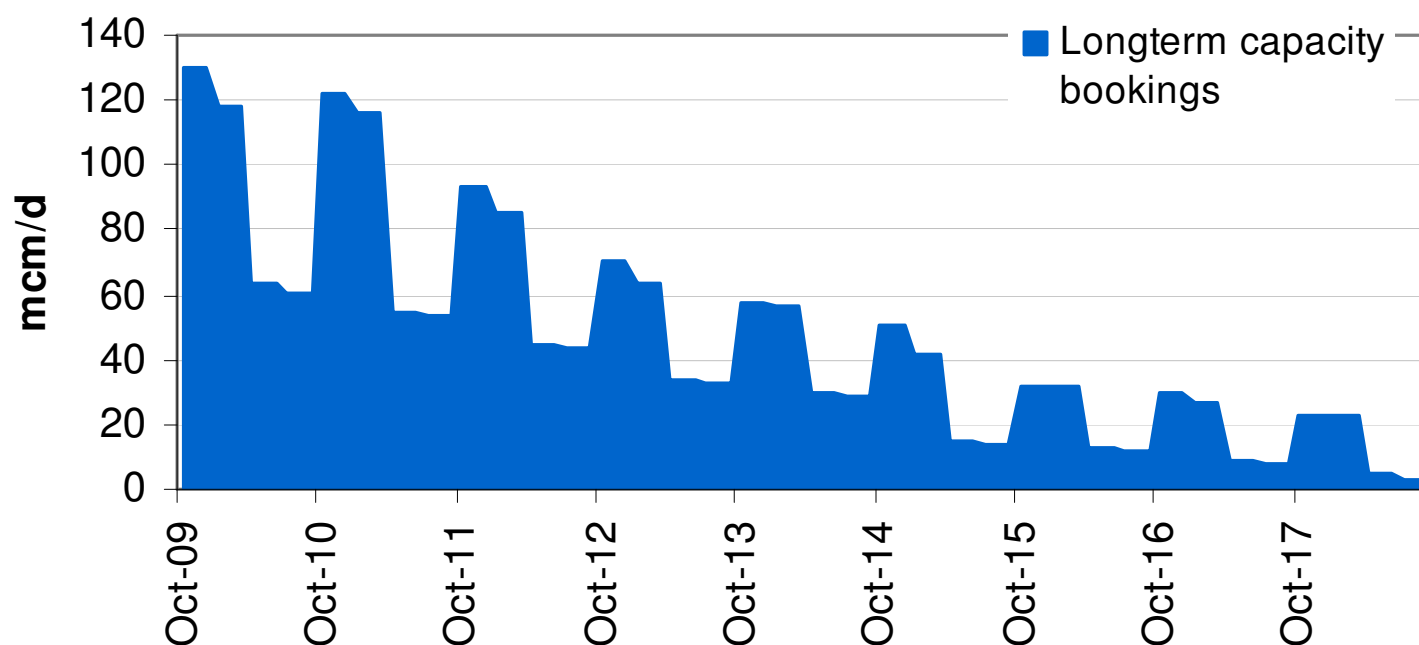
2008 TYS data shows the forecast decline of total UKCS volumes.



# Long-term entry capacity bookings at St Fergus

Bookings made in Monthly and Quarterly System Entry Capacity auctions provide a capacity signal from industry.

**We do not propose a change to the entry capacity baseline of 154mcm/d.**



Long-term bookings as at 22<sup>nd</sup> January 2009

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For non-gas shippers

## A very high level summary of the gas regime

- Gas shippers have to buy entry capacity to get their gas to the National Balancing Point
- They can buy this long-term or short-term
- National Grid is obliged to offer a 'baseline' level of capacity
- If a constraint occurs, National Grid buys back the capacity rights from shippers under a buy-back incentive (shippers set the price)
- Arguably this makes the regime a financial rather than a physical one
- By leaving the baseline for St Fergus at the current level, this re-use proposal is:
  - far less intrusive than if the baseline was reduced consistent with the reduced asset capability
  - more risky to National Grid

# St Fergus capability analysis

## Initial network analysis to determine impact of feeder removal:

	St Fergus Capability	
	With current infrastructure	With feeder removed
310mcm demand day	154mcm/d (stop at baseline)	132mcm/d
400mcm demand day	154mcm/d (stop at baseline)	132mcm/d
590mcm demand day	154mcm/d (stop at baseline)	138mcm/d

## Additional scenario testing:

Scenario	Demand	St Fergus	Teesside	Barrow
1	310	131.0	15.3	6.5
2	310	133.0	25.0	25.0
3	395	131.0	26.0	24.2
4	400	132.6	16.7	10.8
5	400	130.0	25.0	25.0

*All figures mcm*

**Flows at St Fergus remain fairly consistent - geography means they are influenced less by flows at other terminals.**

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# St Fergus capability with increased compression

**Additional compression could achieve the following capability:**

<i>all in mcm</i>	St Fergus	Teesside	Barrow
590mcm (1 in 20) demand day	149	44	28.6
400mcm demand day	147	26.7	25.8

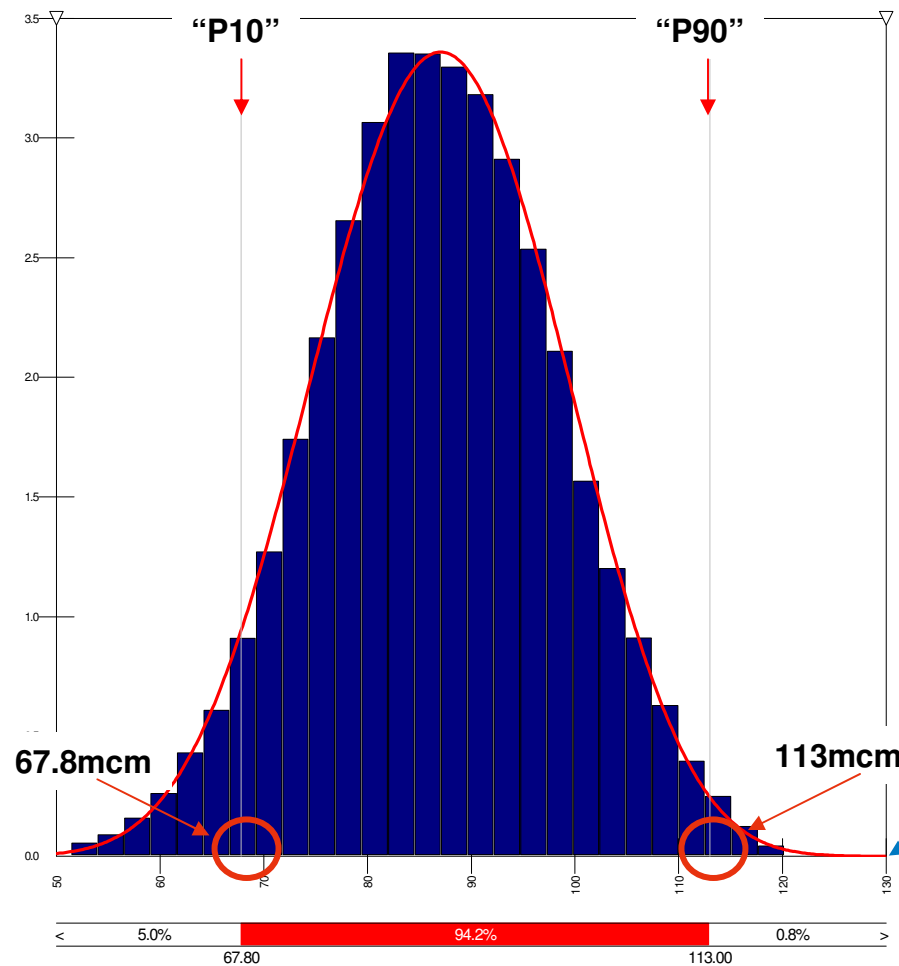
**The cost of adding this compression would be in the region of £80m.**

**Is this reasonable and efficient?**

- ? How long is the period of risk perceived to be?
- ? What is the probability of incurring constraint costs?
- ? Is the cost of extra compression greater than the potential cost of constraints?

# Probability of within day constraints

**We believe there is a low probability of supply levels reaching 130mcm in 2013 - 2018**



## Key points:

- TYS base case forecast used
- Low chance of flows higher than 113mcm between 2013 and 2018
- Little incremental risk of Buy Back against current forecasts
- More network analysis and scenarios to test further

~130mcm = St Fergus capability with feeder removed

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# Potential cost of within day constraints

**To determine the value of the potential risk, we have evaluated Buy Back costs using the previous supply level probabilities:**

## Key points:

- Base case and High case volumes as per 2008 TYS
- Probability “P10/50/90” as per previous slide illustration
- Costs are for the period 2013-2018 – after which we believe there to be no continued risk

£m	Base case	High case
P10	0.0	0.0
P50	21.7	27.3
P90	60.1	77.2

## What does this mean?

<10% chance that  
(at 1p/kWh)  
£60.1m Buy Back  
costs incurred

## Notes:

- Buy back price assumed as 1p/kWh
- Compressor failure rate (for each unit): Kirriemuir 5% / Aberdeen 8%

*“Compressor failure rate” assumes the terminal is unable to  
recover the end of day requirement by overflowing*

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# Gas operations and incentives management

**Key to this proposal is the need to protect gas consumers and industry.**

All gas operations/incentives real or perceived impacts to be identified, evaluated and considered with robust analysis

## Examples

**Gas compression costs** - currently part of Shrinkage Incentive costs

- Estimated increase to gas compression costs ~£5m
- How to ensure NGG and shippers/consumers protected?
- Proposed volumetric cap based on 2013 fuel levels

**Linepack benefit** - value of gas in the feeder to be disposed

- Estimated value of gas ~£2m

# Proposed commercial options

**These options aim to provide a balanced and flexible set of choices.**

**They recognise potential buy back risk alongside potential business growth reward.**

	Upfront payment	Benefit from growth	Exposure to downside
Lump sum payment	✓	✗	✗
Simple royalty	✗	✓	✗
Participatory royalty	✗	✓	✓

- Upfront payment: Value of assets transferred to NGG
- Growth benefit: Net revenue from transported CO<sub>2</sub> volumes (after refurbishment and other costs)
- Downside exposure: Potential exposure to BB costs (capped at cost of additional gas compression - £80m)

Note – no change in baseline, so no reduction in shipper capacity rights

# Explanation of commercial options

## The options in simple terms:

### Lump Sum Payment

- CCS Project pays for the asset (*as per asset valuation – see later*)
- Shipper charges reduced due to RAV reduction
- Buy Back risk covered by National Grid subsidiary

### Simple Royalty

- CCS Project pays royalty fee to shippers for CO<sub>2</sub> volumes flowed
- Buy Back risk covered by National Grid subsidiary

### Participatory Royalty

- CCS Project pays increased royalty fee for CO<sub>2</sub> volumes flowed
- Buy Back risk shared by National Grid subsidiary

# Asset valuation

**The asset value will be paid as a lump sum if this is the preferred option.**

## Asset valuation considerations:

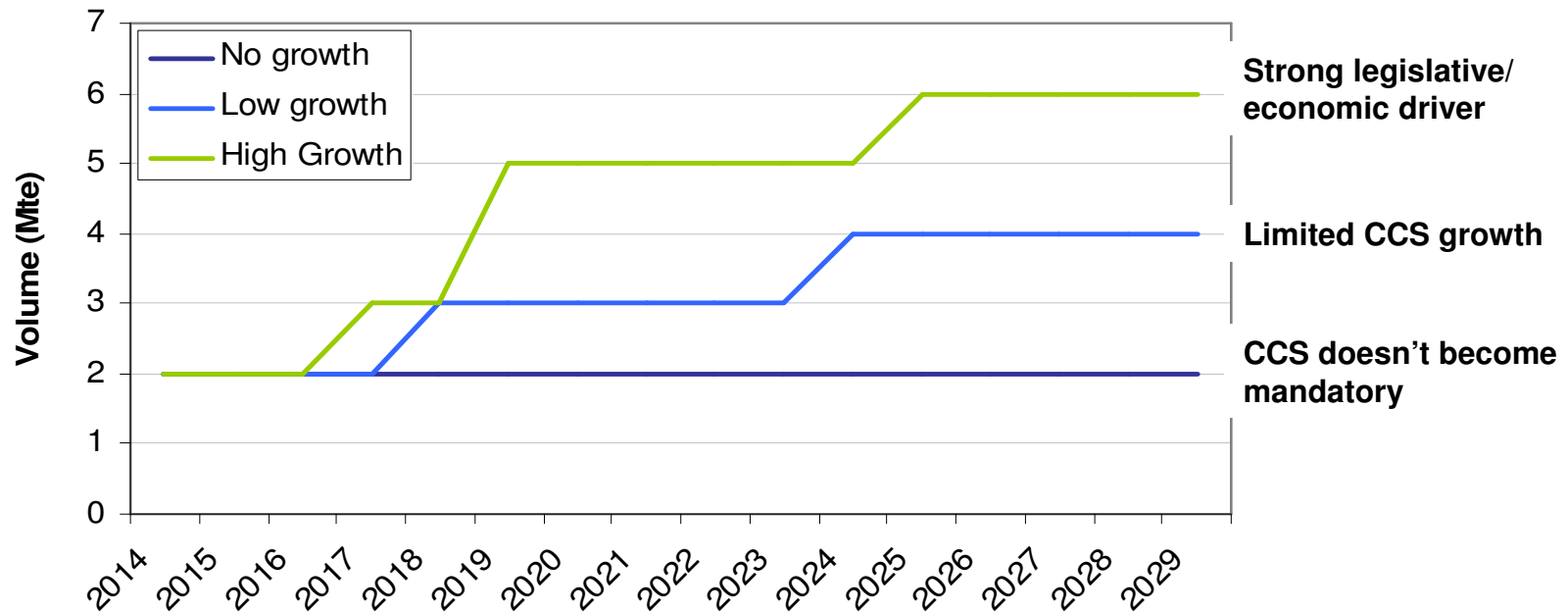
- Wide range of theoretical asset values (between £0.2m and £182m)
- Considerable investment is needed before the feeder is of use to a CCS project:
  - New connection to emitter
  - Modification works to physically detach from NTS infrastructure
  - Refurbishment for CO<sub>2</sub> readiness
  - Wayleaves and consents for new and existing pipelines
- No exposure/restrictions to Shippers as baselines preserved
- Assets fully depreciated before end of DECC competition (2029) with reduced need as gas transportation assets after 2018, based on current supply forecasts
- Shipper charges would be reduced as a consequence of the reduced RAB, following the change in use of the asset.

**If high valuations are expected  
the likelihood of realising any value from CCS is reduced**

# Potential growth in CCS volumes

The expected growth in CO<sub>2</sub> volumes transported could deliver increased revenue beyond a lump sum option.

## CCS notional volume growth examples:



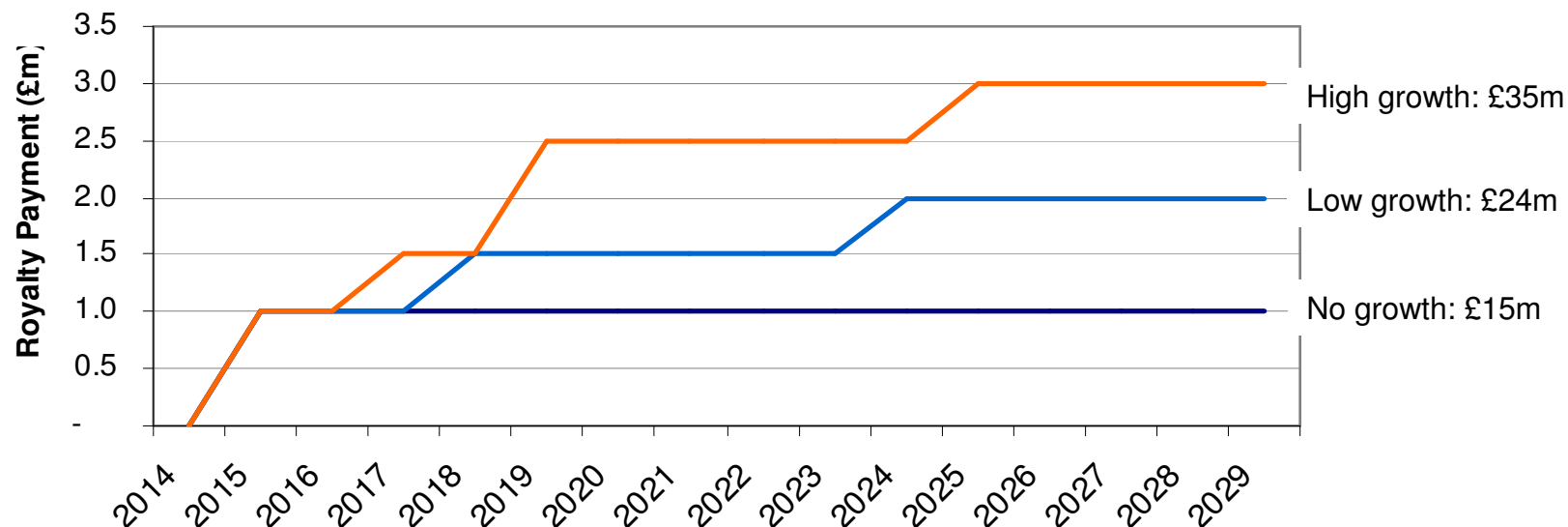
## Potential total CO<sub>2</sub> volumes transported 2014 – 2029:

- No growth = 30Mte / Low growth = 48Mte / High growth = 70Mte



# Simple and participatory royalty options

## Simple royalty options:



## Participatory royalty options:

	Shipper Share of BB Risk	Shipper BB Costs		Shipper Royalty Rate	Shipper Royalty Income 2014 - 2029		
		P50	P90		No growth	Low growth	High growth
	%	£m	£m	£/tonne	£m	£m	£m
Lower Shipper risk share	40%	10.9	30.9	0.75	22.5	36.0	52.5
Equal Shipper risk share	50%	13.7	38.6	0.80	24.0	38.7	56.0
Higher Shipper risk share	60%	16.4	46.3	0.87	26.1	41.8	60.9

# Next steps

**We are keen that you respond to the consultation.**

**Responses due to Ofgem by 22<sup>nd</sup> May.**

- Key to draw out major arguments for / against this proposal
- Key to realising any value is to give an early indication on feasibility of asset release

**Any queries/comments can be sent to [CCS@uk.ngrid.com](mailto:CCS@uk.ngrid.com)**

**We thank you for your time today and the opportunity to explain our proposal.**