Opportunities and Challenges for CCS Projects

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Sharing our perspective on CCS

- CCS is only one mitigation arena, but it will be a major industrial space. We are ready to start.
- Valuing carbon is necessary for CCS investments and should be transparent for consumers.
- Small-scale projects will not demonstrate industrial materiality.

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Power and CCS…

- Early CCS projects will require large amounts of additional power (20-40%), a major deterrent.
- Costs and efficiency of CCS must improve dramatically or it will fail in the marketplace.
- Power companies tend to be uncomfortable with the operational complexity of plants w/ CCS and IGCC in general.
- We need collaboration for progress.

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Serious Questions

- How can we effectively manage “risk” to accelerate action?
- What framework makes sense for liability, government expectations and empowering legislation?

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CCS Costs, Today's Tech

- Larger projects have better $ /tonne metrics.
- Value is maximized with large co-gen synergies with industrial gas use (H2, CO, O2, N2), "plus" commodities like ammonia, methanol, and SNG.
- Best available technologies
  - $40 - $70 /tonne with lots of synergies
  - Some projects >$180/tonne CO2
  - Not able to "replicate" $25 / tonne.
- Valuing carbon will provide economic framework.

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Does it make sense…

- To start CCS with natural gas?
  - Not where other fossil fuels are used.
- To delay starting industrial projects by 10 years waiting for modest demos to prove themselves?
  - We're ready to start now.

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Will CO2 EOR Enable CCS?

- Frankly, not in most locations.
- It's NOT about "putting gas down old wells."
- Old fields require major infrastructure; cost of system recapitalization is huge.
- Current US Permian basin projects support ~$10 - 25/tonne delivered at injection pressure, because they leverage big infrastructure.
- Offshore projects challenged even with "free CO2," storage credits and high oil prices.

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Industry knows how to inject gas!

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- Cumulative 30-yr natural gas recycling at Prudhoe Bay, Alaska
  - ~49 TCF
  - ~275 BCF/yr.
- Permian Basin EOR
  - >40MM t/yr CO2.
- Big projects will sustain robust measurement, monitoring and verification.

** All Prudhoe info calculated from Alaska Oil & Gas Conservation Commission Public filings.*

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Storage: It's about geology…

- Leverage our knowledge base, don't reinvent the wheel.
- Ask the right questions. Use tools to test theories that need testing. Don't just use tools because they're available.
- Ask how..
  - Faults can be great migration barriers for gas
  - Wells don't act as straws
  - The earth has terrific containment systems
  - "Earthquake leaks" from deep reservoirs sounds more like a scary movie than science.

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Natural Containment Systems-- Not one-off reservoirs

- Basins with **multiple** reservoirs, **multiple** seals and **good** hydrodynamic systems.
- Nature's best
  - seal = **salt** layers
  - gas filter = **coal** seams.
- Site selection is key.

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Early projects should..

- Use well understood, very low risk, basin storage sites.
  - Start with depleted oil and gas reservoirs.

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Yes, there are storage issues…

- Implications of long term well system integrity.
- Details of trapping mechanisms, residual saturation, and mineralization kinetics.
- Effective proven solutions for monitoring CO2 in subsurface.
- Suitability of saline reservoirs for high volume storage.

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Provocative Questions?

- Are “storage issues” reason enough to delay early projects?
- Do we know enough about some storage systems to be comfortable starting and learning more as we go?

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Location, Location, Location…

- Leverage **major** basin storage systems
  - Gulf Coast, Permian Basin, San Juan Basin, Williston Basin, Illinois Basin…Southern North Sea Basin, Adriatic Basin.

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Example: Southern North Sea Basin

- Multiple “fail-safe” storage system
- Sub-salt depleted reservoirs
- Coal beds
- Large capacity
- Shallower saline formations.

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Where can we start?

Where it makes sense.

- Leverage refinery and industrial complexes with power, steam and gases near large basin storage sites.
- Consider
  - Value incentives, regulatory framework
  - Carbon-price bridge for early movers.
- ConocoPhillips announced study: Immingham
  - Major UK industrial area, deep water port, Humber Refinery, Cogen =CHP enlargement.
  - Access ~14% UK CO2 Emissions within 50 mi.
  - Enable CO2 pathway to So. N. Sea w > 1.6 Gt storage.

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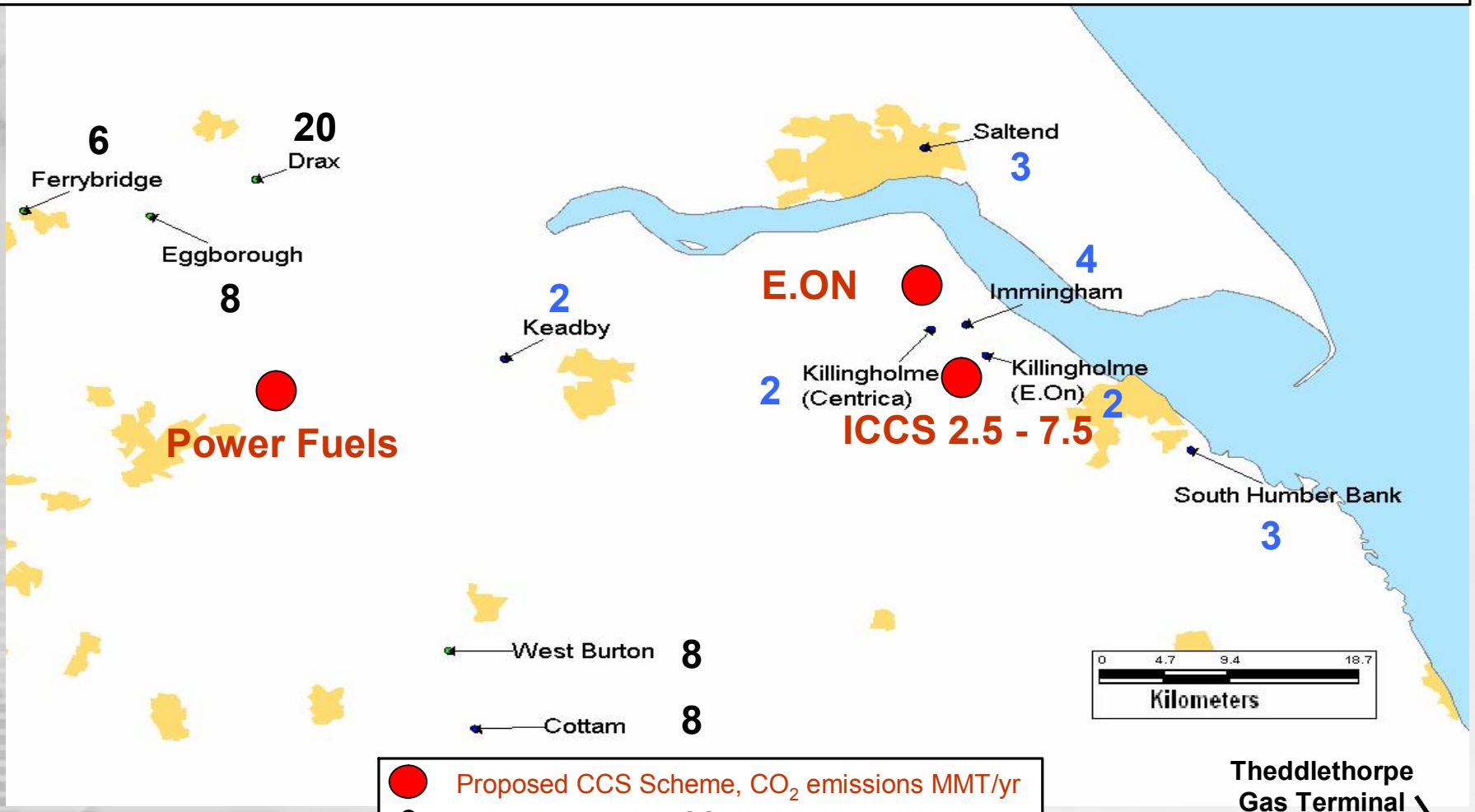
Humber Area Existing Power Plants & Proposed CCS Schemes

Total potential CO_2 emissions ~ 80 MMT/yr (14% of UK)



Immingham Area

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Immingham CHP Plant

- 734 MWe – world class
- 450 MW Phase 2 in construction – commercial operation Q2 2009
- Reliability - critical steam supply to 25% of UK refining capacity
- Fuelled with natural gas, excess refinery fuel gas, liquids back-up
- 3 MM TePY CO_2 reduction vs. separate production of steam & electricity (coal)

Potential conversion to clean coal/coke with CCS

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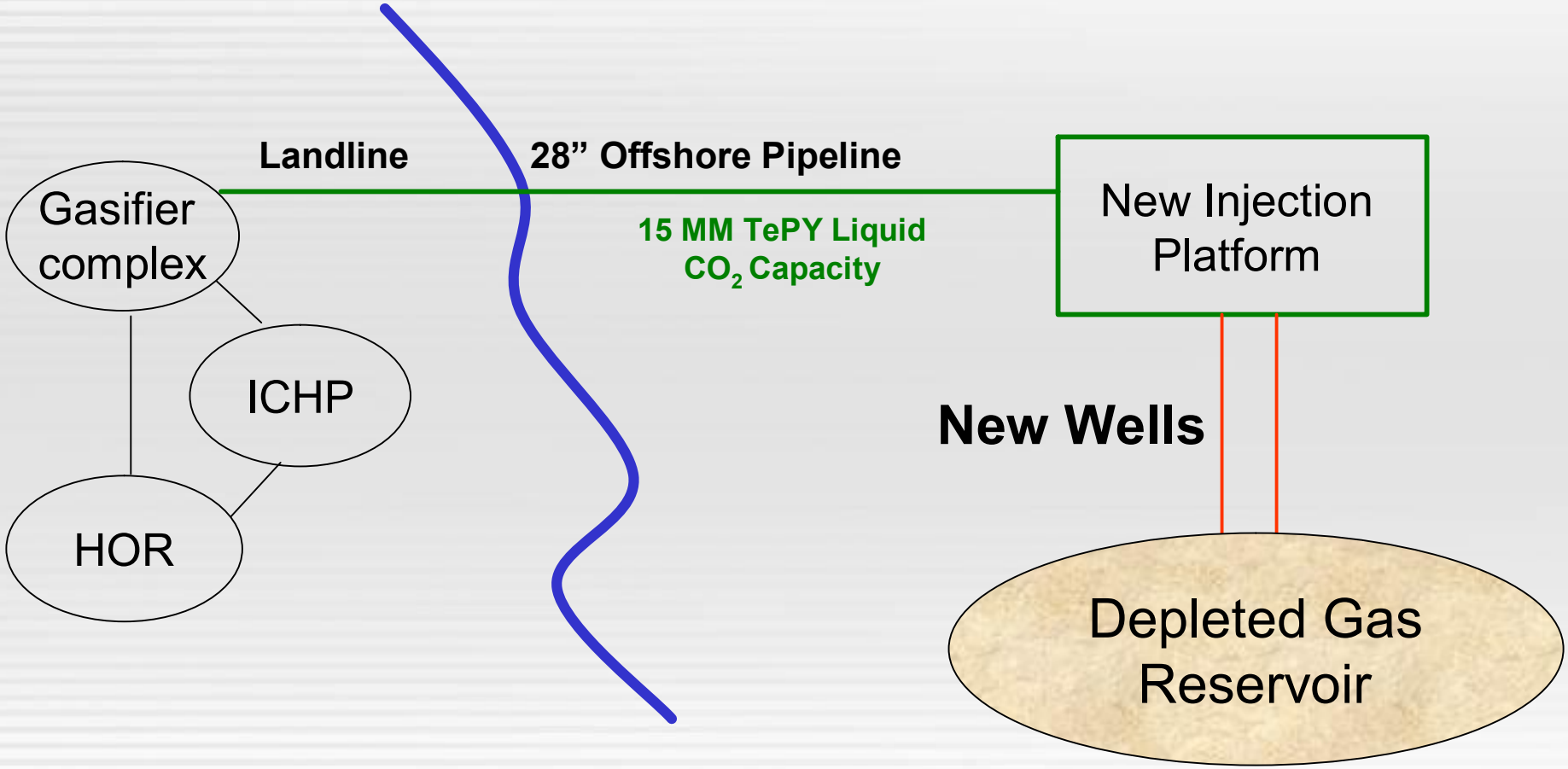
Immingham CCS Overview Schematic



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Good things are happening

- There's room for action and we need to move faster than most of us are comfortable doing.
- We don't need to solve everything first. We need to get moving.
- We can adapt our technology and business models.
- More work is needed on the framework of regulations before we get started.

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The time is now

- “If we wait too long, it won't be an issue of mitigation. It becomes one of adaptation …with society paying a high price .”

  Jim Mulva, ConocoPhillips Chairman and CEO

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www.conocophillips.com/energy

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