

GE Energy

IGCC's Role in Advancing Coal Carbon Policy

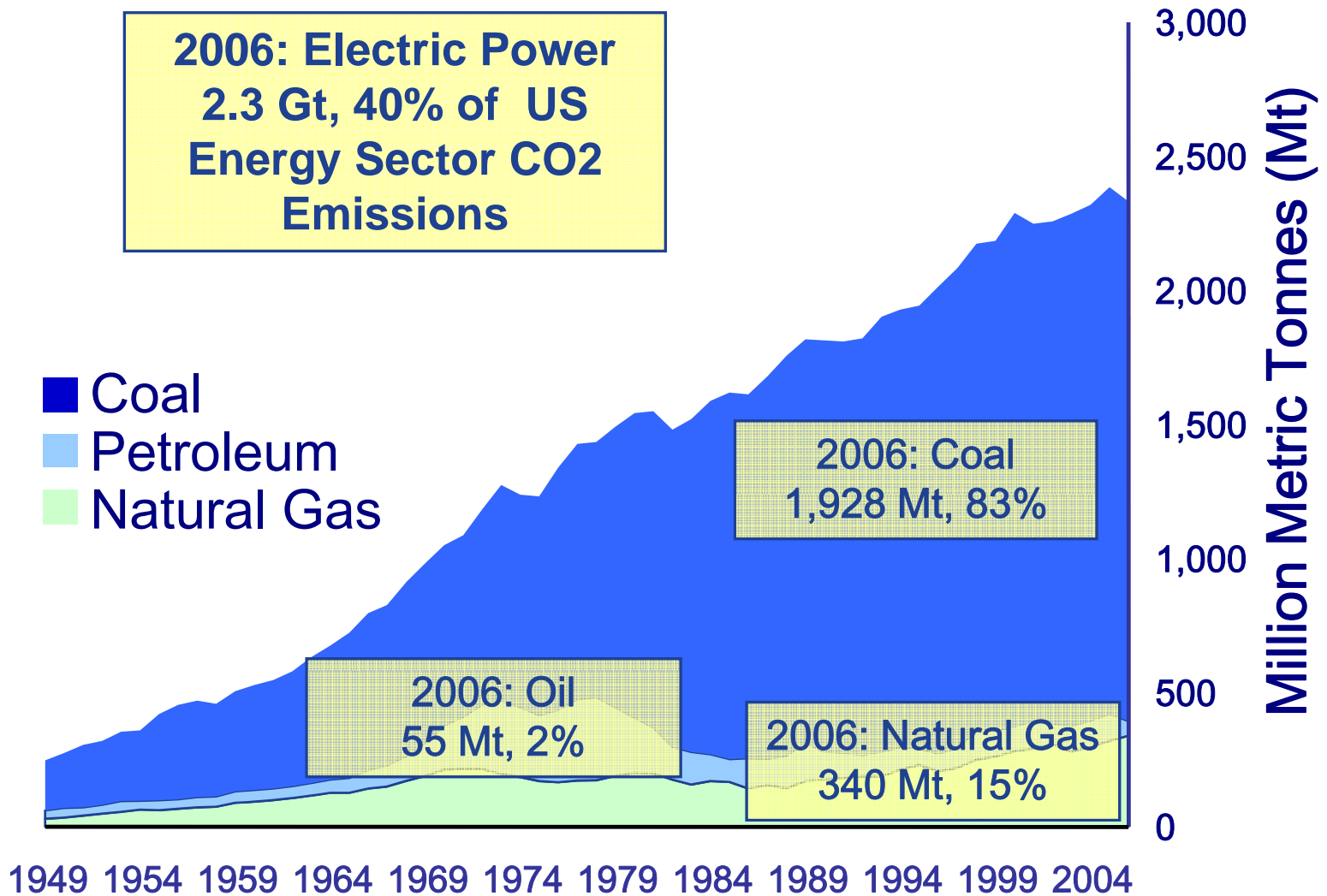


Our challenge is growing...

Reuters - Wednesday, September 24

NEW YORK - Nobel Peace Prize winner and environmental crusader Al Gore urged young people on Wednesday to engage in civil disobedience to stop the construction of coal plants without the ability to store carbon.

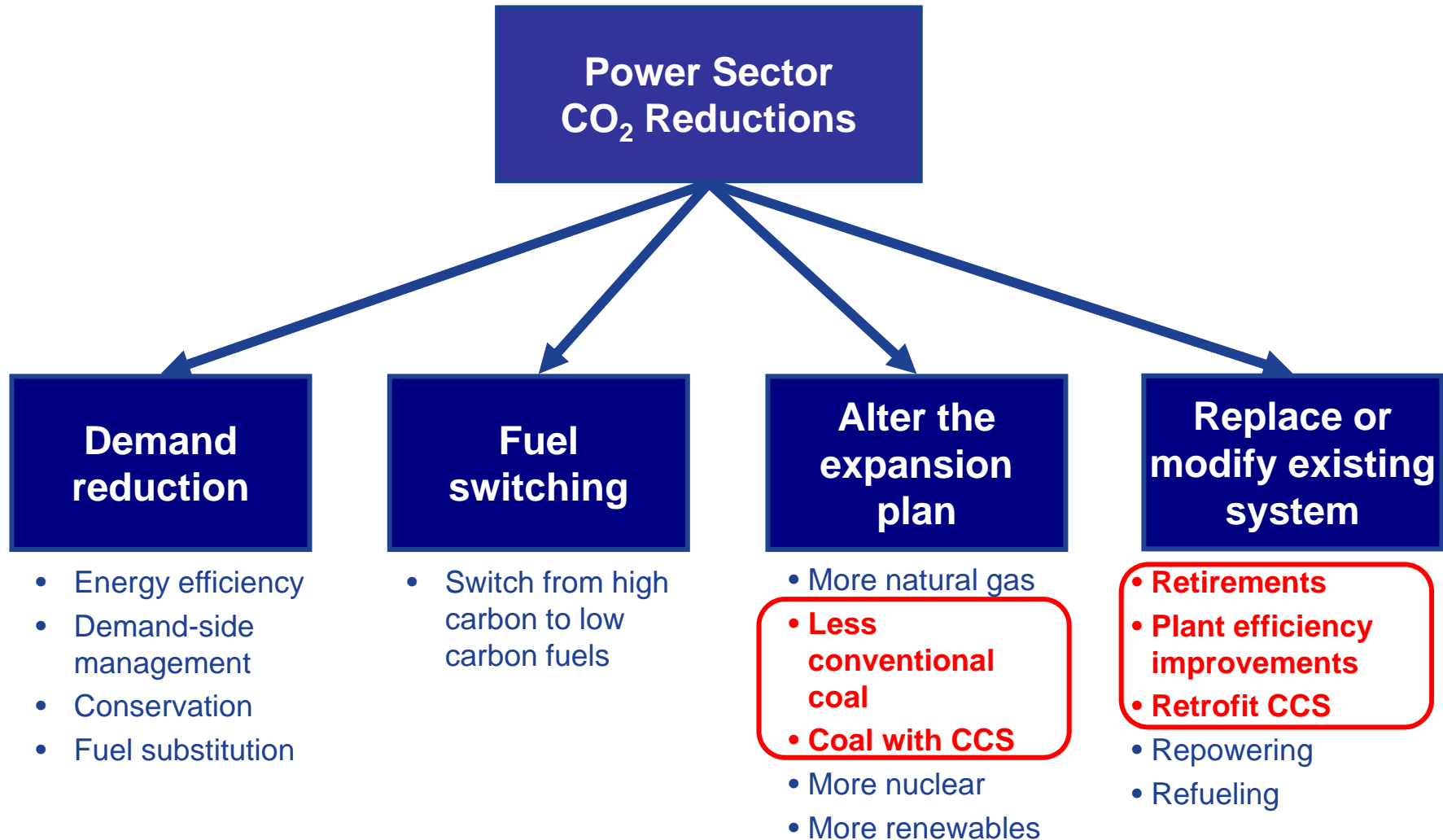
US power sector carbon emissions



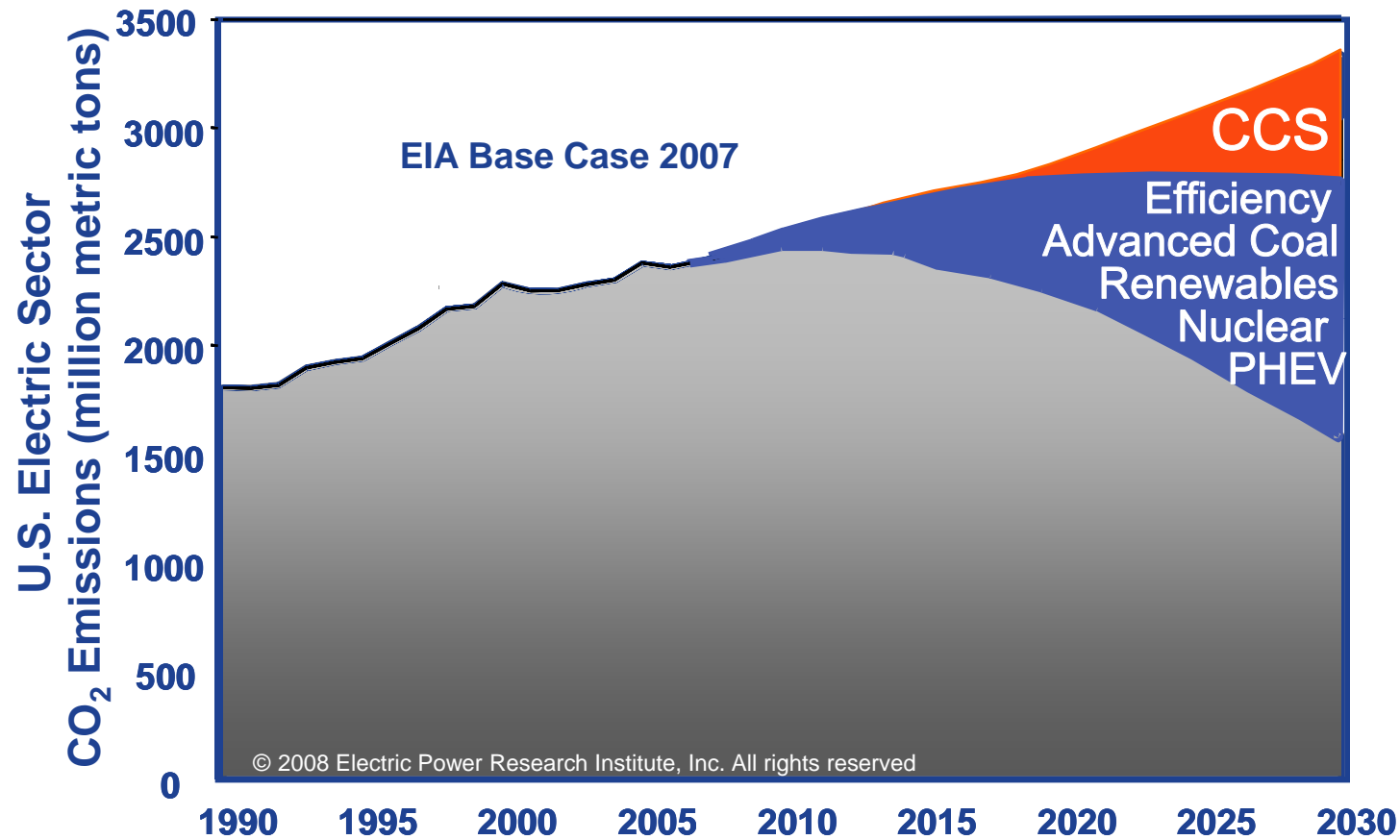
The generation planner's dilemma



What are the options for carbon?



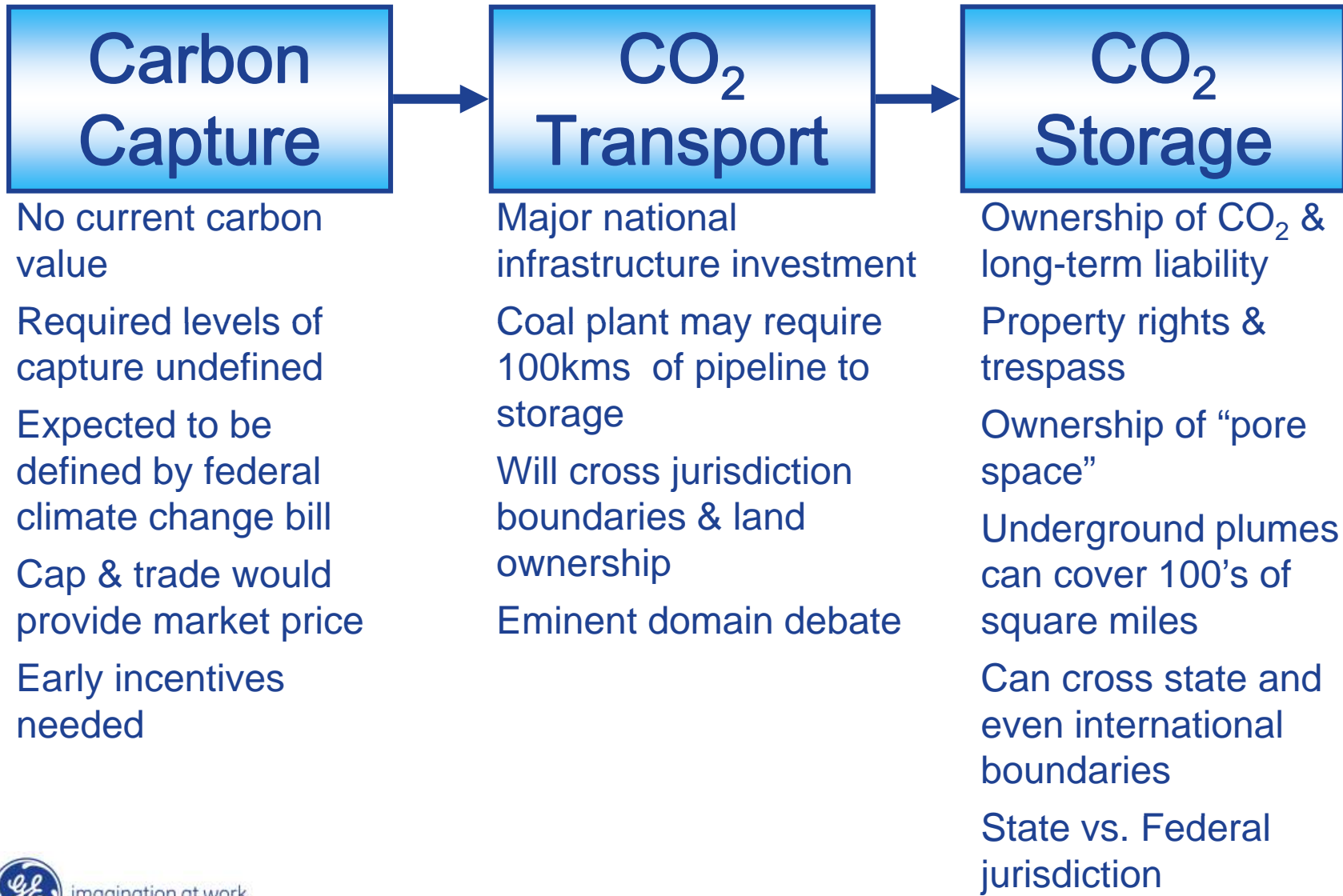
CCS needed to achieve GHG targets



Source: EPRI Prism Analysis

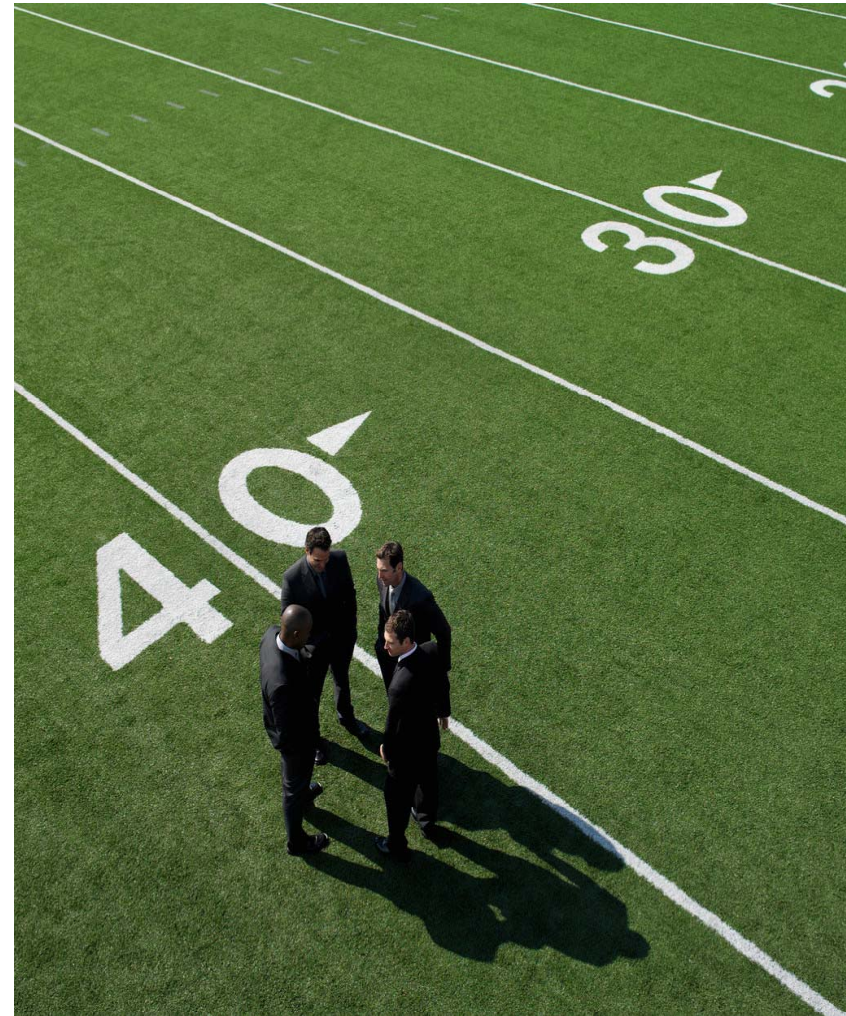


Policy and regulatory gaps



We need a playbook for offense

- **Carbon Capture Ready**
 - Meets well-defined criteria
 - Ready for expected CO2 trigger price under cap and trade
- **Crawl/Walk/Run**
 - Partial=>NGCC=>85%-90%
- **Permitting**
 - Pro-forma CO2 BACT analysis
 - CCS NGCC min base, O&M
 - Trigger price for retrofit
- **Infrastructure investment**
 - Economic benefits flowdown
 - Jobs, energy security, jobs



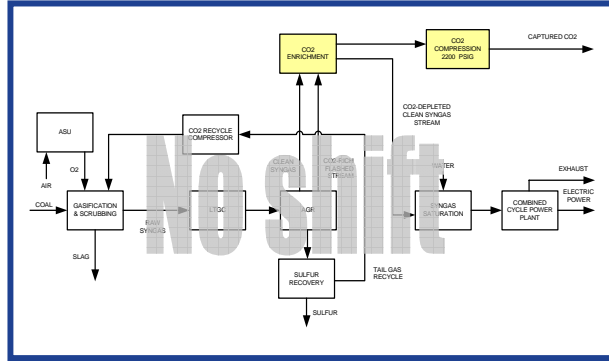
1st play – Carbon Capture Ready

The need:	New coal plants
When can we build them?	Now - for plants meeting clear, well-defined requirements for carbon capture readiness
When do we capture?	When carbon has value, regulatory clarity and relief on liability for stored CO₂
How much do we capture?	65% capture for parity with natural gas combined cycle
What CO₂ quality do we need?	Suitable for maintaining injectivity, storage capacity + optimized for minimum total cost of capture, transport and injection.
What else is needed?	Policy that sets carbon value at avoidance cost + incentives for early movers + regulatory clarity on liability and standards

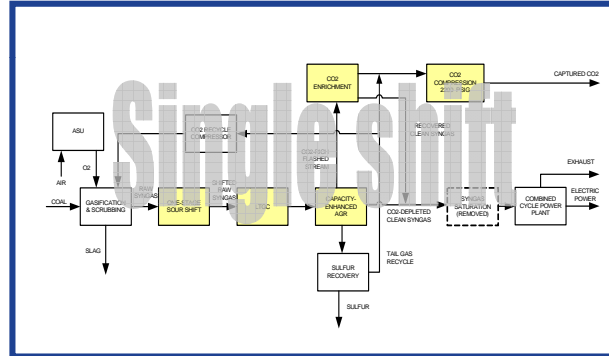
Defining carbon capture ready

All processes and components are in commercial application today	<i>Inventions and those in early technology development do not qualify.</i>
Components should be at, or within accepted engineering limits of scale-up	<i>Technology still requiring pilot scale-up for validation do not qualify.</i>
Incremental investment is needed only for addition of components and process steps.	<i>No significant modification, underutilization or scrapping of existing major equipment</i>
Site utilities – e.g. once-through and makeup water – are sufficient for operation with CC	<i>Post combustion capture likely to require significantly more water with CC</i>
Plant space is reserved and adequate for specific process components and layout.	<i>Supported by engineering analysis with heat and mass balances for component sizing.</i>
Potential life-of-plant sequestration resources and access identified	<i>Candidate primary sequestration sinks as well as back-up sites screened.</i>
CO2 quality must be suitable for sequestration.	<i>Compatible with reservoir geochemistry, well life, maintenance of injectivity and capacity.</i>
Deferring retrofit will incur <10% economic penalty in avoided cost of carbon.	<i>Incentive for adding CC when carbon price or regulatory requirements justify doing so.</i>

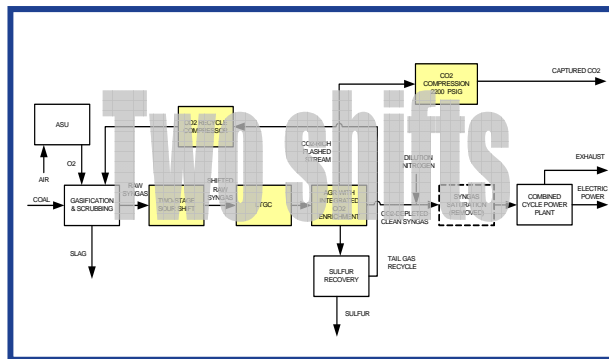
IGCC can help CCS to crawl, walk, run



Capture (%)	5 - 17
Captured CO ₂ (ktons/yr)	225 - 725
Low cost large-scale CO₂ source for CCS demos and storage validation	



Capture (%)	50 - 65
Captured CO ₂ (ktons/yr)	2,200 - 2,700
Retrofit to NG_{eq} – meets CA reg or capture criteria for Fed incentives	



Capture (%)	85 - 90
Captured CO ₂ (ktons/yr)	3,750 - 4,000
Appropriate for EOR or when warranted by market price of CO₂	

What policies do we need to succeed?

Government Policy Measures

Creating Markets	Shaping Markets	Setting Regulations	Public Participation
<ul style="list-style-type: none">• Property Rights• Tradable Permits• Domestic and International Offset Systems• Defined liability	<ul style="list-style-type: none">• Taxes/User Fees• Setting/removing price caps• Subsidies (+, -)• Controlling entry and exit	<ul style="list-style-type: none">• Standards• Bans/Caps• Permits and Quotas• Mandates	<ul style="list-style-type: none">• Legal Standing• Right to Organize• Public Hearings• Information Disclosure Rules

Governments can shape markets multiple ways

US climate change policy

- **Senate Climate Security Act**
Boxer-Warner-Lieberman 2008
 - Cap and trade
 - **Decrease GHGs from 2005:**
 - (-4%) by 2012;
 - (-19%) by 2020;
 - (-71%) by 2050
 - **Failed cloture**
 - **Issues to be resolved:**
 - Protection for consumers
 - Limits on offsets
 - Need safety valve
 - More time & \$ for technology
 - Many others
- **Left to new administration**
 - Candidates favor cap and trade
 - Likely not top 2009 issue



Will we regulate CO₂ under CAA?

EPA's prior position

- CO₂ is not an air pollutant
- Not authorized to regulate

April 07 Supreme Court ruling overturned EPA's objections

- CO₂ an air pollutant under CAA
- EPA tasked to consider need and approach for regulation

July 2008 issuance of ANPR

- CAA ill-suited for CO₂ regulation
- Purpose “to elicit information” on how EPA might regulate under CAA
- No legal effect
- Gives views on how EPA may regulate CO₂ if forced to do so



EPA and CO₂ injection

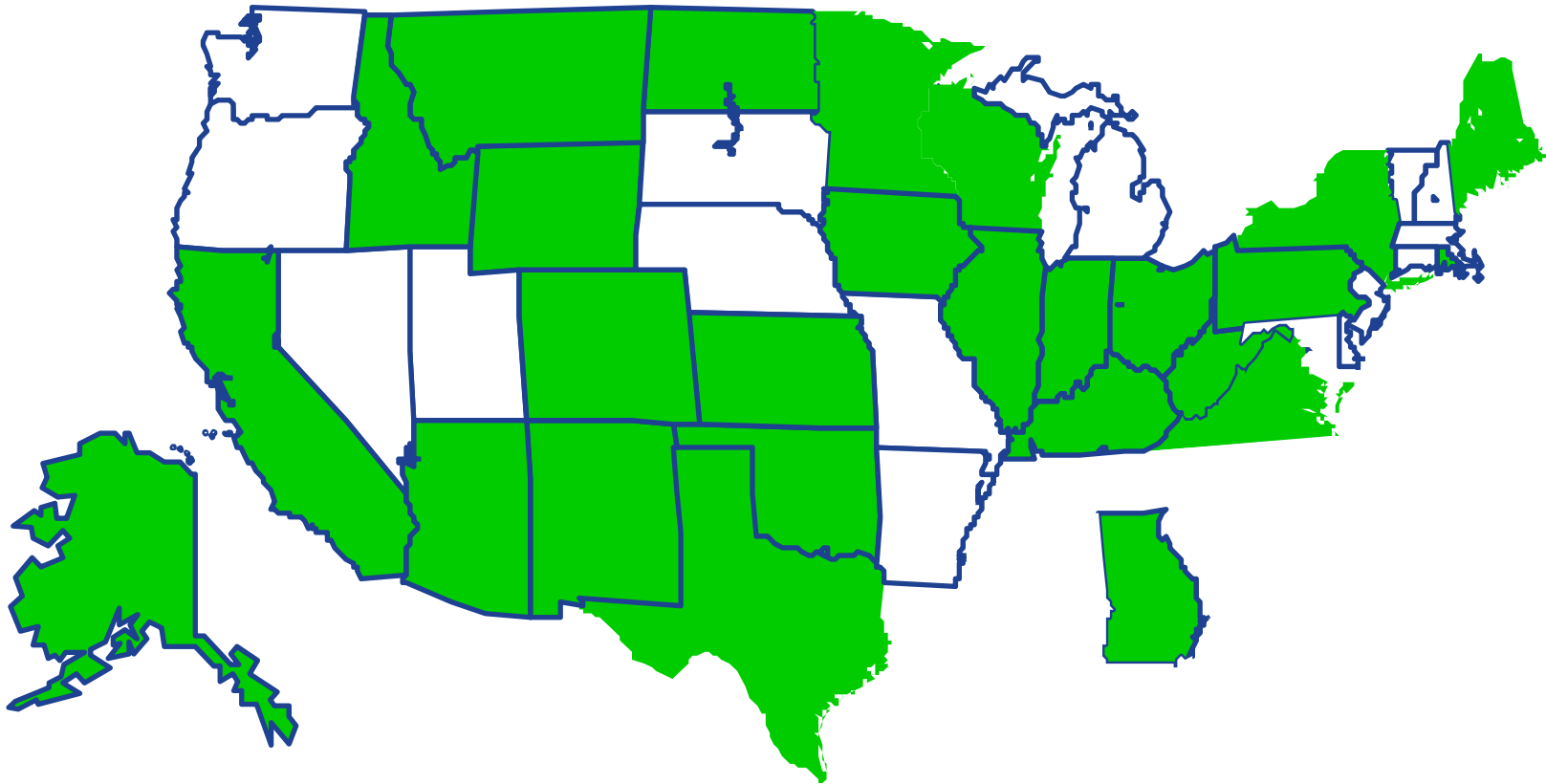
- ANPR for new class VI well for GS
- Authorized under SWDA
- Requirements for
 - Site characterization & modeling
 - Area of Review
 - Overlying covers, under aquifers
 - Well construction and operation
 - Monitoring, site care and closure
- States may choose own stricter standards
- ***But the ANPR doesn't answer:***
 - *Levels of contaminants*
 - *Ambiguity of RCRA & CERCA*
 - *Limits of leakage*
 - *Ownership and long-term liability*



Current Federal funding

<p>Emergency Economic Stabilization Bill</p>	<ul style="list-style-type: none"> - +\$1.25B for advanced coal +\$0.25B gasification for ITC - 30% ITC; minimum 65% capture - \$20/tonne for sequestered CO₂; \$10 EOR (new) - Min 500k tonnes/yr; max 75MM tonnes total
<p>Federal Loan Guarantees (3rd solicitation under Title VII EPACK 2005)</p>	<ul style="list-style-type: none"> - \$6B gasification, retrofit and new coal power - Goal: reduce GHG emissions by min 50% - \$2B for advanced coal gasification - 100% of loan, max 80% of total project cost
<p>CCPI III</p>	<ul style="list-style-type: none"> - \$340MM - 50% cost share, no repay - 300ktons/yr CO₂ CCS (= single IGCC train no shift) - 90% capture (CO₂ in stream)
<p>FutureGen (Restructured)</p>	<ul style="list-style-type: none"> - \$1.3B total: \$216MM FY09¹ - rest as appropriated - Incremental cost of CCS (new) or 50% of CCS retrofit - Op cost share limited to additional fuel - 3-5 yrs CCS operation + 2 yrs MMV - Min 300MW IGCC gross; <i>Min 81% capture</i>

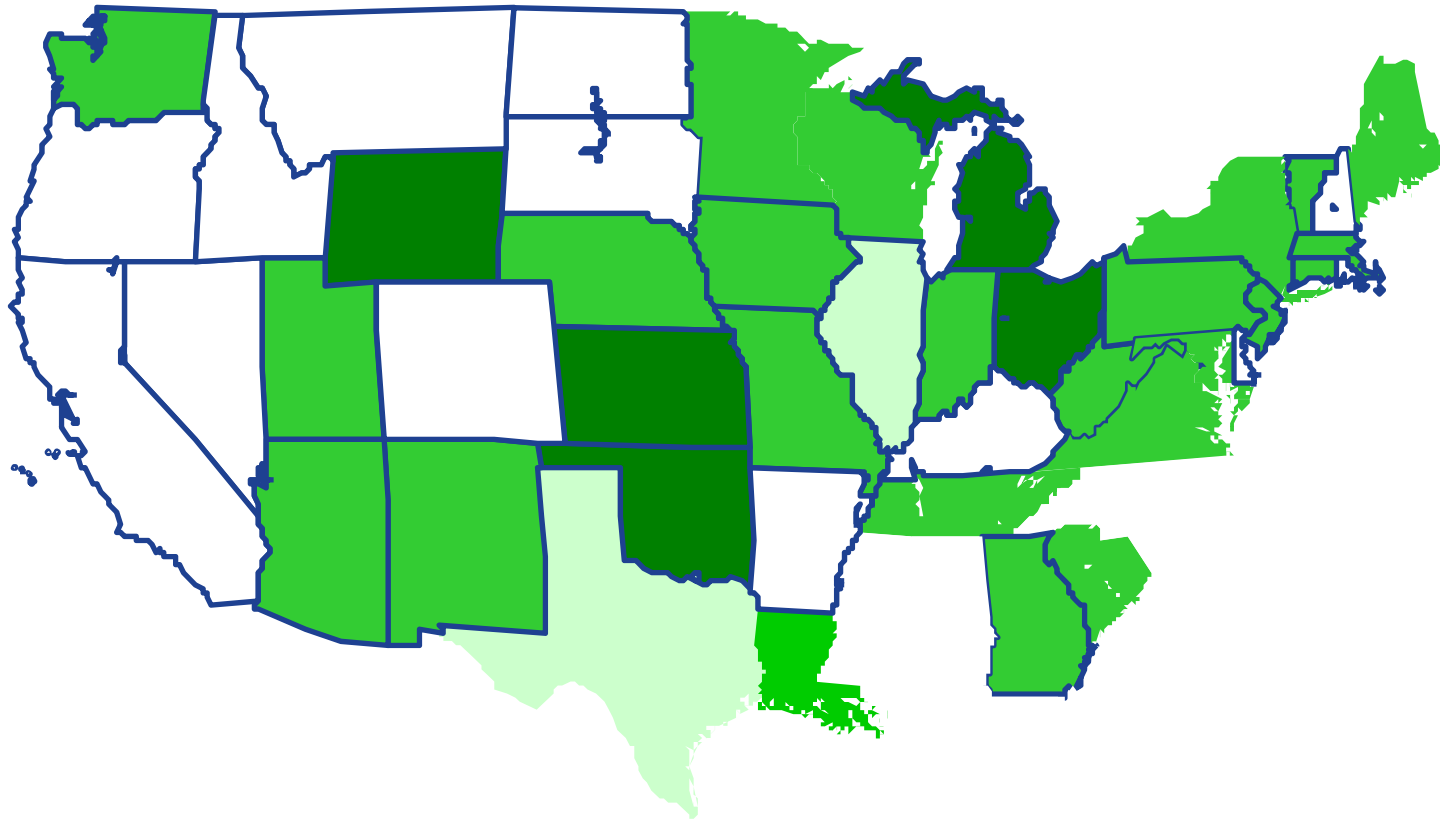
States are defining coal policy



■ States with current and proposed benefits for cleaner coal¹

¹ Source: Coal Utilization Research Council, July 2007

States leading in reducing uncertainty



-  Pending or adopted legislation on CCS
-  State assumption of CO₂ liability
-  Adopted or pending storage permit standards.

Drivers for CCS with IGCC

1. IGCC with carbon capture can be provided now
2. CCS uncertainty lies with storage – validation, acceptance and public acceptance
3. IGCC flexibility supports a crawl-walk-run validation of CCS and with high quality CO₂
4. We need to learn-by-doing – at commercial scale
5. IGCC retrofittability to NGCC equivalence is a compelling solution for maintaining coal build
6. The surest and quickest route to reducing the cost of CCS is to build IGCC plants

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