

The Business Case for Coal Gasification with Co-Production

**An Evaluation of Business Risks and Potential Incentives
for Early Commercial Coal Gasification with
Co-Production Projects**

***Briefing for EPA CAAAC
Advanced Coal Technology Work Group***

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March 6, 2007***



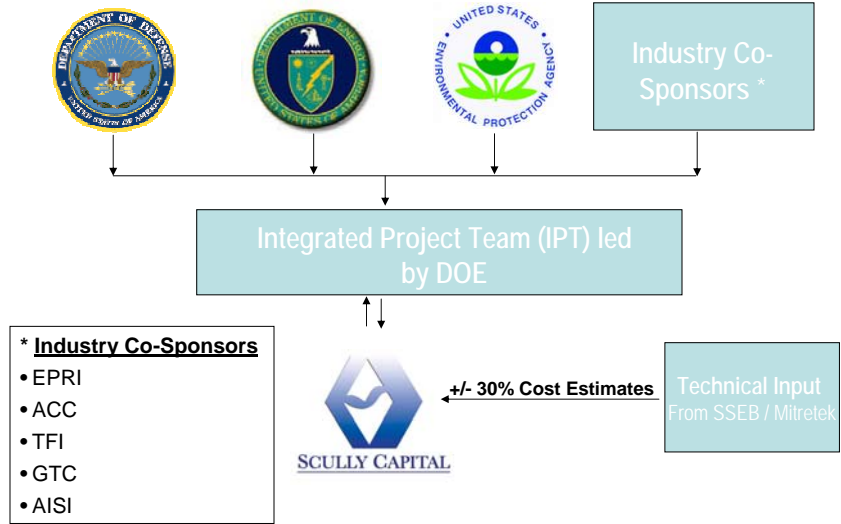
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Overview

- **Focus: Key risks & applicability / usefulness of incentives as seen through the lens of business and government**
- **Bottom Line: It is wise to use incentives in a risk-informed manner.**
- Highlights of findings
- Risk rating results
- Incentive analysis
 - Description of incentives analyzed
 - Results of incentive analysis
- Note: DOE and partners (EPA, EPRI) sponsored a companion “Business Case...” study of IGCC in 2005.



HIGHLIGHTS OF FINDINGS



Highlights of Findings (IGCC, Co-Pro)

- Overall, the analysis suggests that industry could build coal gasification-based projects, *but industry requires purchase agreements + incentives for first few plants (type, level depend on project characteristics).*
- IGCC Exhibit 4.3: Base Case LCOE per MWh

	Investor Owned Utility	Merchant Power Producer	Independent Power Producer	Public Power
Base Case LCOE per MWh	\$48.79	\$56.24	\$57.80	\$37.89

- Crude-equivalent price for bituminous FT fuels *without* carbon capture, compression (CC&C), and sequestration is \$52 – \$56 per barrel (\$68 – \$73 for FT fuels). CC&C adds 5% – 6% to the price.

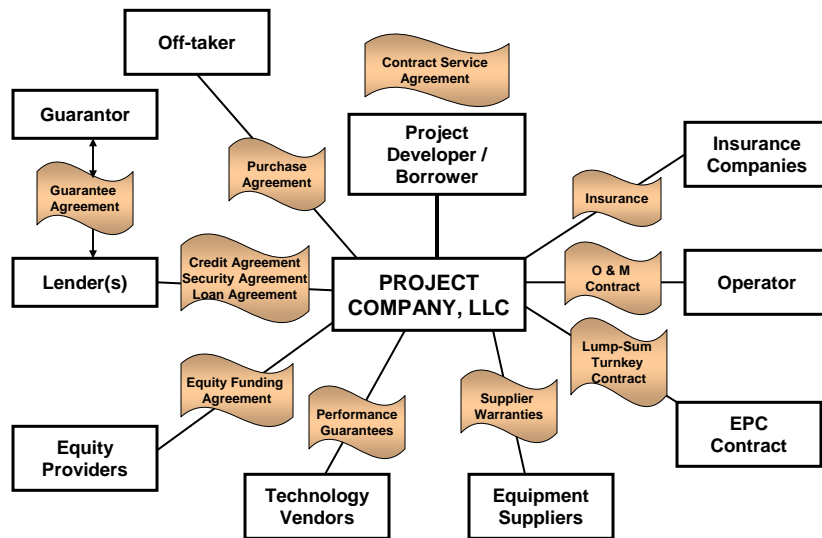


Highlights of Findings (cont'd)

- Key concerns among industry players: Market risk, high capital cost, potential cost overruns, and lack of construction / completion certainty. Excessive downtime?
- Purchase agreement (PA): A flexible tool needed to address certain project risks (e.g., *market*, inputs, performance), enhancing financial feasibility. PAs pose budget challenges, however.
- Tax incentives can reduce output pricing and may positively impact project creditworthiness. Budget cost, however, varies directly with degree of financial “lift”.
- Loan guarantees can provide, e.g., a big (14% – 30%) reduction in FT fuel price, depending on their structure. Budget cost can be zero, depending on terms.
- Skepticism exists about resolving national policy on CO₂.

CO-PRO RISK RATING QUESTIONNAIRE RESULTS; INSIGHTS FROM INTERVIEWS WITH FINANCIAL COMMUNITY & INDUSTRY

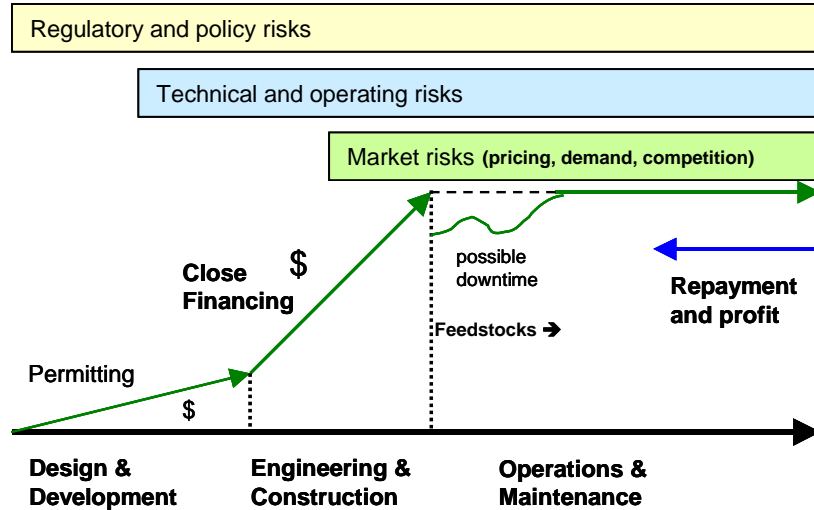
Project Participants & Their Roles





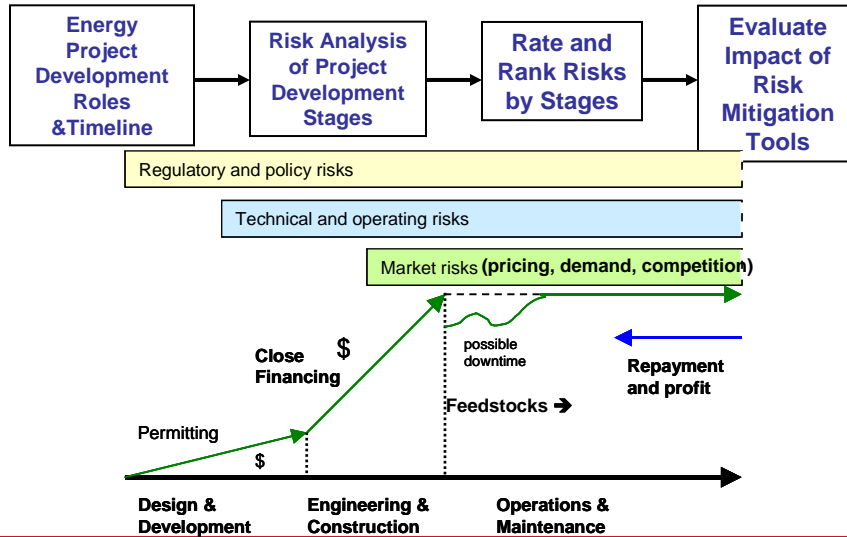
Project Risk: Time Dimension

Both project risks and participant roles change over time.



Risk Framework Approach

This diagram illustrates the study's logic flow and approach to the analysis.





- **Banks/Financial Firms**
 - Credit Suisse
 - Bank of America Securities
 - Standard & Poor's
- **Chemical / Fuel Manufs.**
 - Eastman Chemical
 - SASOL
 - Rentech
 - The Fertilizer Institute
- **EPC Firms**
 - Bechtel
 - Fluor / Hensley
 - Burns & McDonnell
- **Feds (DOD, DOE):**
 - Air Force, DOE/FE
- **Project Developers**
 - Leucadia
 - Tondu Corp.
 - E3 Gasification
 - Beard Energy
- **Technology Vendors**
 - ConocoPhillips
- **Utilities / IPPs**
 - EPRI
 - Excelsior Energy
- **States / NGOs:** Illinois



- Among 33 risks in 3 categories (technical, regulatory & policy, market), 3 *project* risks rate highest:
 - **High capital cost**
 - **Tightness in construction sector (in EPC capacity, warranties)**
 - **Price increases in materials & equipment (risk of budget overrun)**
- Respondents also expressed a similarly high level of concern about two other important uncertainties:
 - **Availability of off-take agreements to help contain *market* risk**
 - **Availability of *incentives* to address project risks**
- **Taken together, these key risks make financing problematic.**
- Risk rating results conform with interview observations.
- Concerns also persist about lack of resolution about – and impact of – carbon policy.



Summary: Highest Risk Ratings

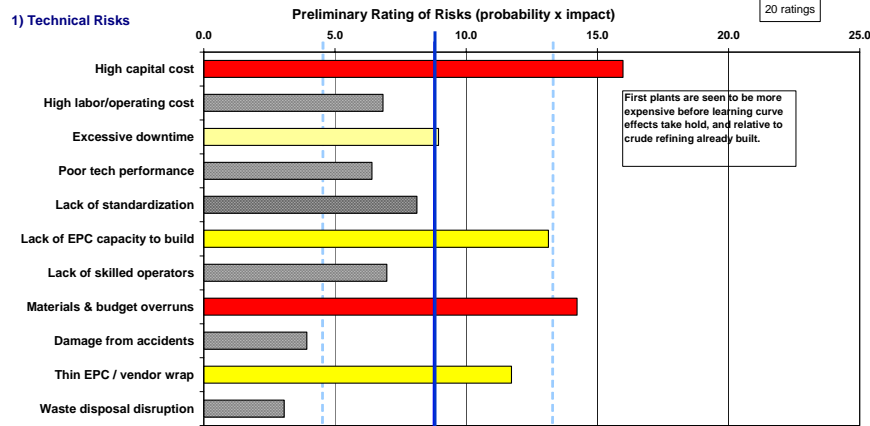
25 pt. scale (5 x 5 = 25)		Co-Prod'n	Co-Prod'n	20	50Rs
Risk Area for IGCC		A	B	2006	2005
Q#	Highest Risks	Probability	Severity	Rating	IGCC
1	High capital cost	3.6	4.5	16.0	14.9
3*	Excessive downtime	2.5	3.7	8.9	13.1
6	Lack of EPC capacity to build	3.6	3.7	13.1	6.5
8	Materials & budget overruns	3.6	4.0	14.2	10.9
10	Thin EPC / vendor wrap	3.4	3.5	11.7	9.5
12*	State air permitting delays	2.2	3.4	7.2	13.0
18*	Regional policy on sequest lag	3.0	2.7	7.8	11.4
19	Nat'l incentives on plants lag	3.3	4.2	13.7	11.8
28	Financing difficult (equity, terms)	3.0	4.2	12.4	13.0
29	DOD purchase agreement thin	4.0	3.9	15.2	NR
30	Long-term off-take inadequate	3.4	4.1	13.9	NR
Overall Average		2.6	3.3	8.7	9.0

- Concerns about high capital cost rate highest for co-production plants.
- Concerns about cost overruns and tight EPC capacity also are elevated.
- Uncertainties about off-take and incentives add to financing challenges.
- Combined, these risks explain why plants are not being built, unaided.



Risk Ratings: Technical

Respondents consider first plants to be more expensive (before learning curve effects take hold and relative to crude refineries). Today's tight EPC market has increased key ratings. Materials costs are also elevated.





Risk Ratings: Technical

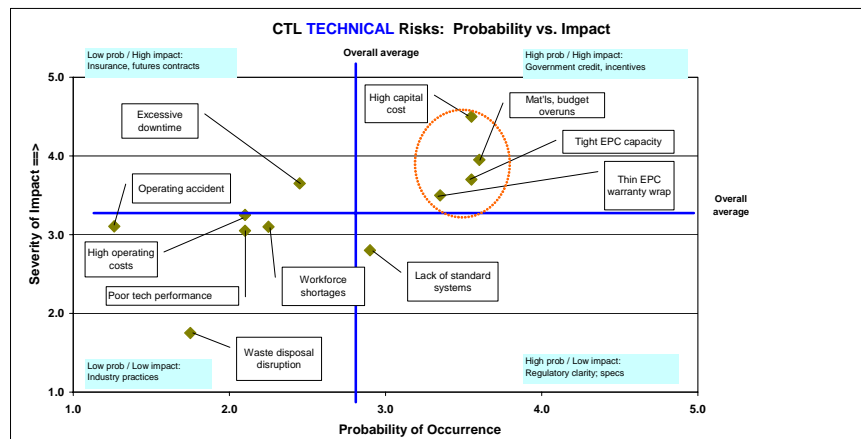
High ratings on capital costs match those for IGCC, but concerns about excessive downtime are muted, in part because chemicals or fuels can be stored (unlike electricity). In addition, chemical firms have more operating confidence. The “EPC wrap” is seen as more problematic in co-production.

Risk Ratings for Co-Production		Co-Prod'n			IGCC	IGCC
		2006	2006	Total	2005	2004
		20			50Rs	33Rs
Risk Area	A	B	A x B		A x B	A x B
Technical	Probability	Severity	Rating		Rating	Rating
1 High capital cost	3.6	4.5	16.0		14.9	19.2
2 High labor/operating cost	2.1	3.3	6.8		7.4	7.9
3 Excessive downtime	2.5	3.7	8.9		13.1	15.2
4 Poor tech performance	2.1	3.1	6.4		8.1	9.7
5 Lack of standardization	2.9	2.8	8.1		9.8	12.3
6 Lack of EPC capacity to build	3.6	3.7	13.1		6.5	6.1
7 Lack of skilled operators	2.3	3.1	7.0		7.3	7.2
8 Materials & budget overruns	3.6	4.0	14.2		10.9	10.4
9 Damage from accidents	1.3	3.1	3.9		5.7	5.2
10 Thin EPC / vendor wrap	3.4	3.5	11.7		9.5	6.8
11 Waste disposal disruption	1.8	1.8	3.1		4.4	3.7



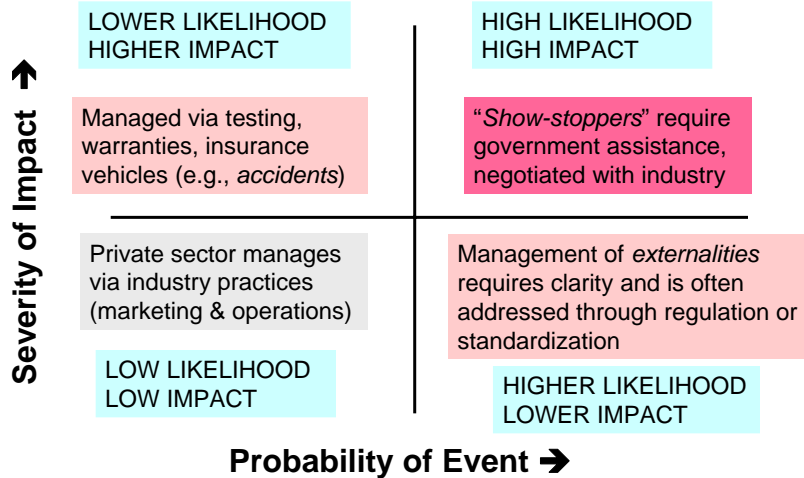
Plot of Technical Risk Ratings

High capital costs, fear of budget overruns, tight EPC capacity, and lack of a real warranty wrap on CTL plants pose risks too great for the private sector to address without government support, particularly for “first mover” projects.





Framework for plotting questionnaire results facilitates risk-informed government participation:



Industry interviews confirm sensitivity testing & “Q” results:

- **Capital Cost:** In general, developers find plant cost estimates high, EPC contractors find the plant cost used low, and others find it to be approximately in the right range.
- **Purchase Agreement/Off-take Agreement:** A long term, creditworthy off-taker was mentioned uniformly as a key requirement to offsetting price volatility in energy markets.
- **Volatility of Oil Markets:** Energy price volatility is seen as a key obstacle to financing CTL plants. Lenders mentioned the cost of FT diesel needed to service debt as a key benchmark in determining the ability of a project to withstand price volatility.
- **Length of Debt:** While lenders mentioned that, in certain project finance deals, the length of amortization can be longer than the purchase agreement, they doubt that it can be done for the first co-production plant.



Important observations include:

- **Internal Rate of Return (IRR):** Most interviewees express comfort with IRRs of 17% – 19%. Many specifically offer that the IRR requirement could increase unless the off-take agreement has sufficient length and quality. *The resulting cost of capital fits well with the WACC range for oil and gas companies.*
- **Technology Risk/Completion Risk:** Lenders & investment bankers uniformly mention the likely lack of EPC wraps with performance guarantees on CTL plants as a key obstacle to arranging financing for projects.
- **Project Finance Structure:** Some interviewees believe a project finance structure is possible, but cite as keys to completing non-recourse financings (a) the apparent lack of EPC wraps and (b) the need for a long-term, creditworthy off-taker. Others indicated that a limited recourse structure might be better for the first plants.



RESULTS OF ANALYSIS OF INCENTIVES FOR COAL GASIFICATION-BASED PROJECTS (BASED ON FINANCIAL MODELING)



Incentives Analyzed

- Incentives analyzed separately and in (limited) combinations:
 - **Purchase (off-take) agreements (PA);**
 - **Tax incentives** in the form of accelerated depreciation / expensing, investment tax credits, excise tax credits, and tax exempt bonds;
 - Credit incentives in the form of **loan guarantees**; and
 - **Grants.**
- Some potential incentives were also analyzed as part of sensitivity testing, e.g., reduced coal cost.
- States may be able to provide some of the same incentives as the Federal government, e.g.:
 - Investment tax credits, grants (e.g., small project dev't. grants);
 - Improved permitting or other regulatory processes (which do not have an explicit monetary value).
- Project structure affects impact of incentives for IGCCs.



Long-Term Purchase Agreements

- **Definition:** Off-taker agrees to purchase a portion of plant output under pre-defined terms, which may involve:
 - Capacity payments
 - Fuel price adjustments / cost pass through
 - *Force majeure* "outs"
 - Price floors / ceilings
 - Liquidated damage / cure rights
 - Fixed start dates
 - Offer value for carbon capture
- But, the budget requirements for a 15-year purchase agreement (PA) for all of a reference plant's output = \$10 billion (for a co-production project).
- PAs more flexibly address project risks than other incentives, but budget scoring is "front loaded".
- PAs complement other incentives very well. A strong PA (e.g., by PUC) can assure a project's revenue stream, reducing the credit subsidy cost of a loan guarantee.

**Co-Pro Results: Tax Incentives**

Type of Tax Incentive	FT Diesel/ Crude Equivalent Price per Barrel	Percentage Change from Reference Case	Budget Impact (\$ millions)	Total Cost (\$ millions)
Investment Tax Credit				
20%	\$ 67 / \$ 52	8%	\$ 129	\$ 109
20% + Expensing	62 / 48	15%	194	87
Excise Tax Credit				
5 Years Production				
10 cent	70 / 54	4%	150	150
25 cent	65 / 50	11%	375	375
50 cent	57 / 44	22%	751	751
10 Years of Production				
10 cent	68 / 52	6%	318	318
25 cent	61 / 47	16%	795	795
50 cent	54 / 42	26%	1,591	1,591
50% Expensing of FT Equip.	72 / 55	1%	20	-
Tax Exempt Debt	\$ 71 / \$ 55	3%	\$ 325	\$ 643

- Cost of tax incentives tends to move directly with benefit, and money is fungible...
- Utilizing tax incentives to enhance creditworthiness may result in little to no impact on price – and may not target key first-plant risks.

**Co-Pro Results: Credit Incentives**

Option	Type of Loan Guarantee			Price Analysis			
	Government / Self-Pay Credit Subsidy	Total Debt (\$ millions)	Debt Guarantee Percentage	FT Diesel Price per Barrel	Crude Equivalent Price per Barrel	Change from Reference Case	Budget Impact* (\$ millions)
Option A	Government	\$ 2,536	100%	\$ 51	\$ 39	30%	\$ 188
Option B	Self-Pay	2,536	100%	60	46	18%	-
Option C	Self-Pay	\$ 2,644	80%	\$ 63	\$ 48	14%	\$ -

*For credit incentives, budget impact is equal to the total cost to taxpayers.

- Loan guarantees can price reduce significantly (14% – 30%) compared with Reference Case results.
- Self-pay loan guarantees are somewhat less powerful, but they offer a zero-budget impact if government correctly assesses risk, making a basket of them revenue and budget neutral.
- **Equal “lift” from self-pay loan guarantee costs government ~\$800 million less than excise tax credit (25¢/gal for 10 years).**



Co-Pro Grants (Cost-Sharing)

- Provide direct funding to project.
- A \$200 million grant results in a 6% – 7% decrease in fuel price, but it is scored in the year it is awarded.
- A 20% Federal cost share (grant) for a \$1 billion IGCC project reduces LCOE by \$4.10 for an IOU, \$5.31 for a merchant plant, and \$5.56 for an IPP.
- Particularly well-suited for early development expenses (pre-financing), such as to help pay for FEED, which helps reduce risk by improving construction cost estimates.



Next Steps

- In light of the conclusion that industry will require incentives for the first few IGCC and/or co-production plants...
- Analyze *combinations of incentives* in more depth to confirm what incentives will mobilize industry and address budget challenges.
- Design project scenarios that may be able to yield competitive fuel price and reduce other risks attendant to a project.
- Analyze cost impacts of sequestration.
- Continue work to assess which risks particular incentives best address... and document their cost.
- Continue monitoring availability of purchasing authorities, loan guarantees, tax incentives, and other incentives.

QUESTIONS & ANSWERS and DISCUSSION

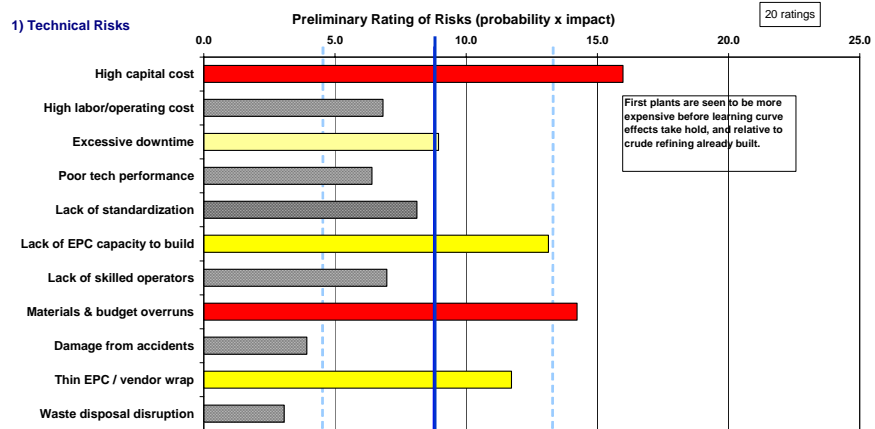
Project Status

	Task	Sponsor	Status
I	Define a base case gasification with co-production	DOE	Complete
II	Develop and populate DOE's financial model for this base case coproduction facility	DOD	Complete
III	Analyze sensitivities for alternate plant configurations and product mixes	EPRI	Initiated
IV	Assess business risks and financing challenges of gassification with co-production facility development	Industry Groups	Interviews Near Completion
V (A)	Analyze the business case for financial incentives for gasification with co-production projects	EPRI	Draft Report
V(B)	Analyze incentives directed towards the environmental benefits of co-production.	EPA	Incentive Discussion & Modeling
VI	Integrate findings in a summary report	DOE	Task 1, 2, 5 have been drafted

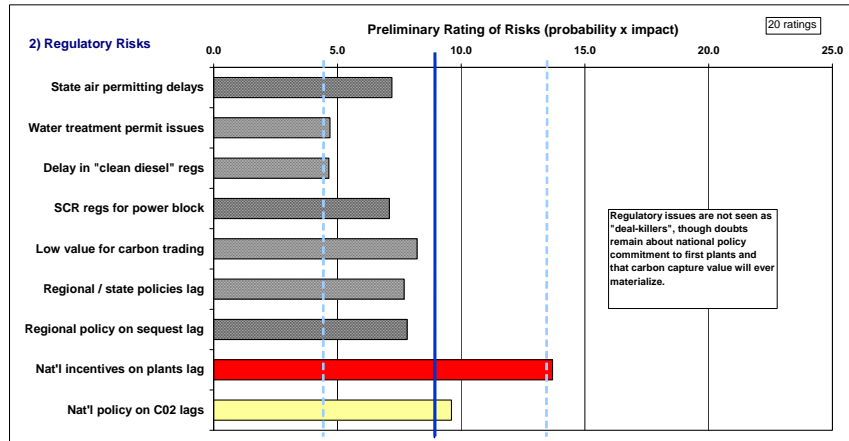
COMPLETE RISK RATING RESULTS FOR CO-PRODUCTION PROJECTS (2006) AND SUMMARY OF RESULTS FOR IGCC (2004, 2005)

Risk Ratings: Technical

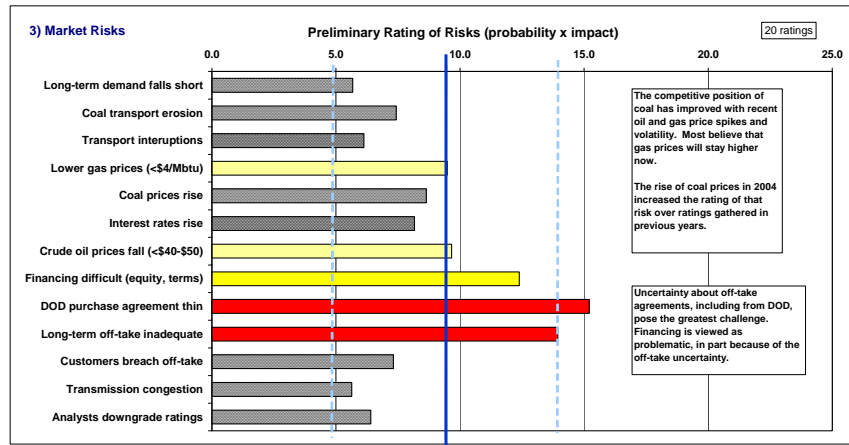
Respondents consider first plants to be more expensive (before learning curve effects take hold and relative to crude refineries). Today's tight EPC market has increased key ratings. Materials costs are also elevated.



Respondents do not consider regulatory issues "deal-killers", but doubts remain about the Nation's policy commitment to first plants and about whether carbon capture value will materialize.



Respondents' uncertainty with off-take agreements, including potentially from DOD, poses the greatest challenge among market risks. Financing, a derivative risk, is problematic, in part because of off-take uncertainty.





Risk Ratings: Technical

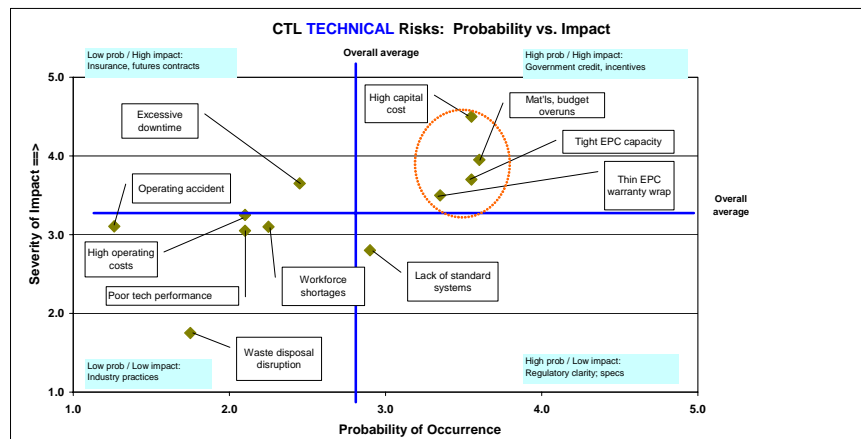
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4 Poor tech performance	2.1	3.1	6.4	8.1	9.7
5 Lack of standardization	2.9	2.8	8.1	9.8	12.3
6 Lack of EPC capacity to build	3.6	3.7	13.1	6.5	6.1
7 Lack of skilled operators	2.3	3.1	7.0	7.3	7.2
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Plot of Technical Risk Ratings

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Risk Ratings: Regulatory & Policy

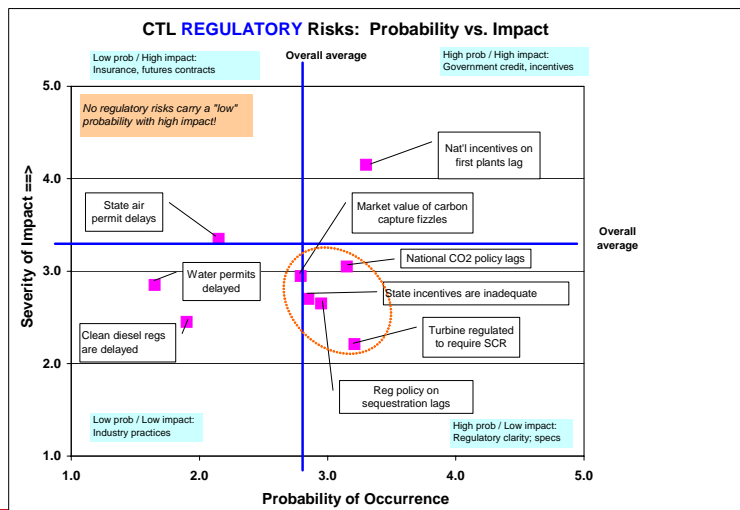
Respondents do not see regulatory issues as "deal-killers", but retain doubts about the Nation's policy commitment to first plants and about whether carbon capture value will materialize. Co-production investors and developers are not as concerned about CO₂ policy as power utilities. Competing fossil prices are a bigger issue for producers of FT fuels than regulatory issues because of market exposure.

	Risk Area	Probability	Impact	2006 Rating	2005 Rating	2004 Rating
	Regulatory					
12	State air permitting delays	2.2	3.4	7.2	13.0	10.9
13	Water treatment permit issues	1.7	2.9	4.7	8.2	7.4
14	Delay in "clean diesel" regs	1.9	2.5	4.7	7.6	9.0
15	SCR regs for power block	3.2	2.2	7.1	8.7	11.1
16	Low value for carbon trading	2.8	2.9	8.2	10.3	10.8
17	Regional / state policies lag	2.9	2.7	7.7	6.6	6.7
18	Regional policy on sequest lag	3.0	2.7	7.8	11.4	11.7
19	Nat'l incentives on plants lag	3.3	4.2	13.7	NR	NR
20	Nat'l policy on C02 lags	3.2	3.1	9.6	11.8	13.7



Plot of Regulatory & Policy Risks

Skepticism persists that national incentives on first plants will provide insufficient encouragement for early projects.



Recent oil and gas price spikes and price volatility improve the competitive position of coal, but respondents reflect their concerns about this market risk by seeking off-take agreements. Most observers expect gas prices to stay higher. Risk ratings for coal price increased after price rises in 2004.

Risk Area	2006		Co-Prod'n	IGCC	IGCC
	Probability	Severity	2006 Rating	2005 Rating	2004 Rating
21 Long-term demand falls short	2.1	2.7	5.7	8.0	7.7
22 Coal transport erosion	2.8	2.7	7.4	8.9	4.6
23 Transport interruptions	2.2	2.9	6.1	8.0	11.2
24 Lower gas prices (<\$4/Mbtu)	2.4	4.0	9.5	7.2	7.0
25 Coal prices rise	2.4	3.6	8.6	7.9	6.3
26 Interest rates rise	2.3	3.6	8.2	10.2	11.7
27 Crude oil prices fall (<\$40-\$50)	2.3	4.2	9.7	11.2	12.5
28 Financing difficult (equity, terms)	3.0	4.2	12.4	13.0	16.1
29 DOD purchase agreement thin	4.0	3.9	15.2	7.4	5.8
30 Long-term off-take inadequate	3.4	4.1	13.9	NR	7.6
31 Customers breach off-take	1.9	3.9	7.3	8.6	NR
32 Transmission congestion	1.9	2.9	5.6	6.8	NR
33 Analysts downgrade ratings	2.1	3.1	6.4	6.2	NR

The inadequacy of off-take agreements creates a clear market risk that hinders financing.

