IGCC Barriers & Opportunities

Presentation to USEPA's Advanced Coal Technology Working Group

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CLEAN AIR TASK FORCE

Clean Air Task Force (CATF)

- **CATF is a nonprofit environmental organization that addresses air quality and atmospheric protection issues.**
- **We employ twenty professionals with backgrounds in science, engineering, law, economics and public outreach.**
- **Headquartered in Boston but located throughout the United States.**

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Environmental Issues Advanced Coal Technology *Must* Address

- **SO_2 & NO_X**
  - **Prevent premature death and morbidity by *dramatically* reducing emissions.**
- **Mercury**
  - **Not enough to remove from the stack, but keep from remobilizing into the biosphere once converted to a solid.**
- **CO_2**
  - **Global warming: twin challenge of both deep reductions AND on a rapid schedule.**

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- **Good News: Recent IGCC air permit applications incorporate advanced pollution controls that lower SO_2 and NO_X emissions to levels that rival natural gas.**
  - **Five IGCC air permit applications filed in last few months of 2006**
    - All use Selexol
    - Over half incorporate SCR
  - **First draft air permit issued for IGCC with Selexol and SCR in November 2006**
- **Trend is faster than predicted by USEPA's July 2006 Environmental Footprints report.**

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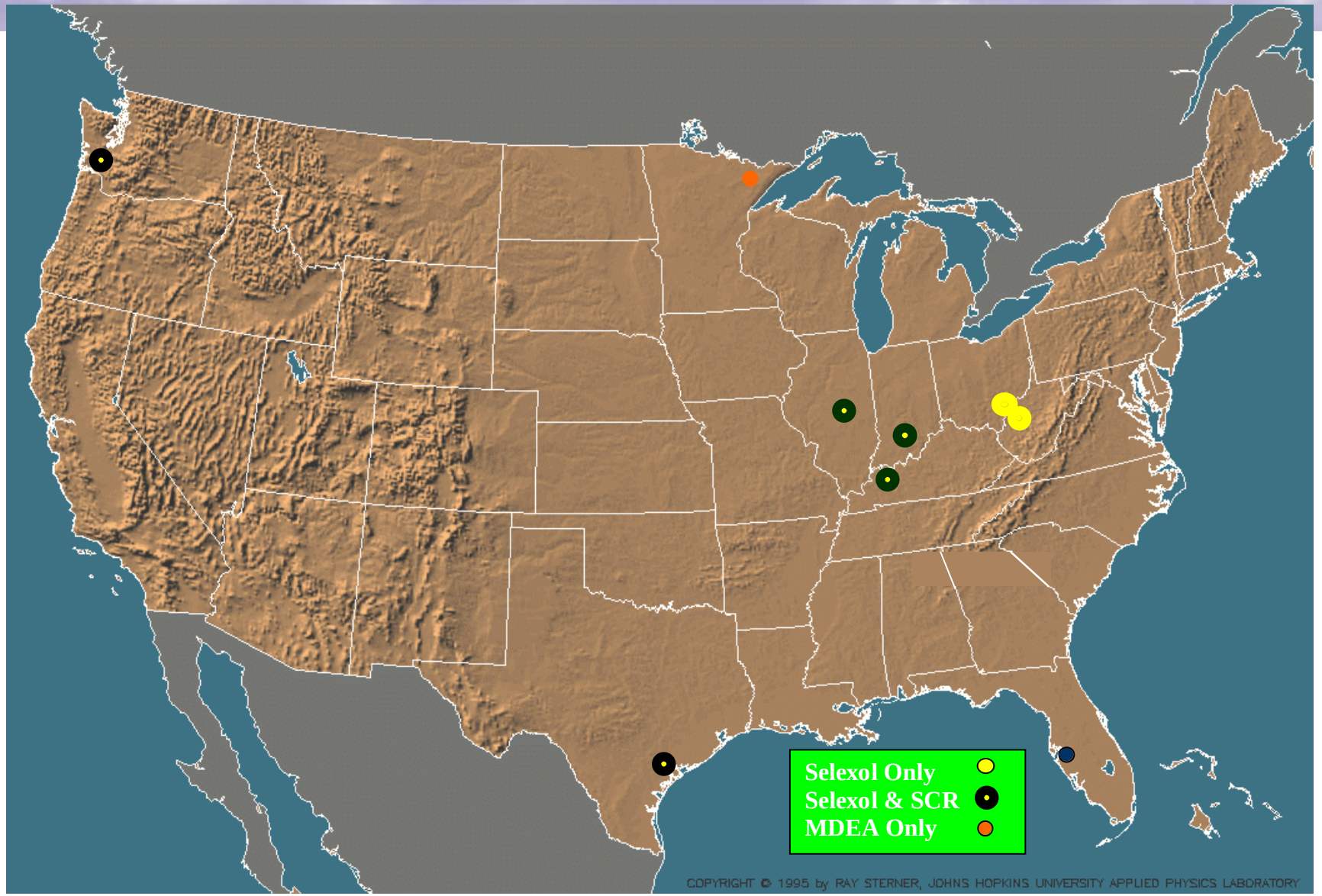
IGCC Plants In Air Permitting Phase



Regulatory Barriers

1. **Why build an IGCC plant and achieve radically lower SO_2 and NO_X when your conventional PC competitor can get an air permit for vastly more pollution?**

	IGCC (lb/MMBtu)	PC
SO_2	~.015	.06-.15
NO_x	~.025	.05-.08

Action: Require IGCC to be evaluated in the BACT determination for proposed PC plants.

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Regulatory Barriers (cont'd)

- **Unintended Consequences of "Netting"**
  - **Many power plants today are proposed at sites of existing facilities.**
  - **These new plants often "net out" of BACT through added controls on existing plant.**
  - **But for IGCC to be the technology choice in these situations, it may NOT enough for IGCC to simply equal PC costs (as with a greenfield site). Instead, IGCC costs must be *lower* to overcome the inefficiencies of having to maintain two different technologies (parts, labor, etc) at the same site.**

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- **Scant attention has been paid to the problem of remobilized Hg once removed from the air emissions.**
  - **PC: Mercury is dispersed in tens of thousands of tons of scrubber sludge**
  - **IGCC: Mercury is collected in vastly smaller volumes**
- **Action: Need regulations that require power plant solid wastes containing Hg to isolated over geologic time.**

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- **The problem: Need deep reductions of CO_2 on a relatively short schedule.**

- **Most attention has focused on two areas:**
  1. **Technology status such as cost, performance and future improvements, and**
  2. **Regulatory and economic environments which drive technology adoption.**

- **Critically important, and often overlooked, is the issue of *technology assimilation* within the power sector:**
  - **If GCS technical uncertainties were resolved today, and current regulations sufficiently strict to drive wide scale adoption, how quickly could the power sector adapt to this new world? Key issues:**
    - Acquiring skills in new areas such as CO2 capture and sequestration.
    - Development of infrastructure such as CO2 pipelines.
    - Sufficient experience at scale within utilities to build and operate multiple plants with GCS economically.
  - **All this must be accomplished in time to stabilize atmospheric CO2 concentrations!**

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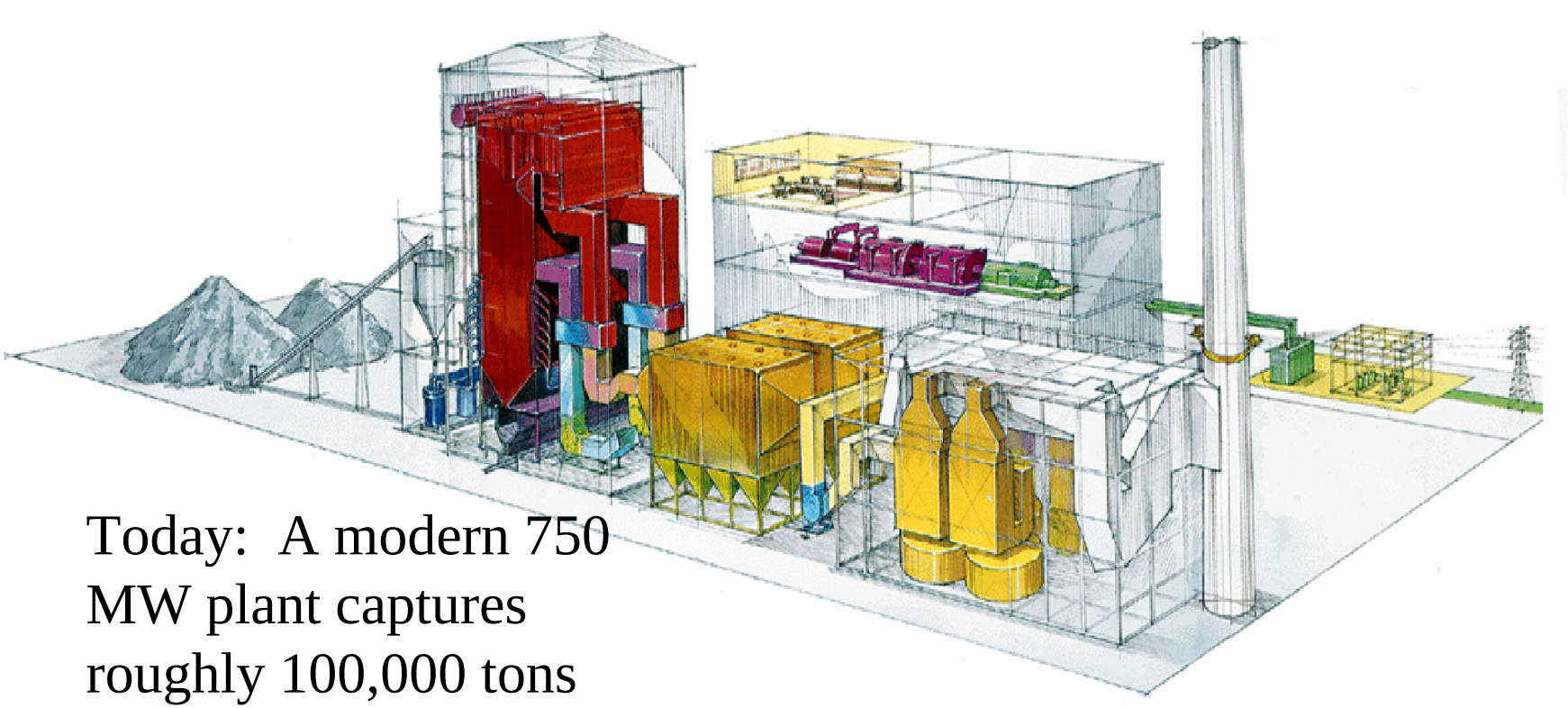
The Coal Transition Challenge



Today: A modern 750 MW plant captures roughly 100,000 tons of SO2 and 5,000 tons of NOx

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The Capture Challenge

(Same 750 MW Coal Plant)

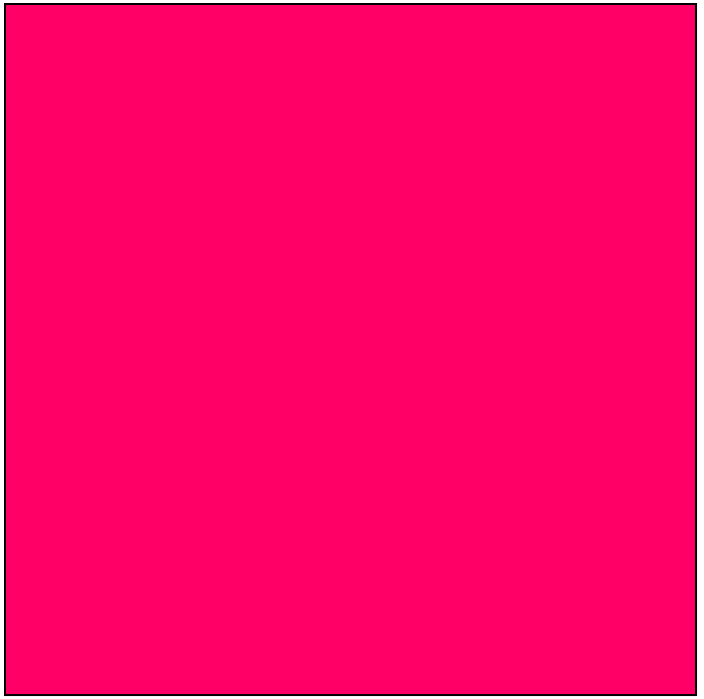
- **Today**

NOx-
5,000

tons,

SO_{2}-
100,0000
tons

- **2035**



NOx, SO_2, CO_2

(about 50 times more)

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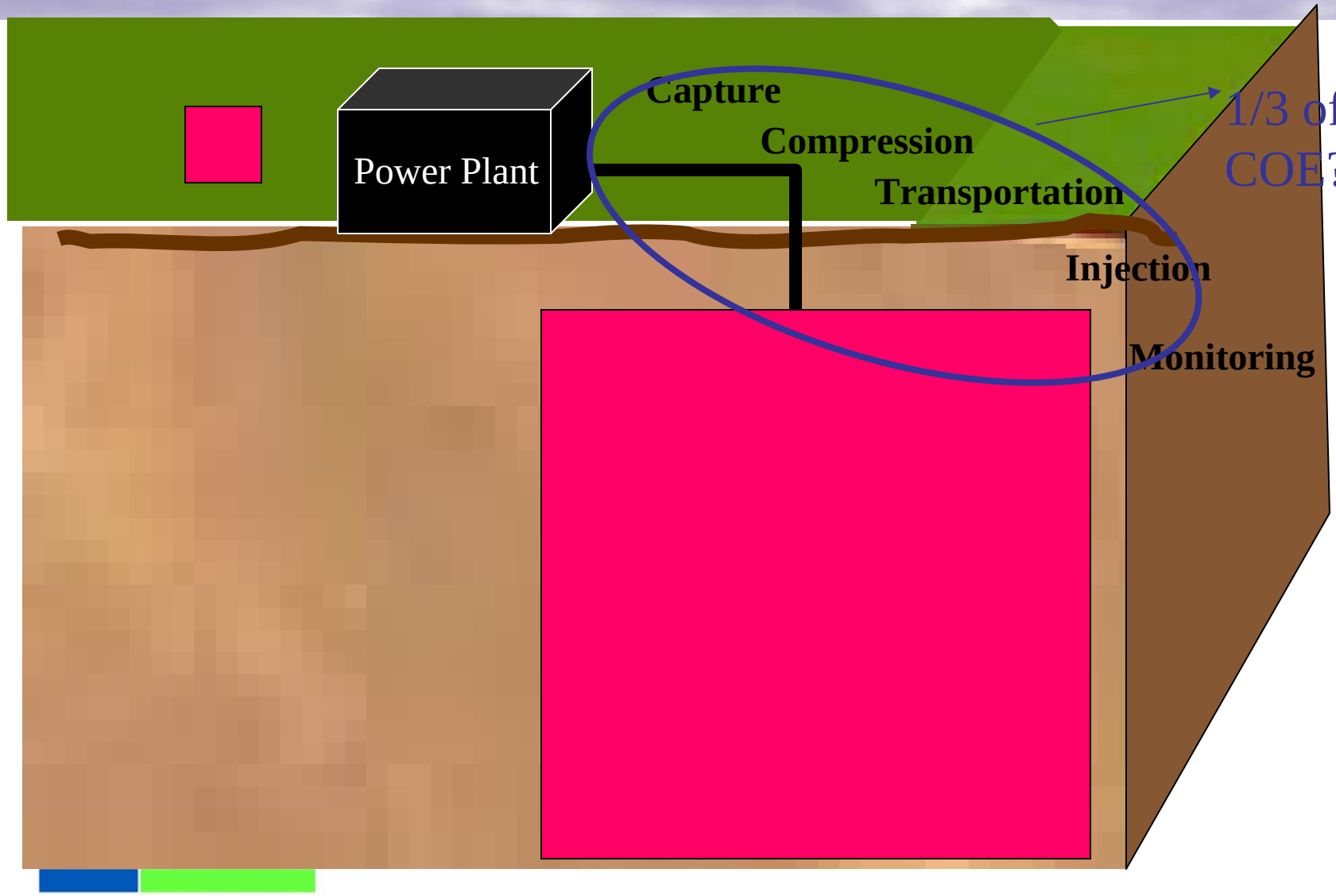
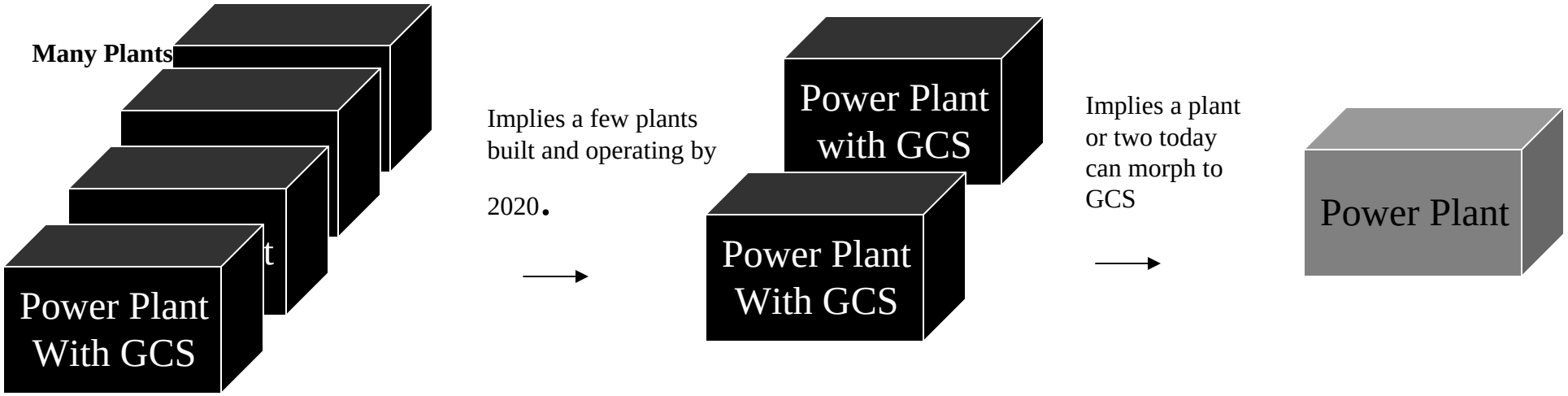
The Sequestration Challenge



Meeting Both Challenges at Large Scale for a Typical Utility



2035

Geologic Formations Proven at Large Scale Sequestration Plus Monitoring, Liability and Related Issues Resolved.

2020

2007

Prove Geologic Formations at Large Scale Sequestration

This will require tests using 1-2 million tons of CO2 per year, not tanker truck quantities.

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- **Lot's of components to GCS**
  - **Capture technologies for the source**
  - **Pipelines**
  - **Verification of geologic formations**
  - **Site selection protocols**
  - **Monitoring**
  - **Liability**
  - **Regulations to support all of the above**
  - **Expertise development and deployment**

- **These components have different development and deployment schedules.**

- **Assimilating these components and skills within the power sector within the short time needed to stabilize CO2 concentrations will be daunting.**

- **How can geologic carbon sequestration be deployed fastest? The complexity implies a path: Deploy as many components individually as possible, and then stitch them together together into a complete GCS system.**

IGCC Fills Key Gaps in CO_2 Sequestration Path

- **IGGC can extract 25% of CO2 at low cost without extensive plant changes such as shift reactors or turbine modifications (see next slide)**
  - **This can produce between 1-2 million tons of CO2 per plant per year--the quantity often cited as needed NOW to conduct tests to verify suitability of geologic formations for large scale (multi-plant) injection.**
    - Verifying the suitability of these geologic formations is central to timely deployment of GCS.
  - **Partial extraction can speed EOR deployment in areas where none is practiced. This may be important in initial build-out of pipeline infrastructure.**
- **IGCC plants that practice partial CO2 extraction today can still retrofit for more extensive capture later as regulations demand.**
- **Building IGCC plants now speeds assimilation within the power sector of skills and expertise central to carbon capture.**

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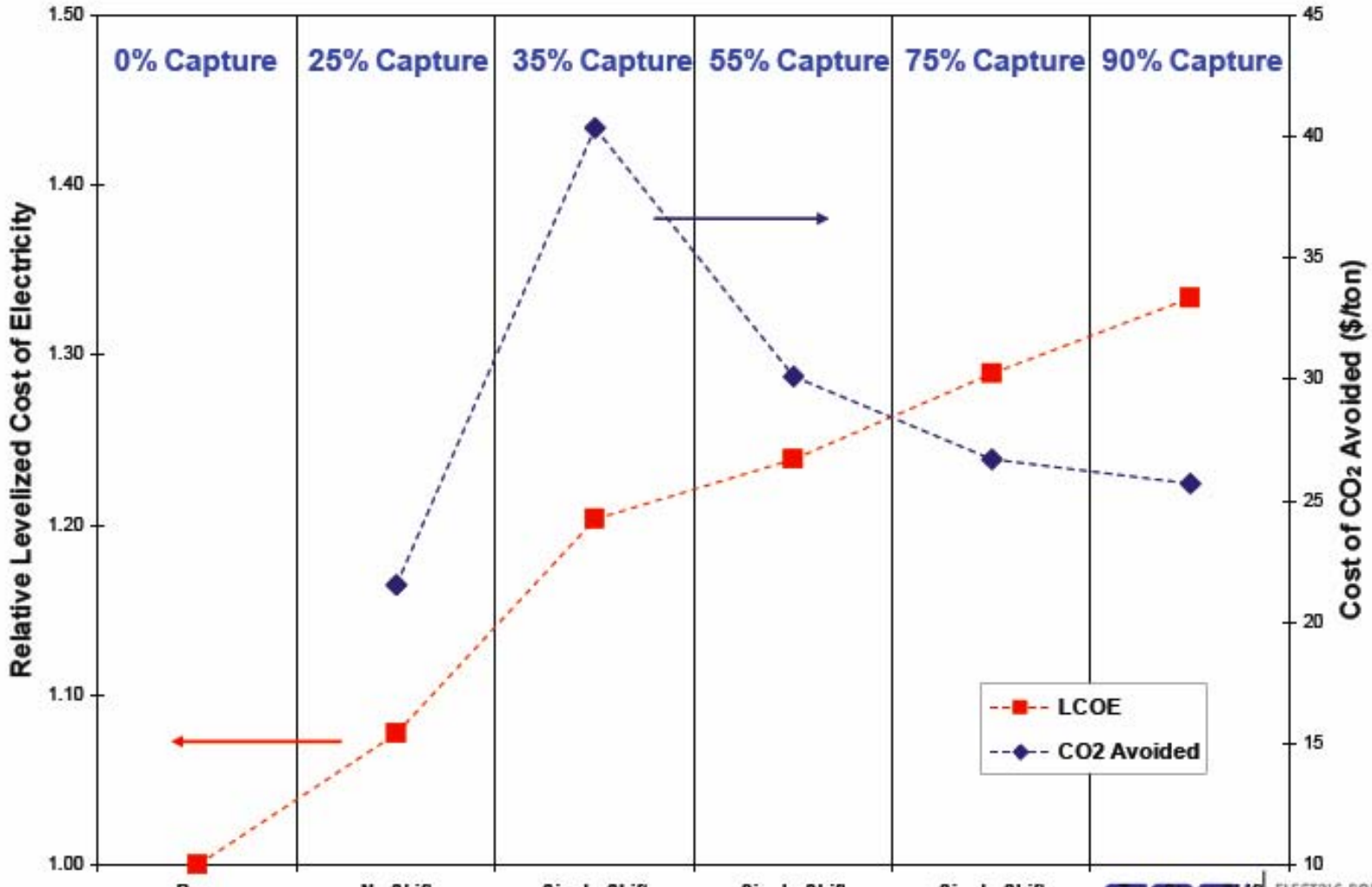
Impact of CO_2 Capture on IGCC COE & CO_2 Avoided Cost (without Transportation & Storage) (June 2006 $ Basis, Bituminous coal)



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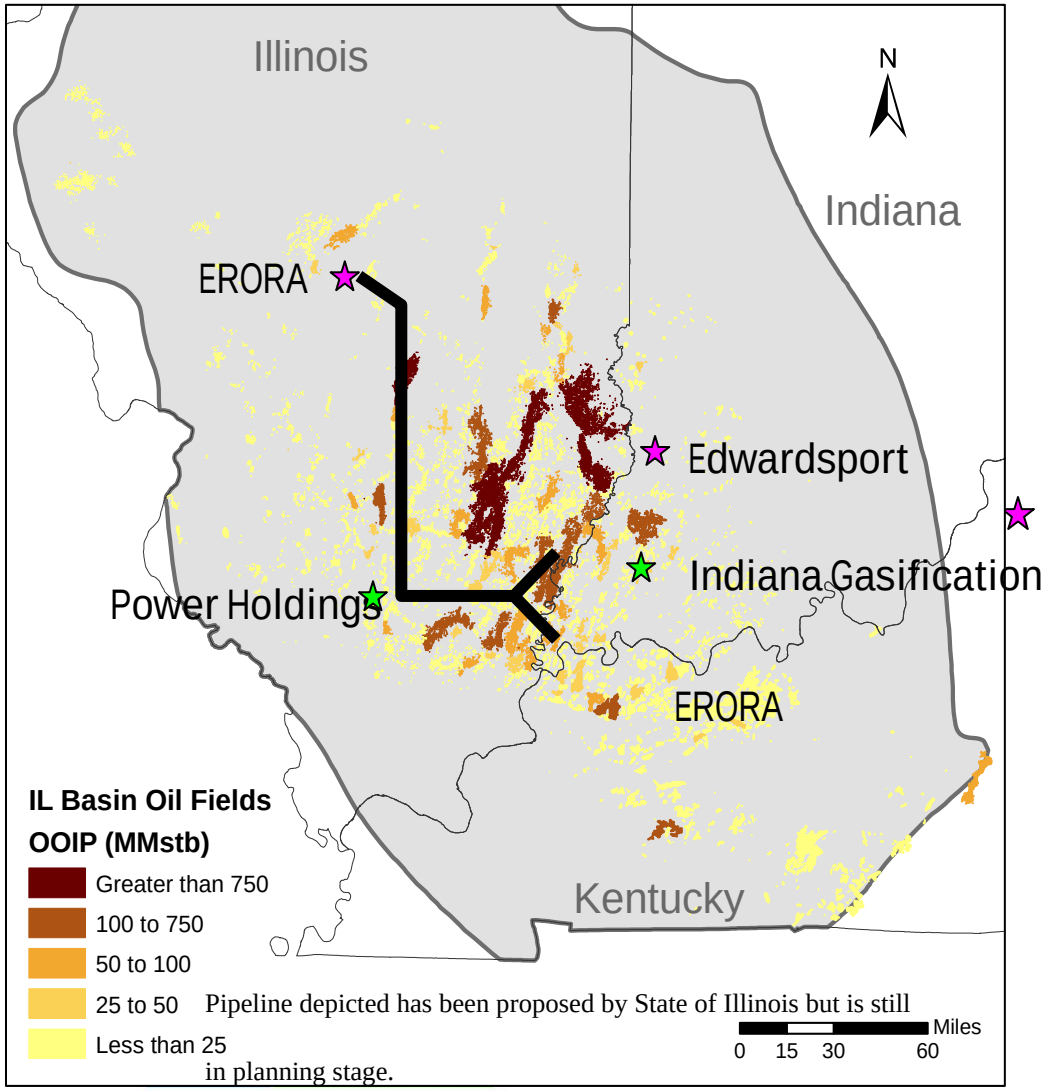
Midwest Example of IGCC Potential to Advance GCS



- Five proposed plants (3 IGCC & 2 SNG)

- Potential to offer relatively cheap source 1-2 million tons of CO2 per IGCC plant to prove saline aquifers and EOR suitability. Even more from SNG plants.

- Provide real capture and injection experience for the power and coal sector.

- Can do it NOW, not 20 years from now.

“We Shouldn’t Pick Technology Winners and Losers”

- **The case for picking technologies**
  - **Like it or not, it happens everyday in board rooms across the globe.**
  - **Society has an interest in avoiding the costs of externalities.**

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What Coal Plants to Build Today?

- **Should we allow investments in new PC plants ($2-$4 billion each) when:**
  - **New PC plants emit far more NOx, SO2 than new IGCC plants.**
  - **New PC plants capture mercury in a form that cannot be kept from remobilizing into the environment without substantial cost.**
  - **PC plants CO2 capture technology is far less mature than IGCC carbon dioxide capture technology.**

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IGCC Pioneer's Penalty Problem

- **The first IGCC plants plants involve more cost and risk than the Nth plant. These risks include:**
  - **Availability**
  - **Higher technology risk**
  - **Higher capital costs**
  - **Higher liquidated damage requirements to insure against construction delays or early performance glitches**
  - **Customer acceptance**
  - **Public opinion that plant must capture CO_2 from outset**
- **The Challenge: How to turn the pioneer's penalty into early adopter's reward???**

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- **Do we subsidize risk or industry-wide costs?**
  - **Risks- Those issues that disappear after the first plants are built and therefore disappear when the subsidy ends.**
  - **Industry-wide costs- Those issues that are fundamental and don't disappear after the subsidy ends.**
- **There is a time and a place for both types of incentives, but subsidizing industry-wide costs, runs significant risks.**

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Possible Incentive Aimed at Reducing Risk

- Subsidize a portion of the “wrap” for the first few IGCC plants.
- EOR Deployment fund
- Allow rate-basing of first few GCS plants that are needed to prove geologic formations.
- Price collar for first few IGCC plants

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