

Creating Value in Carbon Capture & Sequestration

Cross-Border Energy Forum

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A Passion to Perform.

US Has Decided to Deal with Climate Change

...the Miracle on 34th Street

Can an Elected Judge Send a Santa to Jail?
...not in New York at Christmas!



Who Will Condemn the Polar Bears?
...not elected state commissioners



- Kansas Governor Kathleen Sebelius said she will veto a bill to strip the state's top environmental regulator of the authority he used to block expansion of a coal-fired power plant over health concerns. The bill targets state Health Secretary Roderick Bremby's decision in October to reject Sunflower Electric Power's plan to expand the Holcomb Station on grounds that greenhouse gas emissions from the plant are a threat to public health.
 - American Electric Power (AEP), the largest US producer of coal-fired electricity, got approval for a \$2.23 billion West Virginia plant that may advance efforts to reduce emissions of greenhouse gases. By converting coal to gas, the plant promises cheaper capture and sequestration of heat-trapping carbon dioxide than from conventional coal-burning plants.
- Source: Bloomberg

CCS Will Be A Critically Important Technology

Conclusions from the Stern Review – Need for Carbon Capture and Sequestration

“Even with very strong expansion of the use of renewable energy and other low-carbon energy sources, hydrocarbons may still make over half of global energy supply in 2050”

- **The Stern Review’s sober analysis concludes unambiguously that coal will be a part of the energy mix across the globe for decades to come**
- **It is imperative to develop zero-carbon energy technologies since it is impossible to achieve the reductions required unless power can be generated from coal without emitting CO₂**

Outlook

- A dramatic expansion of renewables will be necessary but not sufficient to achieve the emissions reductions required by 2050.
- An aggressive acceleration of clean-coal technology is imperative.

Source: Stern Review

Costs of Carbon Capture & Sequestration

Part of the reason for the wide variation in CCS cost estimates is that studies often do not include all the appropriate costs.

Capture, Transportation, Storage

- **Capital Costs**
- **Interest Rates**
- **Taxes**
- **Energy Costs (prices)**
- **Energy Penalty (process losses in capture)**
- **Liability**

Key Issues

- With present technology, estimates of CCS costs are in the range of \$100-300/tonne of CO₂ emissions avoided. (DOE/EIA)
- Some studies suggest that “capture could be done for \$25-75/tonne, “transport” for \$1-5/tonne and “injection” for \$1-2/tonne. Cost of leasing “pore space” and long-term monitoring and liability issues are not included.
- For a fixed output of electricity, carbon capture imposes a so-called energy penalty by increasing the fossil fuel energy needed to generate that fixed output. Hence, the quantity of carbon captured and stored will be greater than the quantity of carbon actually avoided. (Anderson & Newall, RfF)
- Energy Penalty: 10-15% (David & Herzog, MIT)

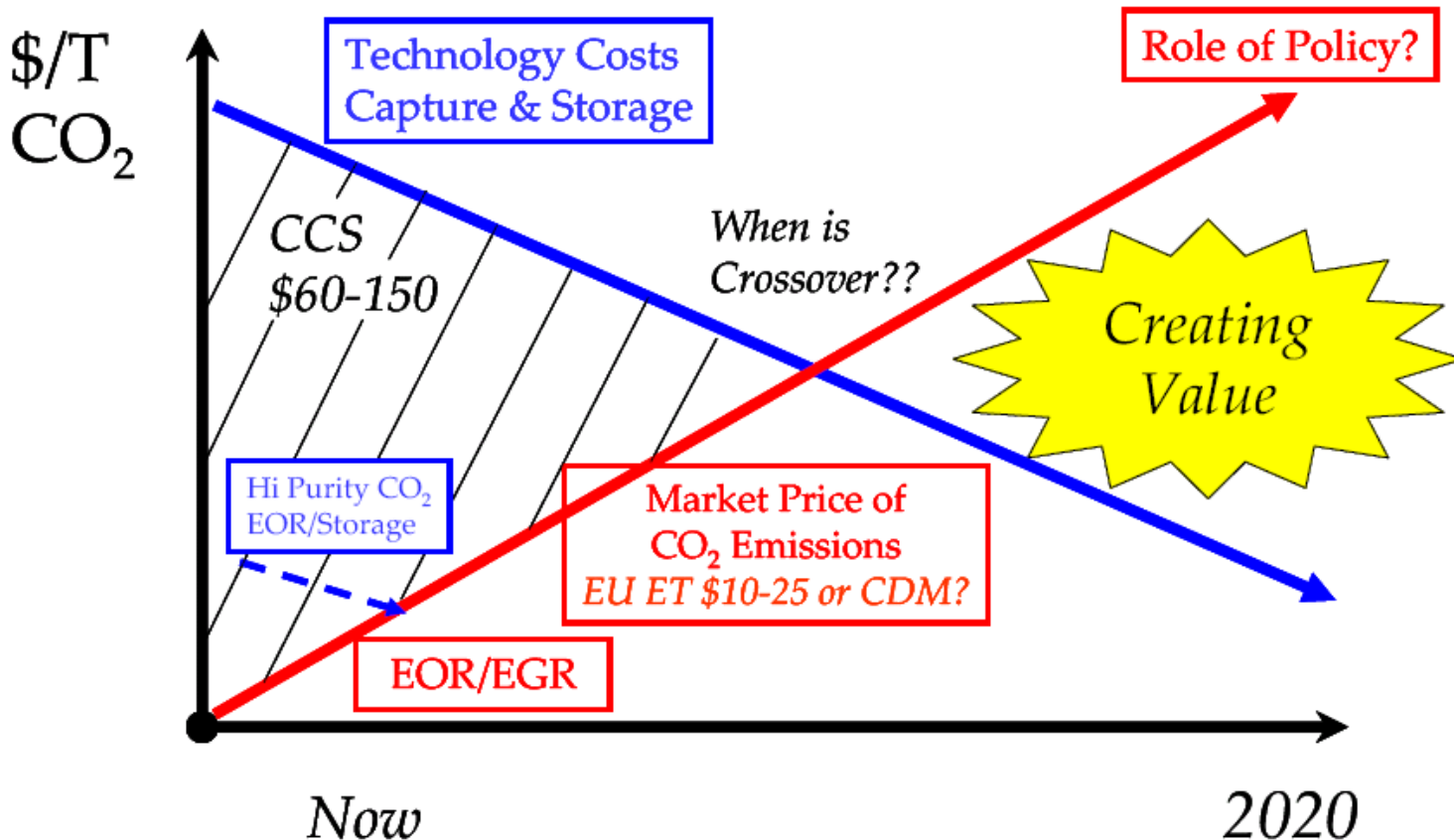
Source: DB Global Markets Research

Creating Value in CCS

Carbon Capture & Sequestration (CCS) Policy Issues

BRIDGING TO CROSSOVER

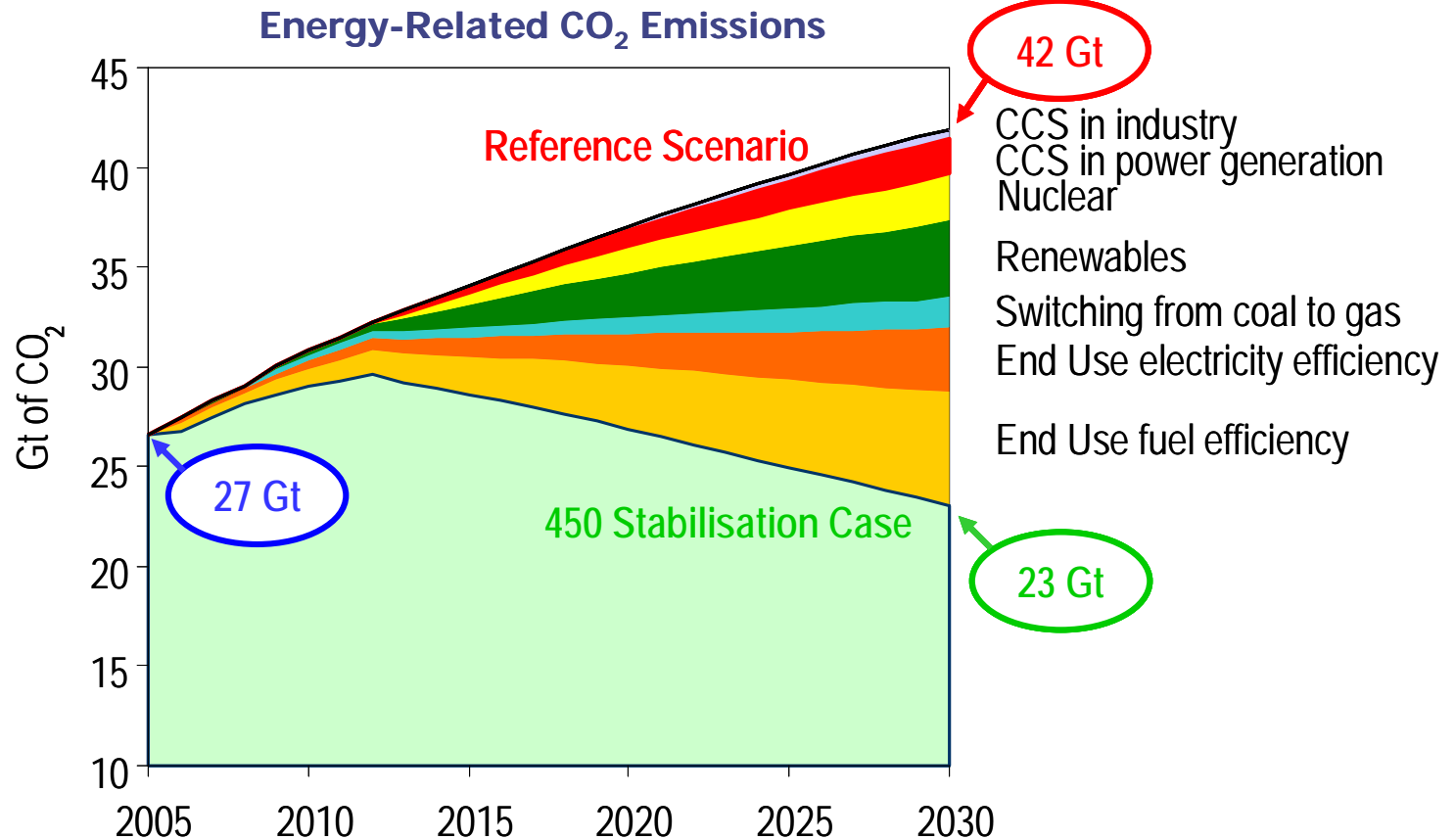
- CCS allowance bonus
- Accelerated depreciation
- Low cost loans
- R&D subsidies
- Government guarantees
- Global finance facility
- Buy-out and retire
- Ratepayers pay for capture.
- Taxpayers pay for guarantees.
- Cost of carbon eventually pays for storage (as it does now for EOR).



Source: BP Alternative Energy (graphic), DB Global Markets Research

This Really Looks Like a Paradigm Shift

Accomplishing This Goal Probably Requires a Complete Energy Rethink



Source: IEA World Energy Outlook 2007

Unintended Consequences & Potential De-Railers

What Can Go Wrong?



- **Energy shortfalls**

What happens if policy mistakes result in shortages?

- **Larger-than-Expected Retail Price Increases**

Public could rebel at the costs and demand adaptation measures rather than abatement policies

- **Economic Failure-to-Thrive**

What will public officials do if the costs to GDP are too great?

- **Three Cold Winters in a Row**

Public/voter willingness to sacrifice for the long-run could be hurt

Source: DB Global Markets Research

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