

Will Carbon Storage Work at Scale?

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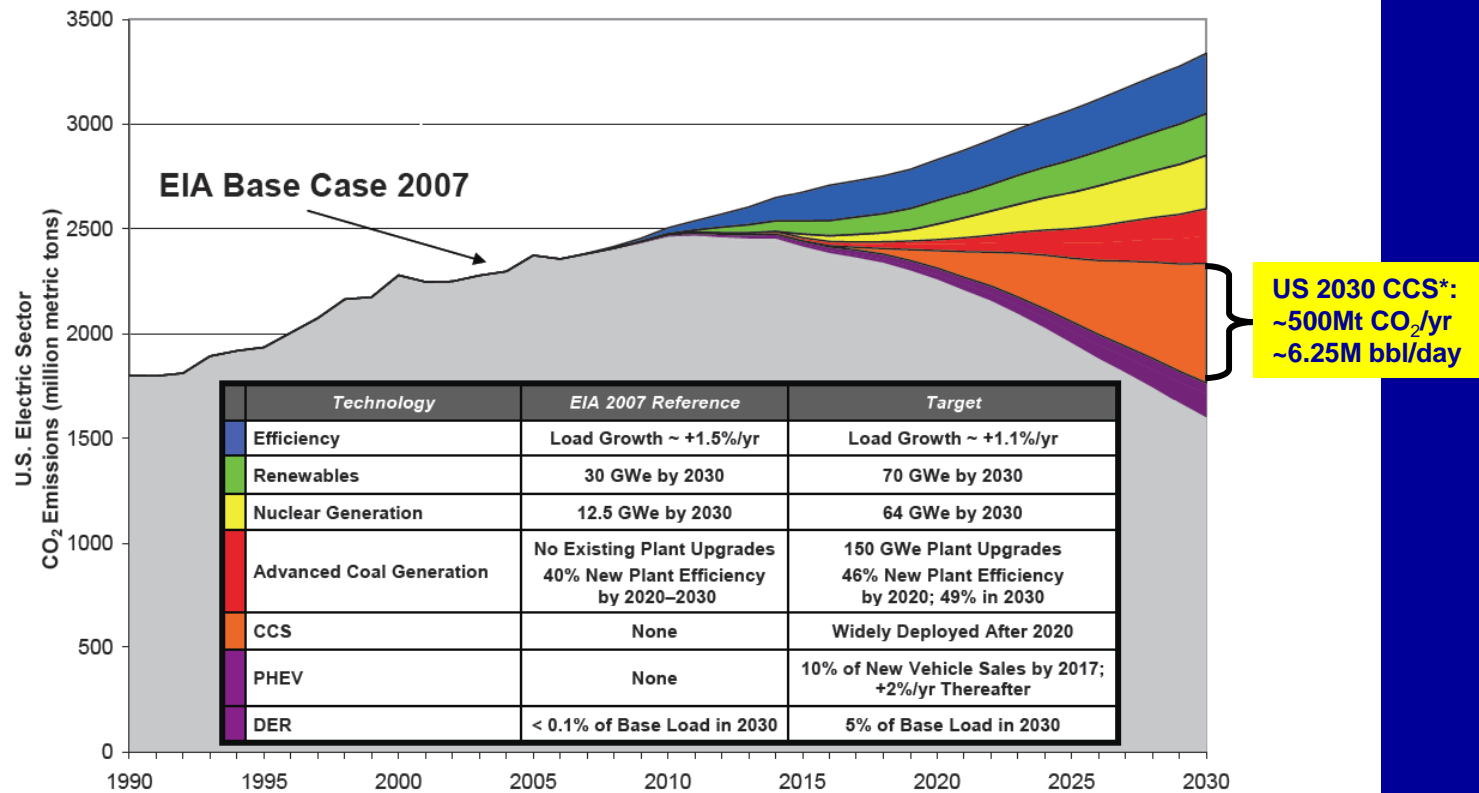
<http://pesd.stanford.edu>

PESD Overview

- Initiated in 2001
- Funded mainly by EPRI and BP
- Six principal research topics
 - 1) Electricity Markets
 - 2) Energy for Development
 - 3) State Oil Companies & The World Market
 - 4) Global Gas market
 - 5) Climate Change policy after Kyoto
 - 6) Emerging Global Coal Market

Carbon Storage at scale

CO₂ Reductions ... Technical Potential*



* Achieving all targets is very aggressive, but potentially feasible.

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13

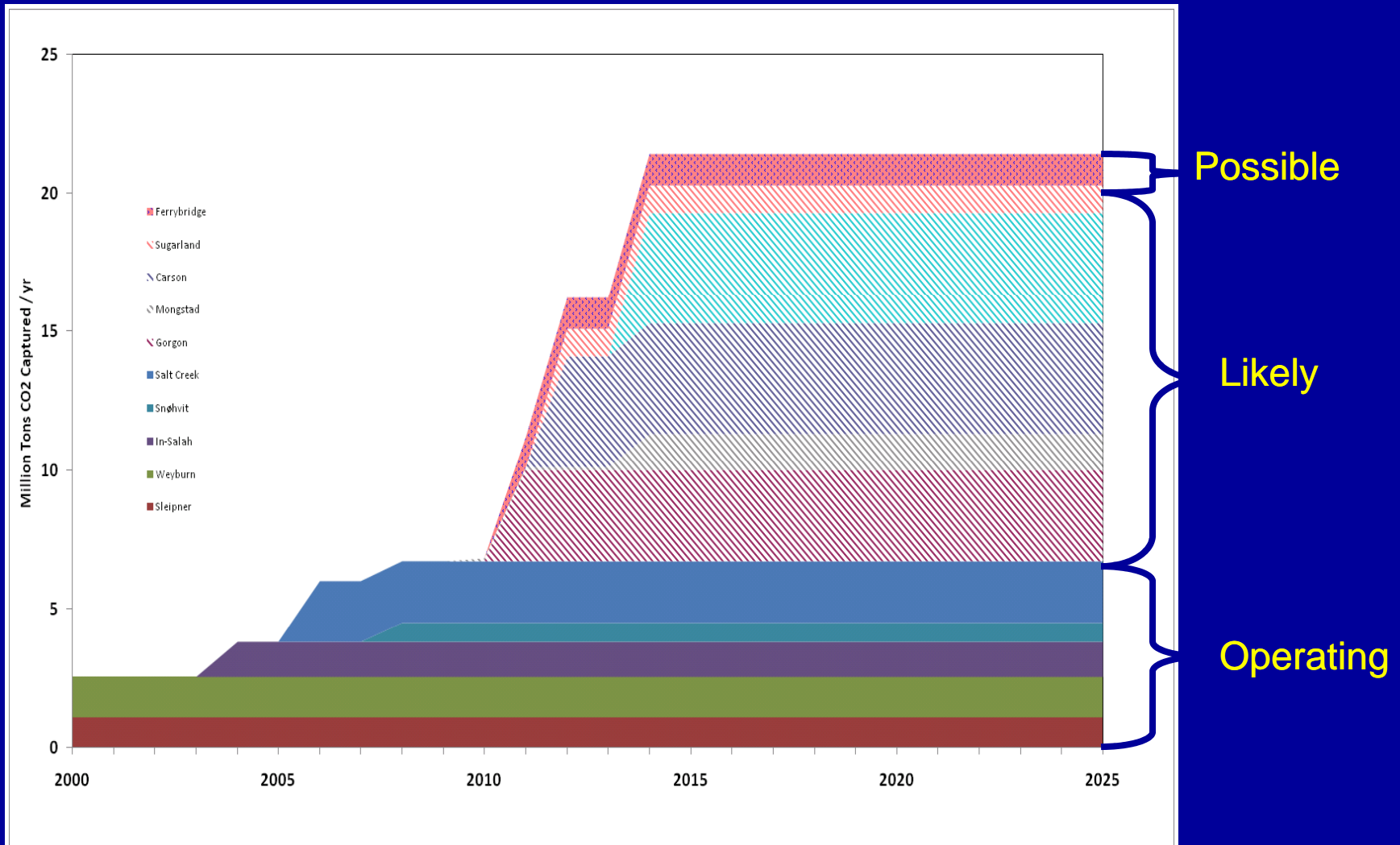
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Source: EPRI, MIT Future of Coal Report

* US Current EOR: ~30Mt CO₂, ~0.4M bbl/day

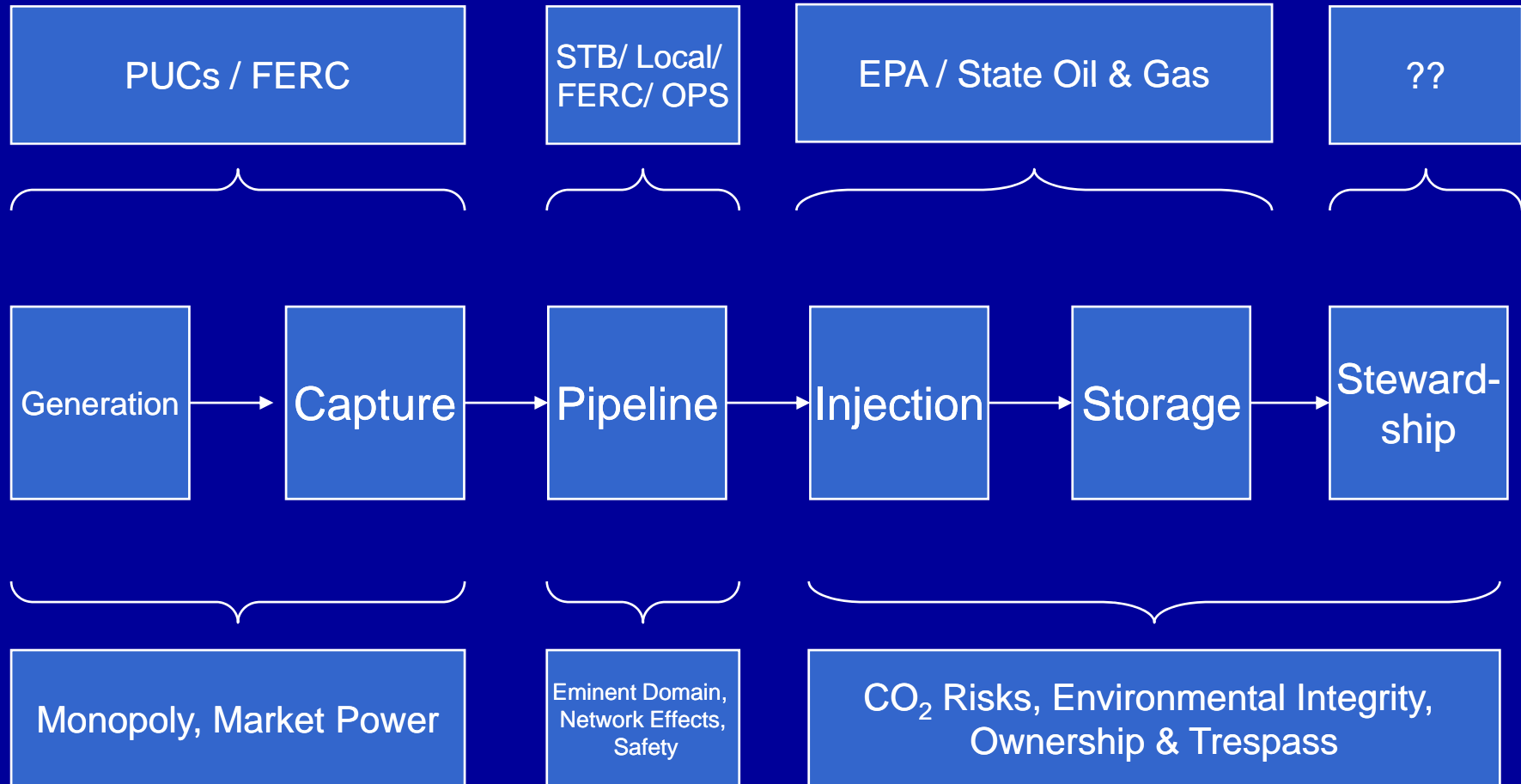
Carbon Storage Project “Pipeline”

DRAFT; quantified and commercial (>1Mt CO₂/yr) projects only



Data: PESD Database

Regulatory Environment



Potential CCS Business Models: Allocating risks and rewards

	<i>Guaranteed Return Model</i>		<i>Unregulated "O&G" Model</i>		<i>Gov't Ownership Model</i>
	Service Provider	In-House Utility	Integrated	Unbundled	
Generation					
Capture					
Pipeline					
Injection					
Storage					
Stewardship					

Potential CCS Business Models: Allocating risks and rewards

	<i>Guaranteed Return Model</i>		<i>Unregulated "O&G" Model</i>		<i>Gov't Ownership Model</i>
	Service Provider	In-House Utility	Integrated	Unbundled	
Generation	Utility	Utility	Hybrid Utility/Eng. Firm	Hybrid Utility/Eng. Firm	Gov't / Utility
Capture	Equipment Manufacturer	Utility	Hybrid Utility/Eng. Firm	Equipment Manufacturer	Gov't / Equipment Manufacturer
Pipeline	Service Provider	Utility	O&G Major	Pipeline Company	Gov't / Contractor
Injection	Service Provider	Utility	O&G Major	O&G Major	Gov't / Contractor
Storage	Service Provider	Utility	O&G Major	O&G Major	Gov't / Contractor
Stewardship	Government	Government	Government	Government	Government

Is Carbon Storage Viable at Scale?

- Large-scale Demonstration Essential
 - Current trajectory not encouraging
- Regulatory Environment Still Untested
- Cost Explosion and Uncertainty
 - Favors rate base business models
- Are Other Business Models Viable?

Thank You

Supplemental Slides

Carbon Storage Project “Pipeline”

DRAFT; all public projects

PESD Carbon Storage Project Database - DRAFT

Project Type	Operating (16)		Likely (14)		Possible (42)			
Project Probability	100%		60% - 90%		0% - 60%			
	Country	Project	Country	Project	Country	Project	Country	Project
	Algeria	In-Salah	Australia	Gorgon	Argentina	Cerro Fortunoso	UK	Drax
	Australia	Otway		Kwinana	Australia	Hazlewood		Eggborough
	Canada	Alberta		Zerogen		Monash		Ferrybridge
		CANMET	China	Greengen		Stanwell		Hatfield
		Fenn Big Valley	Germany	Janschwalde	China	Dagang		Immingham
		Weyburn		Janschwalde II		Daqin		Kent
	China	Qinshui Basin	Norway	Mongstad		Jiangsu		Killingholme
	Denmark	Elsam	Spain	Northwest Spain		Jilin		Kingsnorth I
		K12B	UAE	Abu Dhabi		Shengli		Kingsnorth II
	Germany	CO2SINK	US	Carson		Sichuan		Tillbury
	Japan	Yubari		Decatur		Songliao		Wales
	Norway	Sleipner		Mountaineer		Zhongyuan	US	Barberton
		Snøhvit		Sugarland	Denmark	Kalundborg		Cliffside
	Poland	Recopol		DOE CSR	Germany	Germany		Colorado
	US	Frio			Italy	Brindisi		Indiana
		Salt Creek				Sibilla		North Dakota
					Japan	Hokkaido		Ohio
						Nagaoka		Oologah
					Netherlands	Buggenum		Texas
					Norway	Risavika		West Virginia
					Spain	Repsol		Sweetwater

Factors Influencing Commercial Outcome

Project Case Study

