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CCS Alliance for Risk-based Policy

Risk Study for Commercial Deployment of CCS

Factors Affecting Financing for Early Plants

Risk Rating Results – Internal Presentation:
Coal-based Plants with CCS
July 31, 2008

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Opening Quotes: Consensus to Move on CCS

"The vast majority of new power stations in China and India will be coal-fired; not "may be coal-fired"; will be," said Blair. "So developing carbon capture and storage technology is not optional, it is literally of the essence."

Former UK Labour Prime Minister Tony Blair, Speaking in Tokyo ahead of the 2008 G8 Summit (June 2008) for *Breaking the Climate Deadlock: A Global Deal for a Low Carbon Future (Sir Nicolas Stern)*

"Carbon capture and storage (CCS) for coal-fired power plants is a critical technology if we are to achieve our environmental goals while continuing to use our abundant domestic coal resources. However, CCS storage capacity is not available everywhere, and the technology itself is not fully developed and ready for deployment. We believe CCS ultimately will prove to be one of the least-cost ways to reduce CO2, and we are actively involved in projects to advance the research."

Jim Rogers, President – Duke Energy, June 28, 2007 from Testimony to Senate Environment & Public Works
http://epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=96b0a903-32fc-47f8-9a36-b4ddd9805e2b

"We believe CCS can stimulate faster policy action and help fill the gap between what we need to do and what we have committed to do. …Using CO2 from coal plants for domestic EOR has three advantages: 1) it reduces oil imports and our trade deficit; 2) using old oil wells reduces the environmental burden of drilling new wells; and 3) oil or gas wells are a better place to put CO2 than into the atmosphere."

David Hawkins, NRDC at Gasification Technologies Conference, Oct. 2007

Risk Rating Results for CCS Deployment

- **Risk ratings frame the challenge: financing**
- **Approach & Methodology / Participants**
- **Risk ratings: Highs and Lows**
- **Conclusions**
- **Commercial deployment and financing**

The severity of risk is gauged within a time horizon for the likelihood an event occurs times the impact (detriment) to the project (e.g., on assets and cash flows) for various risks:

<u>Within a Time Horizon</u>

Probability x Impact = Severity of Risk

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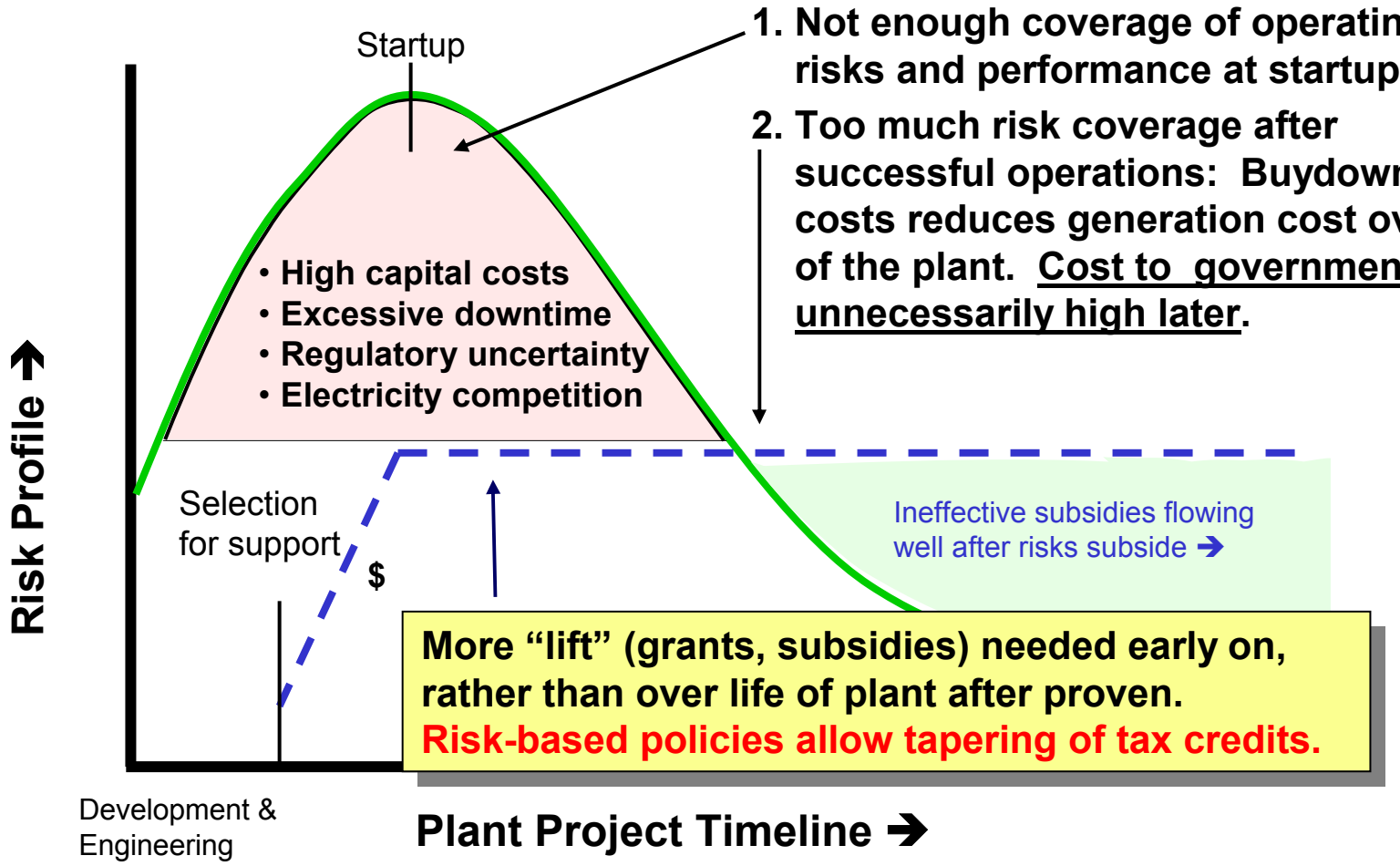
Why risk-based?

First of a Kind Systems: High Risk Early



Source:
Scully Capital, also David Berg

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For Deployment of Coal-based Projects with CCS

Risks ➔ Mitigation Approaches ➔ Actions Needed

CCS Alliance Scope:

I) Risk Study for CCS Deployment (coal power plants or energy projects with CCS)

II) Legal research on critical issues, risks and formulation of mitigation options

A) Risk Analysis

Risk Type	Key Risks
1) Tech-CCS	Capital cost with CCS too high
2) Reg-CCS	State rules on CCS not clear
3) …	
4) …	

Analysis based on Interviews of key actors:
(results of Risk Study)

Category	(Q#) Specific Risk	30 Respondents 25 point scale Rated Severity	Relative Value
ALL (34 Qs)	Overall Average	10.2	Average
Tech - CCS	7. Capital costs for carbon capture equipment (>50% capture) impair financing of a new plant.	17.1	High
Policy	18. National policies lack sufficient incentives (loans, tax measures) for first-of-a-kind plants.	16.2	High
Policy - CCS	13. Uncertainty about EPA carbon emission regulations and CCS hampers permitting on new plant.	15.9	High
Policy - CCS	19. National policies (e.g., tax credits) lack sufficient incentives for sequestration of carbon.	15.6	High
Policy - CCS	17. Regional, state policies fail to provide sufficient clarity about CCS requirements and liability.	15.2	High
Policy - CCS	15. Value of (eventual) carbon emission allowances does not adequately cover costs of CCS.	13.9	Above Avg.
Market-CCS	31. EPA regulations on underground injection of CO2 and liability fail to offer clarity for financing.	13.4	Above Avg.
Market-CCS	34. Prospect of liability for long-term leakage of CO2 from CCS threatens new plant financing.	13.3	Above Avg.
Market	28. Financing of new plant proves difficult (e.g., debt tenors too short, more equity required).	13.3	Above Avg.
Market-CCS	33. Revenues from the sale of CO2 (e.g., for EOR) are not adequate to cover costs of CCS.	12.9	Above Avg.
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Market	23. Current conventional coal plants are allowed to run longer, curbing demand for new plants.	9.7	Average
Tech - CCS	9. The site for CCS could suffer a significant technical failure and more than minor leakage occurs.	7.3	Below Avg
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Market-CCS	32. Transport costs of CO2 become more costly after new plant is operating, threatening run time.	6.1	Low
Market	24. Natural gas prices drift and stay lower (<$4/MBtu), making the plant with CCS uncompetitive.	5.3	Low

B) Mitigation Mechanisms

Government

- Loan guarantees
- Grants (by DOE, etc.)
- Tax subsidies
- Injection regulations
- Permitting approaches
- Carbon emission rules
- Federal “Energy Bank”
- LT purchase contracts

Industry / Investors

- Insurance / bonding
- Engineering backups
- Long-term contracts
- Site review, feasibility
- Collateral, backup supply

C) Government Actions needed for Mitigation

(Match actions with mechanisms)

Near-term / Long-term

- Appropriations
- Legislation
- Tax bill
- Regulation
- Agency action
- Executive order (?)
- Reserves (e.g., SPRO)
- Others ?

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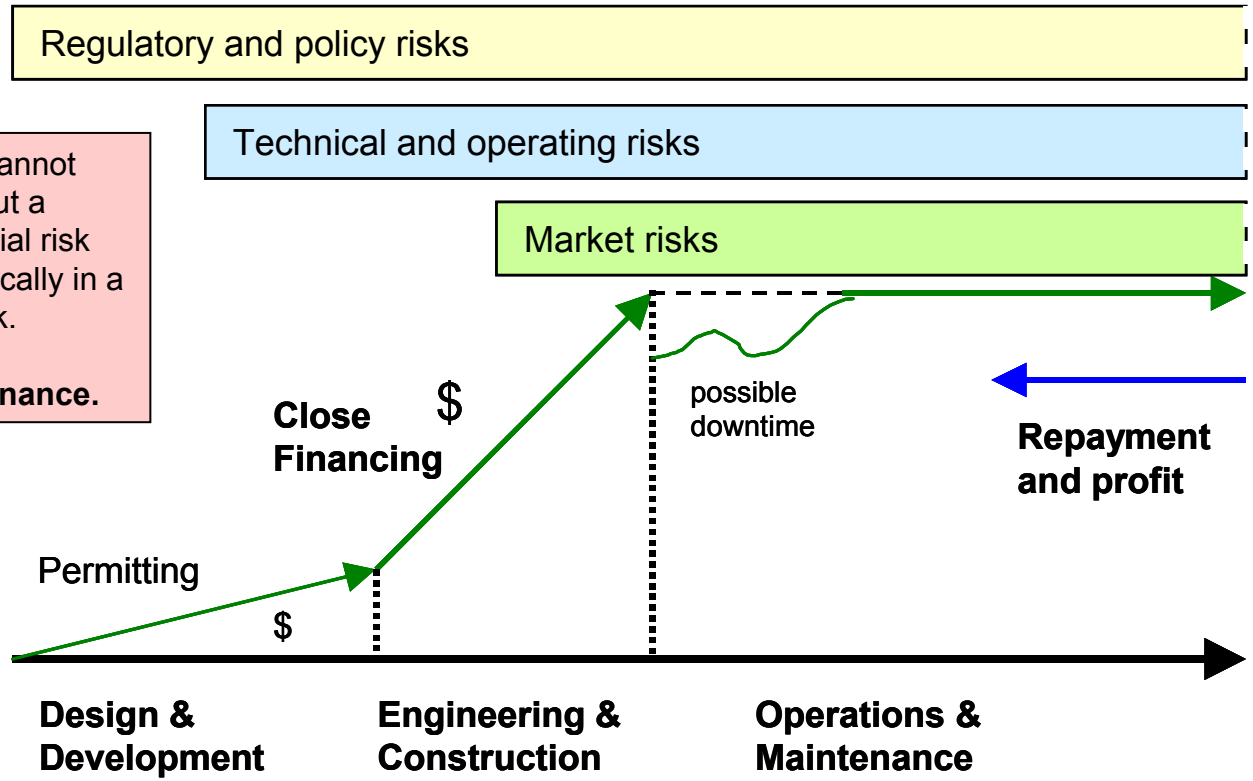
Approach to Commercial Risk Framework

Energy Project Development Timeline → **Risk Analysis of Project Development Stages** → **Rating and Ranking of Risks by Stages** → **Evaluation, Application of Risk Mitigation Mechanisms**

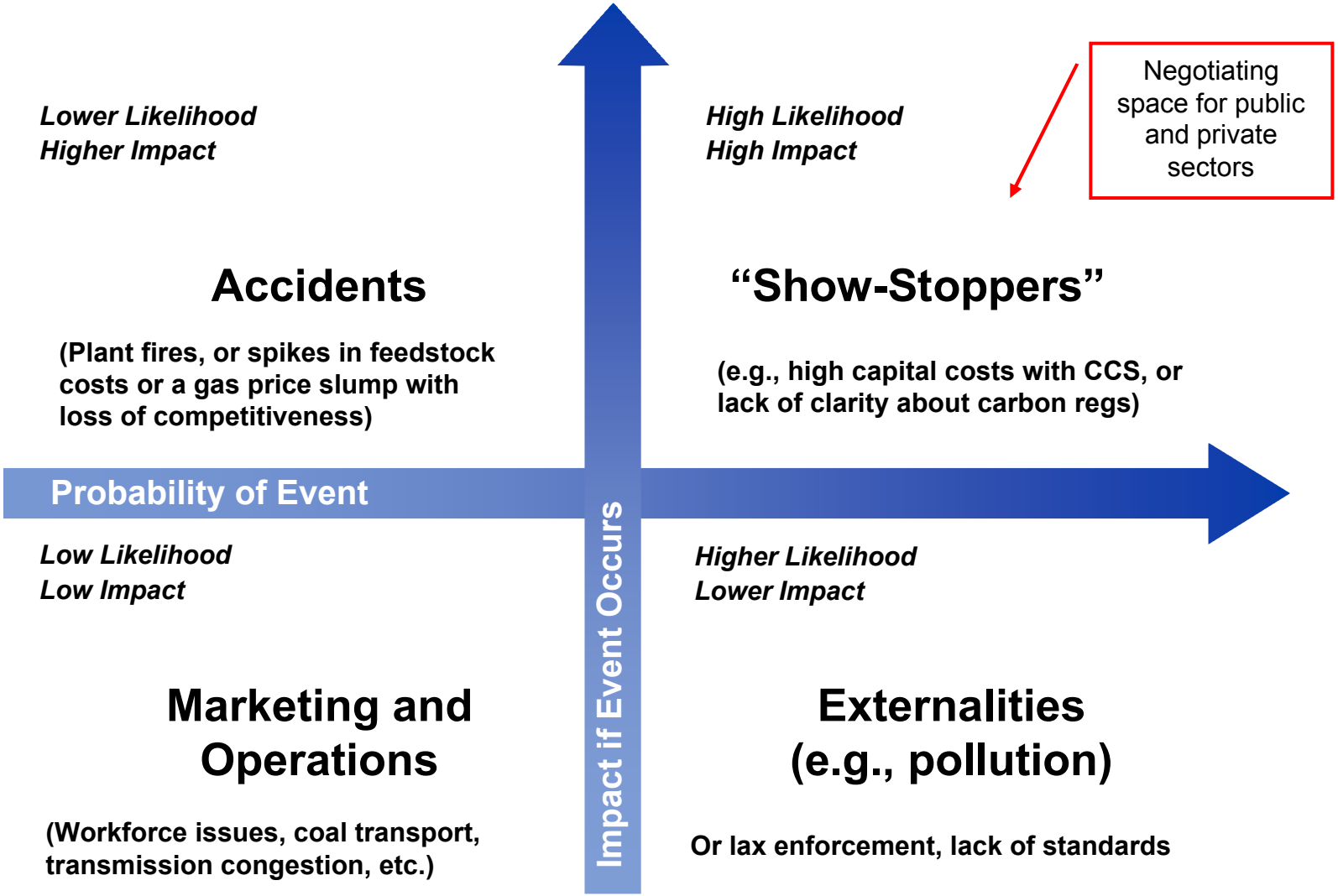
Coal projects with CCS cannot complete financing without a comprehensive commercial risk analysis by creditors, typically in a project finance framework.

Deployment = project finance.



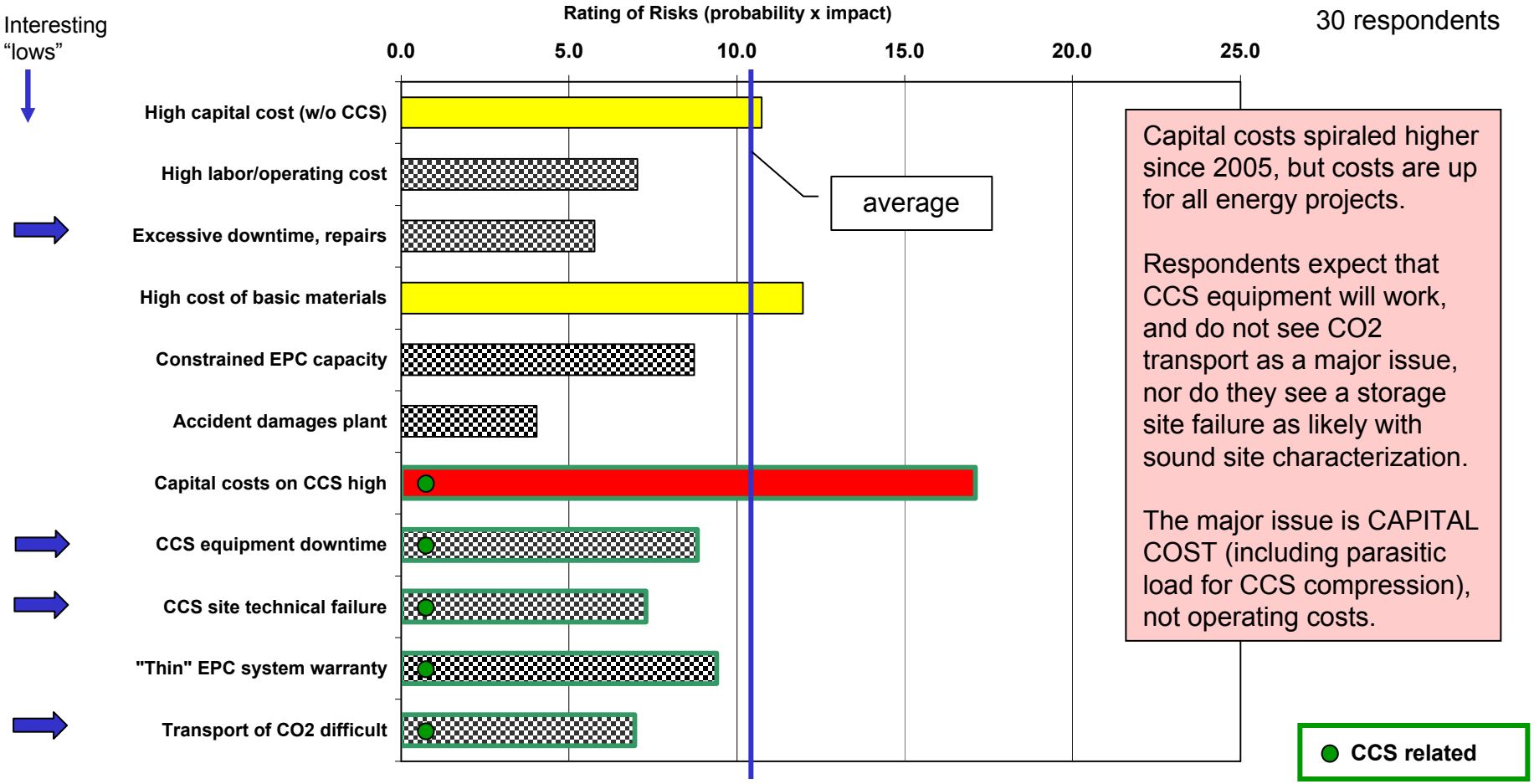
Source: Scully Capital

Plot of Risks: Probability vs. Impact Reveals Nature



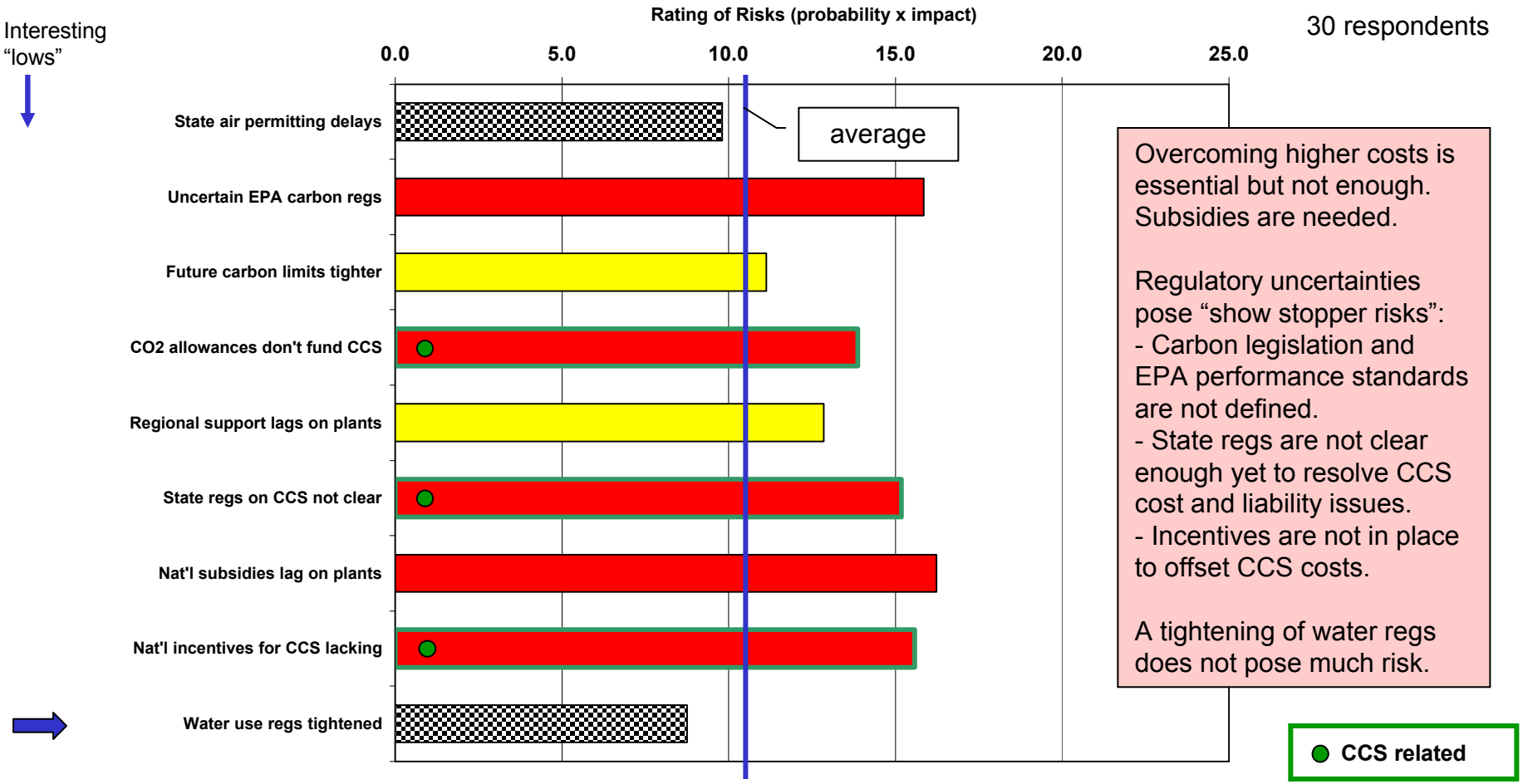
Risk Ratings: TECHNICAL

Deploying CCS creates a large drain on plant production, so capital costs run much higher.



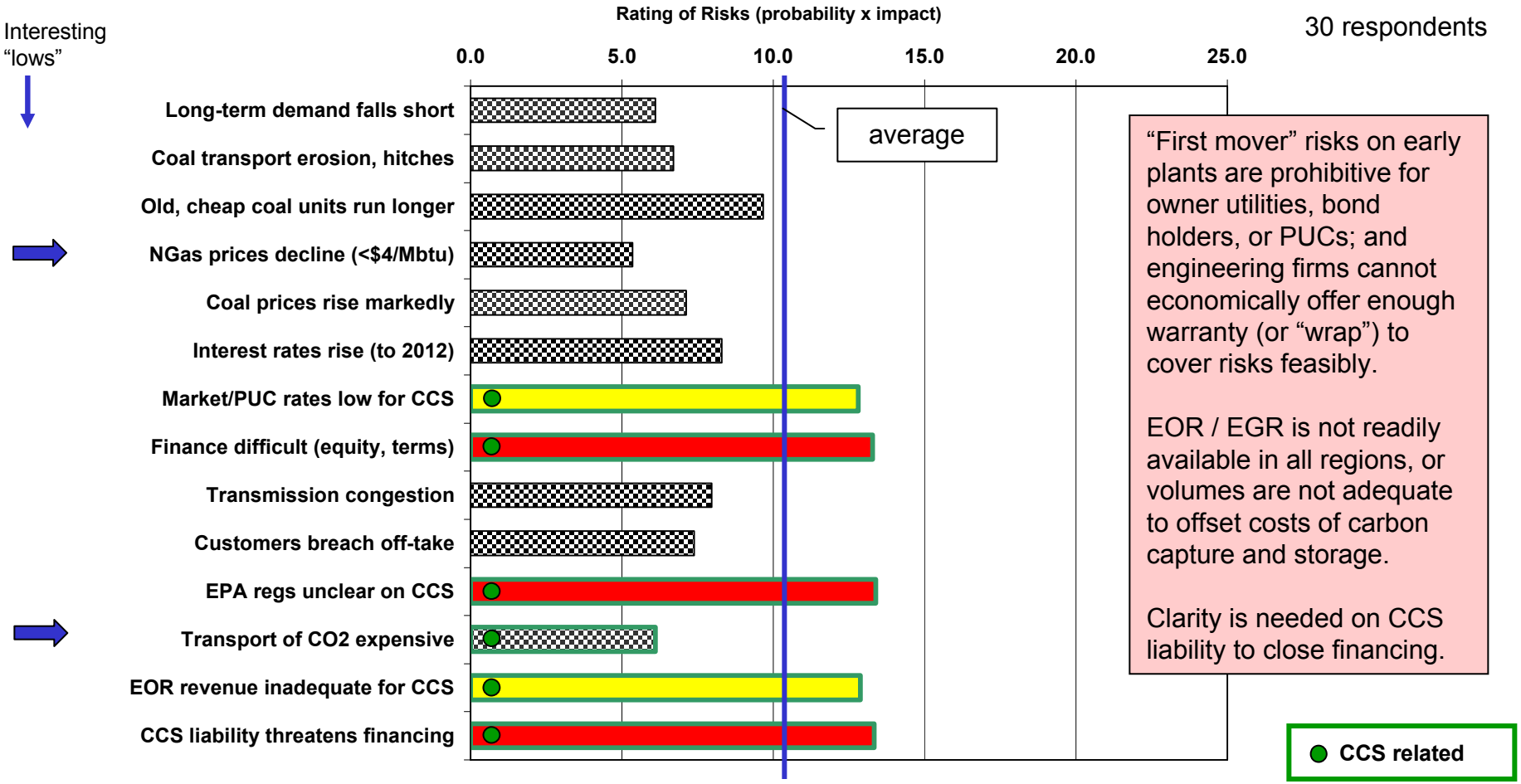
Risk Ratings: REGULATORY

Regulatory uncertainties (federal + state) about CCS costs and liability threaten financing.



Risk Ratings: MARKET

Lack of subsidies and uncertainty about liability for CCS make financing very difficult.



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Risk Ratings on CCS – Observations

- **Capital costs have run up since 2005, but costs are up for projects worldwide.**
- **Respondents expect that CCS equipment will work, and do not see CO2 transport as a major issue, nor do they see a CCS site failure as likely. CAPITAL COST for the plant with CCS is the key barrier, not variable costs.**
- **Subsidies are needed to overcome higher costs, but that is not enough.**
  (Subsidies could be paid for by injection fees on CO2, or user levies on coal)
- **Regulatory uncertainties pose "show stopper" risks for deployment of CCS:**
  - Carbon emission legislation and EPA regulatory rules on CCS are not defined.
  - State regulations are not clear enough yet to resolve CCS cost and liability issues.
  - Incentives (tax credits, loans, allowances) are not in place to offset higher CCS costs.
  - A tightening of water regulations does not pose much of a risk currently.
- **"First mover" risks are prohibitive for owner utilities, bondholders, or PUCs; and engineering firms cannot economically offer enough warranty (or "wrap") to cover risks. Few owners want to finance <u>early</u> CCS demos and plants.**
- **<u>EOR is not readily available in all regions</u>, or demand is not adequate to absorb costs and volumes needed for carbon capture and storage from power plants.**
- **Clarity is needed on CCS liability to close financing – perhaps a "showstopper".**
- **Increases in coal prices or interest rates were not rated high risks.**
- **Lower NGas prices (<$5) would pose competitive problems; not seen as likely.**

Mechanisms for Mitigation of Critical Risks

Mechanisms and incentives tend to take A) some form of subsidy or B) risk assumption:

A. Traditional "Cost-based" Mechanisms: Subsidies for higher cost technologies early

- **DOE Grants:** traditional federal funding provided by appropriations and procurement (limited availability).
- **Investment tax credits / ADepr (accelerated depreciation):** capital subsidies partially available under Section 48A&B. More helpful with early funding while risk is highest versus later production tax credits.
- **Unit tax credits** (e.g., production tax credits, or CCS tax credits): Ensures that technology works before tax subsidy is provided, but does not shoulder much risk, which is borne early by plant owners. Can only be utilized to the degree income is earned. Many PUCs require pass through to rate payers.
- **Rate subsidies (allowances or feed-in tariffs):** Similar to production tax credits, but comes in as revenue rather than tax benefit. Can be tailored better than federal tax credits to regional and local attributes.

B. Progressive "Risk-based" Mechanisms: Negotiated between public – private sector actors

1. **Loans or guarantees:** Under EPAct 2005, DOE offers loan guarantees for first-of-a-kind plants. Improves capital structure by reducing equity and interest rates. Much less costly to federal budget than tax benefits.
2. **Federal off-take contract:** Federal off-take agreement can boost credit standing, provide revenue boost.
3. **State rate regulation:** Conventional rate regulation is preferred by lenders; enhances debt financing.
4. **Dispatch preference:** State could also grant dispatch preference to a baseload unit, but this would not cover technical downtime (repairs) or shutdowns for regulatory compliance issues (e.g., CO2 injection).
5. **Offsets and Liability transfer:** To address "long-term, indefinite" liability for CO2 leakage, carbon offsets could be purchased, and a liability transfer could be negotiated between plant owners, states, insurers, and federal agencies. No cost subsidy truly addresses indefinite long-term liability.

Risk-based mechanisms may trigger less federal budget impact, covering more projects.

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Risks vs. Mechanisms for Mitigation (X = helps cover risk)

Mechanisms in place

Risk not covered well

Q#	Specific Risk	Risk Level	"Subsidize higher cost technologies early" Cost-based Incentives / Mechanisms: DOE Grants	Investment tax credits / ADepr	Unit tax credits	Rate subsidies (allowances)	"Negotiate risks between public - private sectors" Risk-based Incentives / Mechanisms: Loans or guarantees	Federal off-take contract	State rate regulation	Dispatch preference	Offsets and Liability transfer
	Exists now ? ==>		Small	Partial	No	No	Yes	No	Some	Some	No
7	Capital costs with CCS high	High	X	X			X	X	X	X	
18	Nat'l subsidies lag on plants	High	X	X			X		X	X	
13	Uncertain EPA carbon regs	High				X		X	X	X	
19	Nat'l incentives for CCS lacking	High							X		X
17	State regs on CCS not clear	High									
15	CO2 allowances don't fund CCS	Above Avg.			X		X	X	X		X
31	EPA regs on CCS hinder finance	Above Avg.						X	X	X	X
34	CCS liability threatens financing	Above Avg.									X
28	Finance difficult (equity, terms)	Above Avg.	X	X	X	X	X	X	X	X	X
33	EOR revenue inadequate for CCS	Above Avg.			X	X		X	X		
16	Regional support lags on plants	Above Avg.	X	X	X	X	X	X			X
27	Market/PUC rates low for CCS	Above Avg.			X	X	X	X			

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Risks ➔ Mitigation Approaches ➔ Actions Needed

Q#	Highest Risks	Comment	Outlook / Actions Needed
7	**Capital costs with CCS high**	Capital costs remain a major threat for first units. Engineering backlog is global. Revolving credit could assist "FEED".	DOE LGs and some tax credits are in place. Appropriations and a tax bill are needed for subsidies.
18	**Nat'l subsidies lag on plants**	DOE LGs and some tax credits (Sec. 48 A&B ITCs) are in place.	Appropriations, and a tax bill are needed from Congress
13	**Uncertain EPA carbon regs**	Uncertainty about EPA regs on CCS injection and GHG curbs remain.	EPA UIC draft regs are out for comment. GHG legislation is much farther away.
19	**Nat'l incentives for CCS lacking**	CCS is not economic; subsidies are essential, especially for first plants.	Demos of CCS must move ahead. DOE regional partnerships are useful.
17	**State regs on CCS not clear**	Sites for CCS will likely span multiple states, requiring cooperation.	"Fossil supply" states will likely take the lead on CCS policy as with EOR.
15	**CO2 allowances don't cover CCS costs**	Uncertainty about CO2 policy breeds a lack of confidence in allowances.	Carbon legislation must spell out allowances for CCS explicitly.
31	**Lack of clarity in EPA regs on CCS hinder finance**	Lenders need clarity on CCS rules. Regulated rates with CCS could help.	State rules on CCS would promote financial closings if long-term, "no tail".
34	**CCS liability threatens financing**	Lack of resolution for "post-injection" liability on leakage freezes capital.	State rules help, but federal backing long-term would provide more resolution.
28	**Finance difficult (more equity, short tenors)**	Financing difficulties are symptomatic of other risks not being resolved.	State rules on CCS enable progress, and federal backing would help.
33	**EOR revenue inadequate for CCS**	With oil above $100, EOR is a financial boon, but volumes needed are low.	Federal assistance may be needed for CO2 pipelines and permitting.
16	**Regional support lags on plants**	States need to be engaged with Congress in designing approaches.	Risk-sharing between states and federal agencies is important.
27	**Market/PUC rates low for CCS**	Higher capital costs and economic losses with CCS give PUCs heartburn because of "rate shocks" to consumers.	Higher natural gas prices keep coal in play; but PUCs need to pass through federal subsidies for CCS.

Summary Points for CCS Deployment

- CCS is not economic and subsidies will be needed for first plants.
- Some tools are in place, but legislation is needed to resolve uncertainties. Financing is key: No financing = no CCS deployment.
- Utility bond holders require certainty on CCS liability with no indefinite, long-term exposure after injection. Private owners and insurance could manage first losses, states may want to play to encourage plants.
- With dependence on coal-based electricity for 12 hrs a day, more in some regions, CCS is vital for progress on carbon emissions.
- The current pace of electricity demand and the rise and volatility of natural gas prices require that advanced coal plants be built now.
- Grants and tax credits are easy for industry to ask for, but are difficult for Congress to fully fund. Levies on coal may be needed; but those funds would need to be sequestered for coal projects.
- Risk-based policies (such as loan guarantees, capacity payments) can help stretch limited government funds across more projects.
- If risks are addressed through a mix of policies and demos, early plants could be built with CCS to demonstrate feasibility.

Path Forward: Risk Mitigation Mechanisms

Offset costs

Financing

- Establish extent of private insurance capacity on CCS risks
- Utilize loan guarantees and tax credits to offset CCS costs
- Develop financial mechanisms and offsets for risk transfer

Clarify regs

Regulations and State Actions

- Track EPA UIC regulations and comments for resolution of CCS liability issues
- Monitor state actions on CCS and carbon emissions
- Work with state PUCs willing to support plants with CCS in rates

Address LT liability

Federal Legislation

- Garner financing for CCS demonstrations (e.g., Boucher bill)
- Utilize results of CCS demonstrations to refine risk assessments
- Follow congressional legislation on carbon emissions, allowances and incentives for reductions, including ultimate liability for CCS

END / MOVING AHEAD

Perspective – CCS: MAKING IT HAPPEN (EU Roundtable)

"CCS is necessary if we are serious about fighting climate change. It is not about pumping taxpayers' money into energy companies' pockets. I wish we could move to a carbon-free society without CCS, but [this] is not possible, so we should be serious about it."

By 2020, all power plants could be forced to be capture-ready with CCS and by 2025, and there could be regulation on the average amount of CO2 per kW/h that installations would be allowed to emit.

"I have some difficulty with regulation because we still do not know the real costs of CCS. To have regulation, we need to have at least some idea of the costs. For that, we need demonstration projects and for the technology to be tested on a broader scale."

Andris Piebalgs, EU Commissioner for Energy, May 2008

http://www.friendsofeurope.org/Portals/6/Documents/Reports/2008-05-27_CCS_Report_for_web.pdf

Rating Respondents: Sophisticated on CCS Issues

Gasification Technologies Council
Conoco Phillips
GE
Siemens
Air Liquide
Chevron
Excelsior Energy
Warley Parsons
CH2M Hill
Burns & McDonnell
Potomac-Hudson Engineering
Oglethorpe Energy
Eastman Chemical
e3Gasification
ZeroGen (Australia)

Arkansas Electric Coop Corp.
National Rural Electric Coop Assoc.
Minnkota Power Coop
Pace Energy Consultants
LECG Consulting
Hensley Energy
EPRI
World Coal Institute
ICO2N (Canada)
Natural Resources Defense Council
World Resources Institute
Imperial College of London
MIT
U.S. Dept. of Energy (Fossil Energy)
New Energy Finance

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Risk Study: Technical, Policy, Market Risks

30 Respondents

25 point scale

	Category	(Q#) Specific Risk	Rated Severity	Relative Value
	ALL (34 Qs)	**Overall Average**	**10.2**	Average
Highest Risks	Tech - CCS	7. Capital costs for carbon capture equipment (>50% capture) impair financing of a new plant.	**17.1**	High
	Policy	18. National policies lack sufficient incentives (loans, tax measures) for first-of-a-kind plants.	**16.2**	High
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	Market	24. Natural gas prices drift and stay lower (<$4/MBtu), making the plant with CCS uncompetitive.	5.3	Low

From interviews of key actors (owners, builders, financial entities, agencies, states) critical risks in three major areas are evaluated in a project finance credit analysis framework. Risks are rated (1 to 5) for "likelihood" and "impact" if a risk event occurs. The product (25 point scale) provides a "severity" of risk for specific events affecting deployment with CCS.

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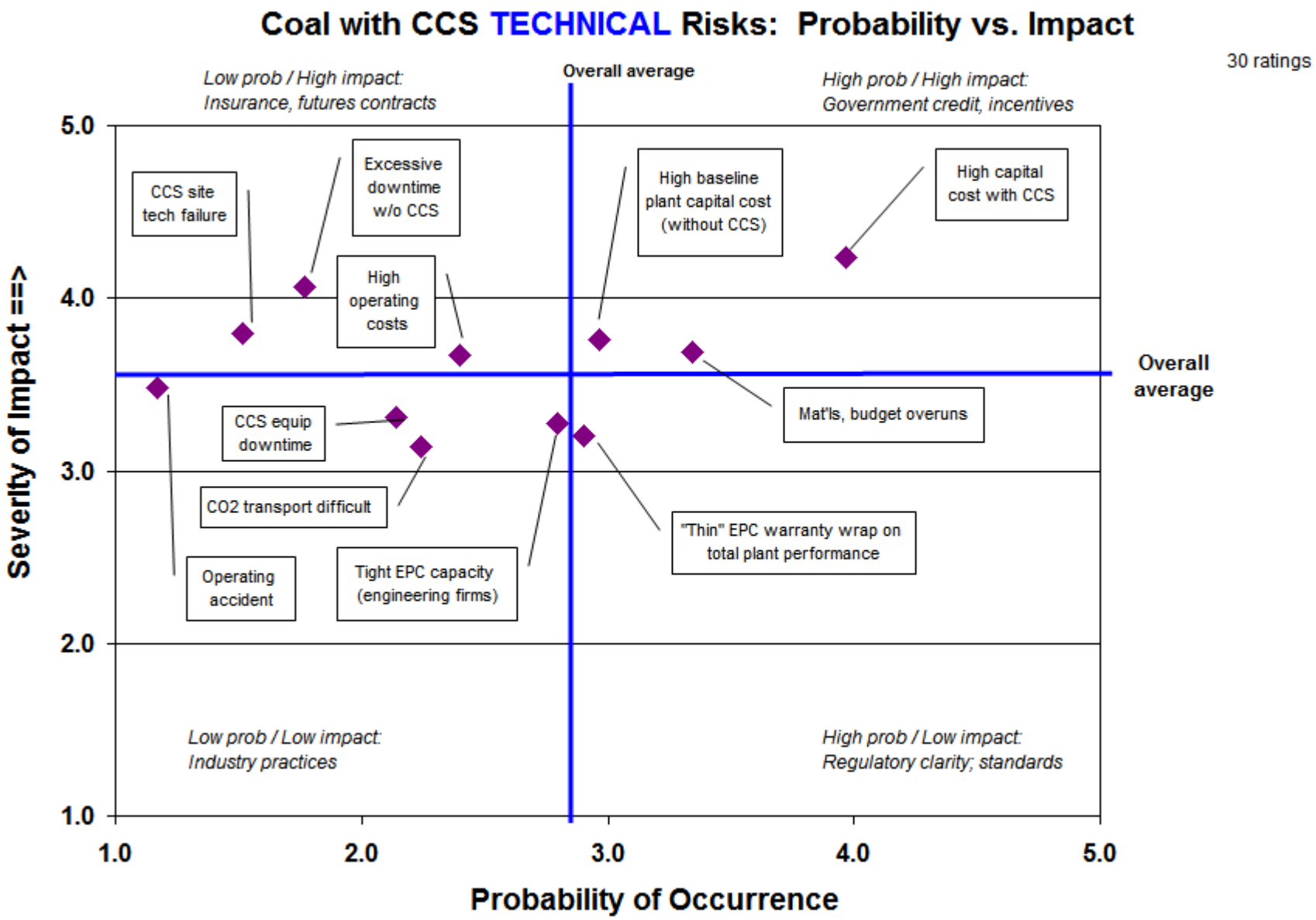

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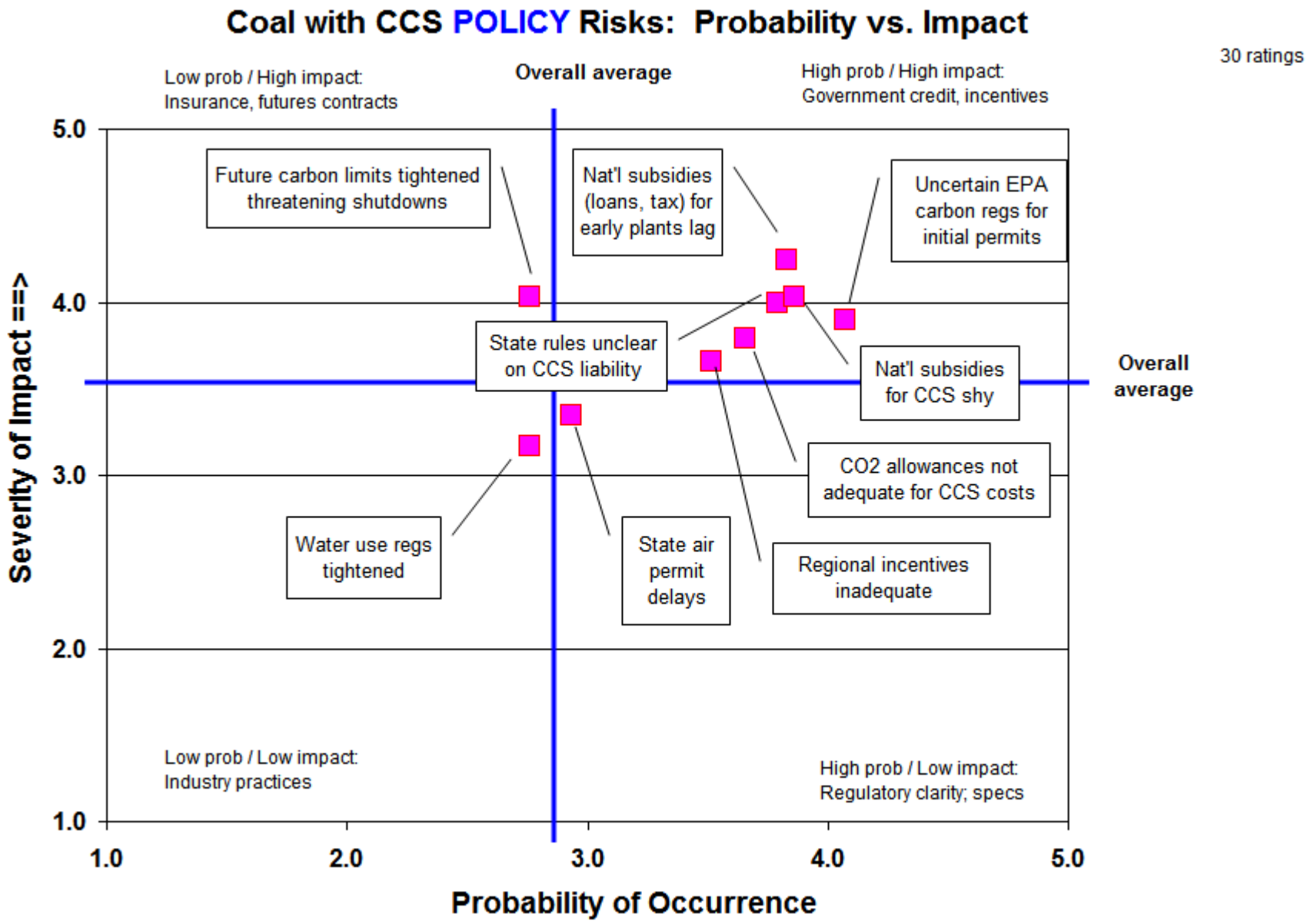

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