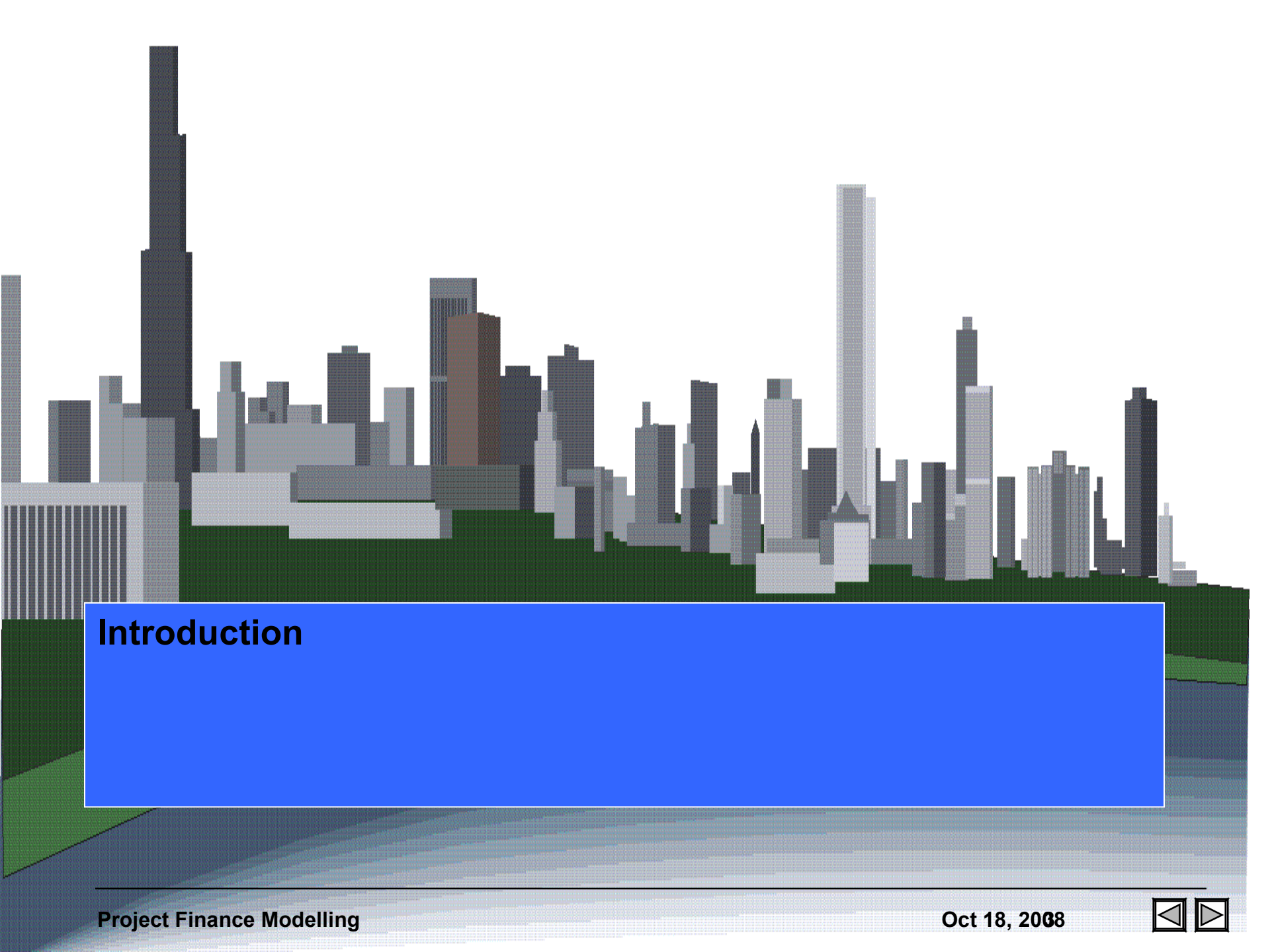


Risk Analysis in Project Finance

Risk Analysis Contents

- Introduction
- Risk Classification
- Project Risk and Examples of Project Failures
- Risk Allocation and Problems
- Risk Analysis of Residual Exposure
- Recovery and re-structure in the event of project failure





Introduction

Risk Analysis in Project Finance Models

- Project finance analysis to a large degree involves identifying, allocating and mitigating risk. One must therefore be able first to identify risks and then to measure how effective the contracts and other mitigating factors (covenant, debt service reserve, liquidated damage) are in managing risk.
- Project Finance Adage:
 - At the beginning of the project
 - ✓ Lender has the money
 - ✓ Developer has the experience
 - At the end of the project
 - ✓ Developer has the money
 - ✓ Lender has the experience



Introduction: Two Components of Trade

- As the growth of trade transformed the principles of gambling into the creation of wealth, the inevitable result was capitalism, the epitome of risk-taking. But capitalism could not have flourished without two new activities that had been unnecessary so long as the future was a matter of chance.
 - The first was bookkeeping, a humble activity but one that encouraged the dissemination of the new techniques of numbering and counting.
 - ***The other was forecasting, a much less humble and far more challenging activity that links risk taking with direct payoffs.***
- “The Remarkable Story of Risk”



Project Finance Risk Analysis Process

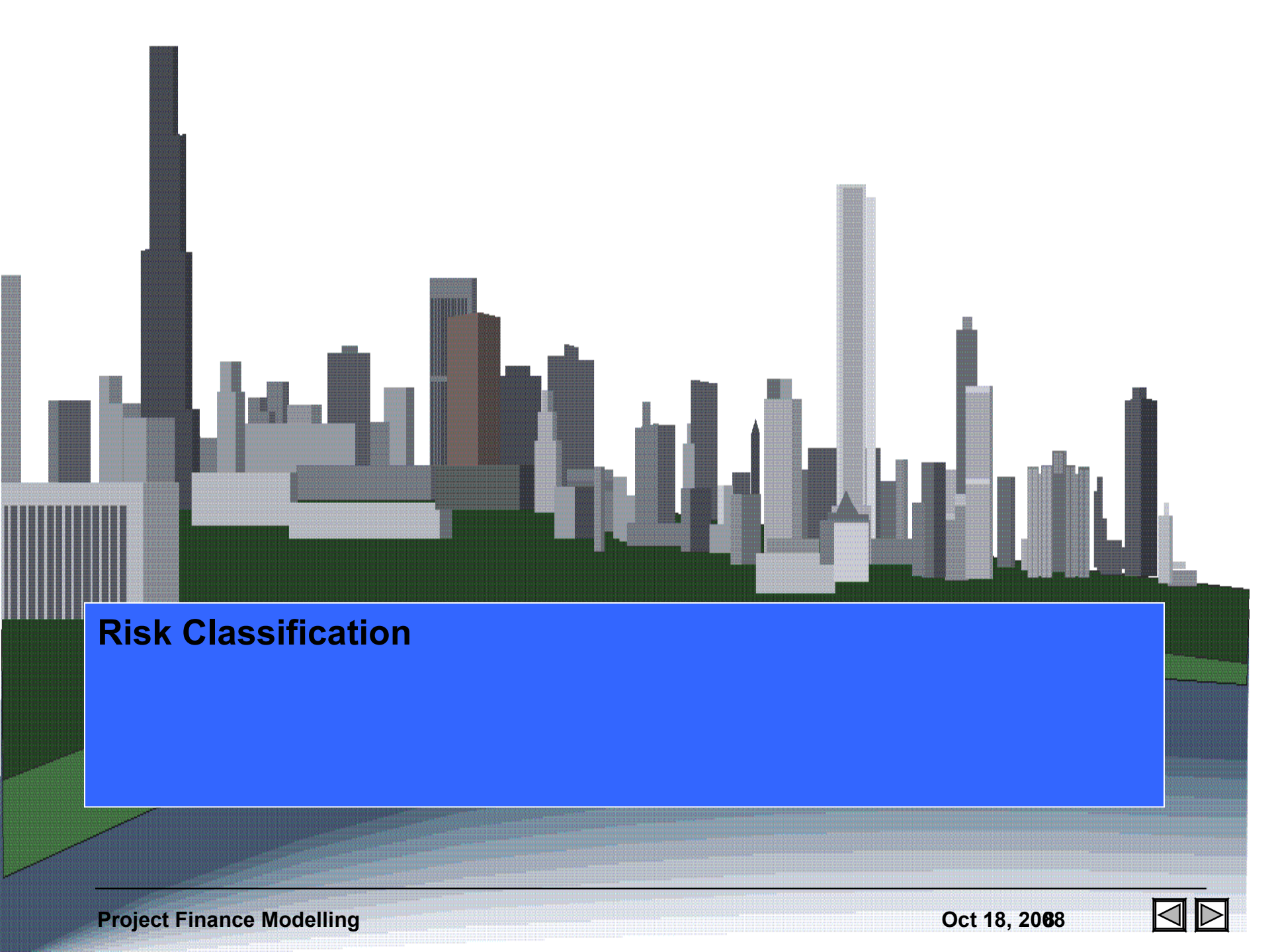
- The analytic task begins with identifying a broad spectrum of risks to which lenders might be exposed
- Determine which risks the project can avoid through allocation of those risks elsewhere
- Those risks that remain unallocated, unmitigated or minimal in consequence, determine the risk of default.
- Project risks must be limited – *“A banker is a man who lends you an umbrella when it’s not raining.”*



Risk Management

- Risk
 - The chance of loss
 - A dangerous element
 - To expose to danger
- Management
 - Judicious use of means to accomplish an end
- Risk Management Evolution
 - Currency, Interest Rates, Metals, Petroleum, Natural Gas





Risk Classification

Alternative Risk Classifications

- There are many ways to classify risk. (Arguing about which way to classify risks is not very interesting.) Some of the alternatives include:
 - Construction period versus operation risks according to the phases of project finance
 - ✓ Construction risks include technological risks while operation risks include market risks.
 - Risks associated with free cash flow and financing cash flow
 - Project risks, financial risks and political risks (Yescombe)
 - 16 risks in project finance (Tinsley)
 - S&P six risks
 - Moody's seven risks
 - Export Credit Agencies



Begin Risk Analysis with Free Cash Flow Value Drivers – Project Risks

- Revenues
 - Forward prices and contract sustainability
 - Volume and capacity utilization
 - Credit quality of off-taker
- Operating Expenses
 - Efficiency in converting inputs to outputs
 - Operation and maintenance expense volatility
 - On-going Capital Expenditures
- Capital Expenditures
 - Completion and technology
 - Over-run
 - Delay
 - Credit and protection of construction company



Classification of Risks – Free Cash Flow

- Project finance risk can be classified in a number of different ways. One is the free cash flow items of
- Construction Risk and Capital Expenditures
 - Cost over-runs
 - Construction delays
 - Plant performance
- Commodity Price Risk
 - Trends in prices over time
 - ✓ Productivity
 - ✓ Equilibrium long-run cost of production
 - ✓ Upper and lower boundaries
 - Volatility
- Volume Risk



S&P Categorization of Six Risks

- The first objective of its analysis determines how well a project can sustain ongoing commercial operations through the term of the rated debt, and, as a consequence, how well the project will be able to service its obligations (financial as well as operational) on time and in full. Project level risks are those intrinsic to the project's business and the industry in which it operates (e.g., a merchant power plant selling power into the U.K. electricity sector). Broadly, there are six steps to assessing project level risk:
 - Evaluate project **operational and financing contracts** that, along with the project's physical plant, serve as the basis of the project enterprise;
 - Assess the **technology and performance** of the project enterprise;
 - Analyze the **competitive position** of the project;
 - Determine the risk that **counterparties** present to the project enterprise;
 - Appraise the project's **legal structure**; and
 - Evaluate the **financial risks** that may affect forecast results.



Moody's Comments on Risk Classification and Assessment

- The analysis of project finance transactions is a complex procedure.
 - Risks analyzed include
 - ✓ Economic risk,
 - ✓ Construction,
 - ✓ Operating
 - ✓ Technology risk
 - ✓ Legal
 - ✓ Political
 - ✓ Regulatory risk.
 - Frequently, the participants in each transaction analyze such risks in minute detail and put in place structural enhancements that seek to mitigate them.



Categories of Risk (Yescombe)

- Commercial risk
 - Commercial viability, completion risks, operating risks, revenue risks, input supply risks, force majeure risks, contract mismatch, sponsor support
- Financial Risk
 - Exchange rates, interest rates and other market risks not directly related to the project
- Political Risk:
 - Risk of expropriation, currency convertibility and transferability, and political violence, including war, sabotage or terrorism.
 - Risks of unanticipated changes in regulations or failure by the government to implement tariff adjustments because of political considerations.
 - Quasi commercial risks arising when the project is facing state-owned suppliers or customers, whose ability or willingness to fulfill their contract obligations towards the project is questionable.



16 Risks in Project Finance

- Operating: Technical
- Cost
- Management
- Participant
- Completion
- Supply
- Market
- Infrastructure
- Environmental
- Political
- Force Majeure
- Foreign Exchange
- Engineering
- Syndication
- Funding/Interest
- Legal

See the project finance folder to consider how these risks are defined and classified.



Analysis of Major Risks According to Phases of Project Finance

- Risks During the Construction Phase
 - Cost over-runs and delay in completion
 - Performance of technology
 - Environmental and political risks
 - Credit quality and experience of contractor
 - Legal and other costs
 - Mitigation
 - ✓ Use of fixed price, date certain turn-key contracts
 - ✓ Sponsor support and limited recourse
- Risks After Completion
 - Price and contract sustainability
 - Volume and traffic
 - Operating cost, technology performance and other costs



ECA Risk Classification

- General Project
 - Should have long-term contracts from credit worthy entities
 - ✓ For output, input, O&M
 - ✓ Extend beyond the term of the financing
 - Appropriate allocation of risk to parties best suited to take risks
 - ✓ Sensitivity analysis to assure that DSCR is sufficient to ensure uninterrupted debt service
 - ✓ Similar project cost to others in the market
 - ✓ Product pricing should reflect market-based financing
 - ✓ Mitigate exchange rate risk through denominating revenues in appropriate currency
 - Participants
 - ✓ Demonstrate technical, managerial and financial capabilities
 - Technical
 - ✓ Proven reliable technology
 - ✓ Feasibility study
 - Host Country
 - ✓ Commitment to proceeding, Legal and regulatory



Analysis of Major Risks According to Phases of Project Finance

- Revenue Risk
 - Commodity price (Non-contract projects)
 - ✓ Production costs and capacity expansion
 - ✓ Historic prices and volatility
 - ✓ Price trends and long-term equilibrium
 - ✓ Industry productivity and technology changes
 - Volume
 - ✓ Price elasticity
 - ✓ Short-term marginal cost of production
 - ✓ Substitutes and product differentiation
 - Contract sustainability
 - ✓ Credit quality of off-taker
 - ✓ Economic viability of project
 - ✓ Legal structure



Analysis of Major Risks

- Revenue Risk continued
 - Mitigation
 - ✓ Hedging of commodity prices
 - ✓ Size of project relative to off-taker
 - ✓ Risk insurance for contract performance
- Operating Cost Risk
 - Technology Risk
 - ✓ Breakdown, repairs and scheduled maintenance
 - ✓ Future increases in productivity
 - ✓ Technology changes that reduce competitiveness
 - Foreign Currency and Political Risk
 - ✓ Exchange rate risk
 - ✓ Contract risks and law changes
 - ✓ Expropriation



Price versus Output Risks

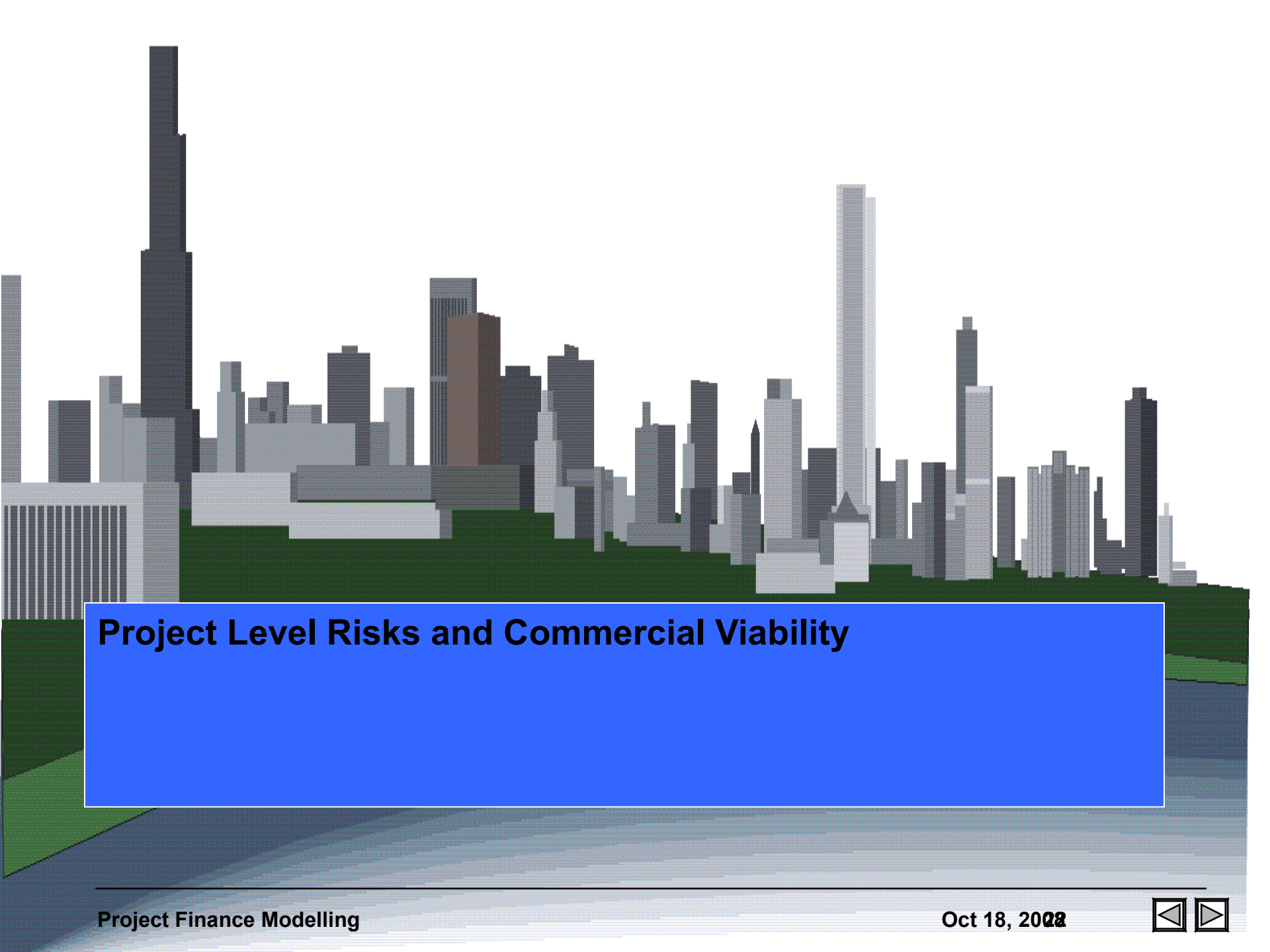
- Market-risk project financing is where a level of either price or volume risk (but almost never both) exists.
 - These financings without contracts are typically for larger capital expenditure items have much higher equity funding, shorter terms (usually within 10-12 years), and higher spreads relative to the contract-supported forms.
 - Lack of long term contracts does not necessarily mean unacceptable structure, but may call for different loan structures to assure faster prepayments in higher cash flow years and slower amortization in leaner years.



Volume Risk

- A good project should exhibit reliable revenue stream. Therefore volume and price risks need to be carefully assessed. The project needs to produce and sell its designed volume of output at certain minimum prices to account for downside or stress situations.
- In most project financing, the volume risk is not assumed by lenders either because of
 - (1) committed purchase of the output, at some price by the sponsor or one or more users of the output, or
 - (2) the output is basically a commodity and the nature of the market negates the need for reliance on any one or more known purchasers.
- Depending on the output's nature, the price risks could be covered through comfort with market price, minimum price guarantees, or cost plus pricing arrangements.





Project Level Risks and Commercial Viability

Approach to Risk Analysis

- To discuss risks, rather than focusing on classifications and checklists, we discuss cases in which risks caused project failure.
- Begin with discussion of Eurotunnel
- Next, risk analysis during for the three primary cash flow variables
 - Capital expenditures and the construction phase
 - Revenues in the operation phase
 - Expenses in the operation phase
- After discussing these risks, political risks are addressed
- In addressing failures, examine the mistakes that could have prevented the failure.



Project Risks and Causes of Project Failure – S&P Risk Categories

- Delay in completion (increase in IDC)
- Capital cost over-run
- Technical Failure
- Revenue Contract Default
- Increased Price of Raw Materials
- Loss of Competitive Position
- Commodity Price Risk
- Volume Risk
- Overoptimistic Reserve Projections
- Exchange rate
- Technical Obsolescence of Plant
- Financial Failure of Contractor
- Contract Mismatch
- Uninsured Casualty Losses
- US Nuclear Plants
- Eurotunnel
- Alstrom Combined Cycle
- Dabhol; AES Drax
- California Wood Plants
- Natural gas plants
- Argentina Merchants
- Euro Disney; Tollways; Subways
- Briax Gold Project
- Jawa Power in Indonesia
- Iridium
- Stone and Webster
- MCV





Eurotunnel Discussion

Eurotunnel

- The Eurotunnel is the largest project financing and provides an effective case study in how economic viability was not addressed?
 - Why was there no mitigation of construction cost?
 - Would an EPC contract mitigated risk?
 - Was leverage appropriate for volume and price risks (was there a second way out)?
 - How should the volume and price risks have been assessed?
 - Could the indirect delay risk of completing the rail links been foreseen?
 - What were the problems with management – sponsors and lenders (overconfidence, complex systems, not appropriately listening to alternative viewpoints etc.)?



Eurotunnel Background

- August 1994, the British Isles and continental Europe were linked together for the first time in 8,000 years. The Channel tunnel, or Chunnel as it is better known, is Europe's biggest infrastructure project financed wholly by private capital. The desire to link Britain and France dates back more than 200 years.
 - A French farmer named Nicolas Desmaret argued in 1751 in "A Dissertation on the Ancient Link Between England and France" that the two countries should once again be linked, "... either by bridge, tunnel or causeway."(1) Fifty-one years later Napoleon approved a plan drafted by Albert Mathieu, a French mining engineer, for twin tunnels with surface-reaching chimneys for ventilation. However, England and France went to war a year later and the plan died. Similar afflictions tainted the link devised by Thome de Gamond in the 1830s. The first serious construction attempt took place in the early 1880s. Tunneling had actually begun from both the British and the French coasts, but after a mere 2,000 yards the British became uneasy with the potential success of the project and called it off.(2)
 - Over the next 100 years, studies were taken, proposals were written and various holes were drilled. Harold Wilson's Labor Party government forfeited tunnel construction in 1975, opting to pursue the Anglo-French Concorde project instead.
- It wasn't until late in 1984 that the British and French governments reached an agreement to build the tunnel. The project became official with the signing of the Paris Agreement on March 14, 1986.(3) This triggered the largest binational joint venture ever, as well as unprecedented cooperation between the two nations. As Dr. Brian Mawhinney, secretary of state for transportation, said: the tunnel "... is perhaps the greatest example of international collaboration in transport."



Eurotunnel Background - Continued



- Eurotunnel is the British company serving as the operators, and its partner is Trans-Manche Link, a French construction company. Cooperation also has been extraordinary between European Passenger Services and the French and Belgian rail companies, SNCF and SNCB, which run the Eurostar services among London, Paris and Brussels.
- The architectural result is a 50-kilometer (31-mile) tunnel connecting Folkestone, England and Calais, France. It consists of two parallel tunnels, allowing for traffic in both directions, and is linked by a third which provides air conditioning and technical services. Passengers are able to exit the highway on either side of the Channel, pick up a ticket at a tollbooth and drive onto Le Shuttle. Crossing the Channel via the tunnel takes a mere 35 minutes compared with 75 minutes by ferry.
- There also are through trains carrying passenger and freight services. These include an hourly service between London and Paris, taking three hours, and between London and Brussels, taking 2 hours, 45 minutes. Sleeper services are available from London to cities in Germany, Switzerland and other connections, between Scotland, Wales and cities throughout Europe.(5)
- The tunnel is a small, yet expensive, piece of a much larger puzzle. It is the missing link in a plan which includes building a high-speed rail system across England and expanding France's Train de Grande Vitesse (TGV) system.

Euro tunnel

- 31 Mile tunnel between England and France
- Similar project in Japan had 100% cost over-run
- Financed by 225 banks
- Construction expected to be completed in May 1993; actual was in December 1994
- Original construction budget was £4.9 billion; actual £12 billion
- Bankers egos and ties got in the way
- Problems with rail links
- Serious aspect of risk misjudged
 - Completion
 - Traffic
 - Infrastructure



Eurotunnel Time Line

Eurotunnel: Calendar of a Crisis

1981

UK Prime Minister Margaret Thatcher and President Mitterrand of France announce studies for a fixed Channel link

1986

Channel Tunnel agreement signed

1987

First public row erupts between Eurotunnel's co-chairman Sir Alastair Morton and the tunnel's contractors TransManche Link, but the company still manages to raise £770m on the stock market. Total costs of the tunnel estimated at £4.9bn and construction finally gets underway in December

1988

Eurotunnel warns of delays as construction costs rise

1990

Undersea service tunnel breaks through but the group is forced to raise another £566m from investors through a rescue rights issue

1994

The tunnel is finally opened by the Queen and President Mitterrand in May, a year late, following protracted rows with TransManche Link. A week later the company launches another £858m rescue rights issue

1995

Sir Alastair warns that Eurotunnel is in grave danger as the cost of the project balloons to nearly £12bn, the group's debts soar to £9bn and interest payments stand at £2m a day. The company is forced to suspend interest payments

1996

Eurotunnel unveils a loss of £925m – one of the biggest in UK corporate history. It announces a restructuring plan to stave off bankruptcy. But a fire in the tunnel compounds its woes

1997

Despite a storm of protest from French shareholders, Eurotunnel's restructuring plan, whereby banks swap loans for shares, is finally agreed. The government extends the concession to operate the tunnel by 34 years to 2086

1998

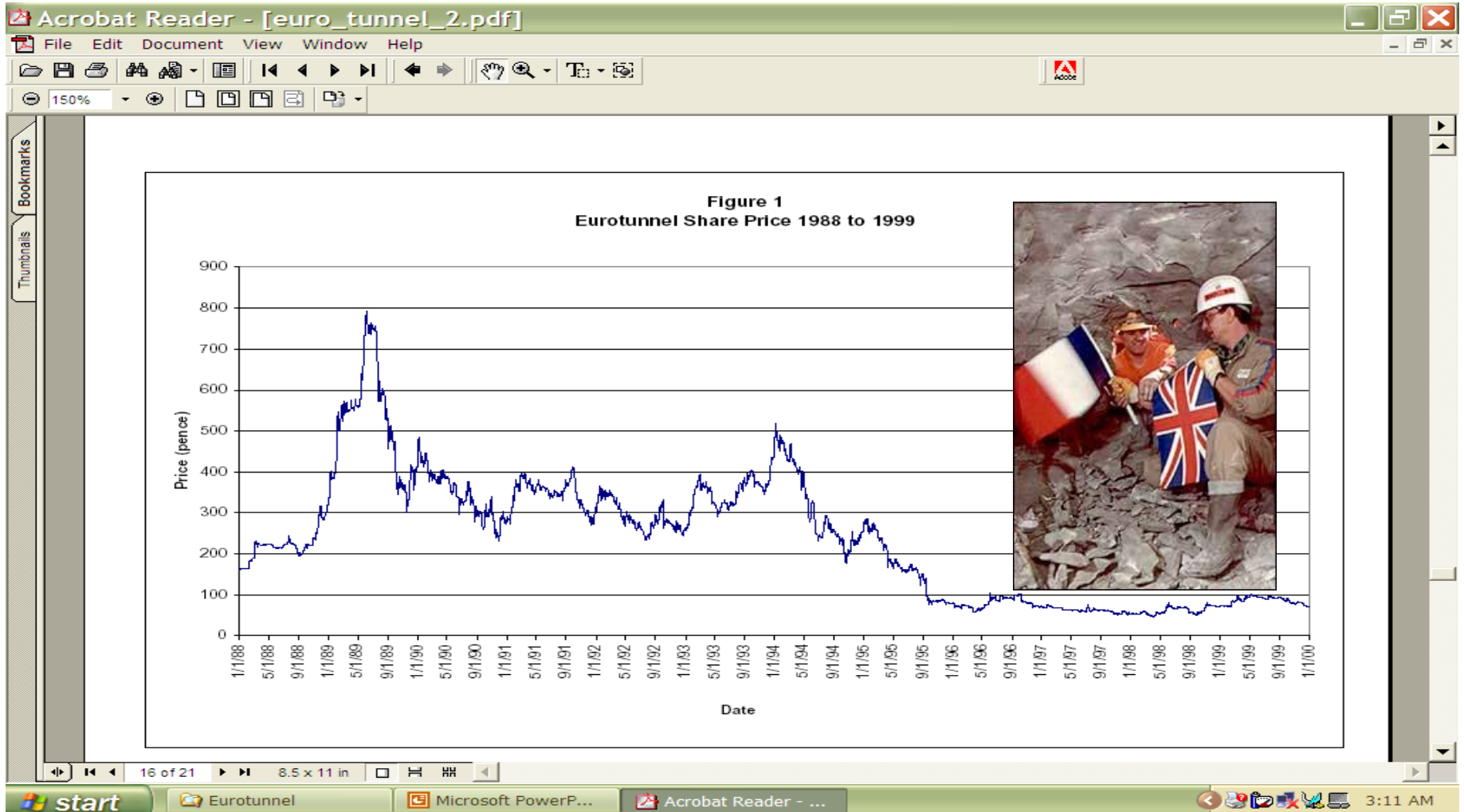
Eurotunnel announces its first operating profit

March 1999

Eurotunnel announces its first net profit and plans to pay back some of its debts.

Initial Cost Estimate to be 4.9 billion GBP

Stock Price and Market Capitalization



Eurotunnel Mistakes

- Eurotunnel comments
 - "We were predicting that on Eurostar there would be 21 million passengers (annually)," admits David Freud of Warburg, the investment house which sold Eurotunnel shares to the public.
 - The actual figure was *less than a third* of that.
- "So the traffic forecasts were not just out by a little bit. They were completely potty; they were nowhere."
- Those who drafted Eurotunnel's prospectus failed completely to foresee a robust response from the ferries.
- When the world's most successful investor, Warren Buffett, said, "if you overpay for an asset, there ain't no cure", he might have had Eurotunnel in mind.



Eurotunnel – Price and Traffic Estimates

- Not only did P&O not fade away, as Eurotunnel had thought likely, it fought back with better ships and lower prices, retaining the loyalty of passengers who had been forecast to switch to the tunnel.
- Another blow to Eurotunnel was the unexpected emergence of no-frills airlines, offering rock-bottom prices on short-haul trips to a wide range of European destinations.



Eurotunnel Forecasts and Actual

Eurotunnel Prospectus Revenue Forecasts (GBP Millions)							
	Prospectus Date				Actual	Nov 87 vs Actual	Dif as % of 87 Proj
	November 1987	November 1990	May 1994	May 1997			
1993	488	393	0	0	0		
1994	762	764	137	0	82		
1995	835	833	525	0	304	531	64%
1996	908	904	737	0	483	425	47%
1997	986	980	829	567	531	455	46%
1998	1,072	1,070	901	649	666	406	38%
1999	1,158	1,165	993	654	654	504	44%



Contractual Problems

- Eurotunnel's difficulties were in part due to the wrong contractual structure set up at the origin of the project.
 - The main contracts were signed at a time where Eurotunnel had virtually no existence.
 - Eurotunnel lacked powerful sponsors to defend its interests against opportunistic contractors (especially, the construction companies).
 - ✓ As a consequence, these co-contractors imposed long-term contractual features extremely unfavourable to Eurotunnel.
 - ✓ These conflicts were not anticipated at the very beginning of the project since the construction companies initially held a part of Eurotunnel's shares.
 - The other important contractor, the bank syndicate, was unable to stem the opportunistic behaviour of the construction companies due to its lack of expertise on technical features.



Cost Over-Runs

- This cost escalation was at the origin of a major conflict between Eurotunnel and the construction companies (The TML consortium). This conflict appeared from the very beginning of the construction schedule as the construction companies were faced with technical problems caused by poorer than expected ground conditions under the English coast. These first difficulties led to tunnelling delays and cost overruns.
- In the following years, the main conflict concerned the cost of the rolling stock. The TML consortium argued that the Intergovernmental Commission (IGC) imposed major safety changes that led to considerably more sophisticated shuttles than expected.
- Jack Lemley (former Chief Executive of TML) asserted in this spirit that IGC had “free rein to change physical criteria without providing the money to do so” (Lemley 1995). TML run many disputes against Eurotunnel in order to obtain compensation for cost overruns.



Cost Over-Runs and Contract Problems Continued

- This series of disputes was partly due to the incentives / penalties scheme of the construction contract. In reality, the construction contract signed in 1987 charged almost all the construction risk to Eurotunnel.
 - For tunnelling costs (representing roughly 50% of overall costs), TML was only responsible for 30% of cost overruns with TML's contribution being capped at a maximum of 6% of the target cost. Eurotunnel would pay 100% of any cost overruns over this cap. Even when the contract seemed to be favorable to Eurotunnel (TML was assumed to support 100% of cost overruns on the terminals and the fixed equipment in the tunnel), some covenants gave TML the possibility to transfer cost overruns to Eurotunnel. Indeed, the construction contract explicitly made provisions allowing TML to ask for price adjustments in case of unpredictable ground conditions, changes imposed by the IGC or asked by Eurotunnel. Hence, it is not surprising to notice that the resolution of the disputes was largely in favour of TML. Despite an agreement was found just before the rights issue of 1994, Eurotunnel had to pay for the main part of cost overruns.
- In 1993, a few months before the opening of the Tunnel, a dispute emerged between Eurotunnel and the Railways. Eurotunnel initiated an arbitration before the International Chamber of Commerce in 1993 in order to renegotiate the Railway Usage Contract. Eurotunnel argued that the Railways breached the contract on several features (concerning for example the starting date of Eurostar or the delay in the construction of high speed rail link between London and the tunnel) and claimed £2 billion. The claim was finally rejected.



Eurotunnel Data

Table 1. Evolution of projected construction costs (in £ million – 1985 prices)
Data are drawn from Eurotunnel prospectus (1987 offer for sale, 1990 and 1994 rights issues).

	November 1987	November 1990	May 1994	% change 1987-1994
Tunnels	1329	2009	2110	58.8%
Terminals	448	491	553	23.4%
Fixed equipment	688	814	1200	74.4%
Rolling stock	245	583	705	187.8%
Bonuses and contingencies		72	46	
Direct works			36	
Additional costs until the completion of the Tunnel			194	
Total construction costs	2710	3969	4844	78.8%

TABLE 4.5 Eurotunnel: combined profit and loss account

	£ million		
	Years ended 31 December		
	1994	1995	1996 (provisional)
<i>Turnover, other operating income and capitalized expenditure</i>			
Turnover and other operating income	30.6	298.6	448.1
Own work capitalized*	715.8	-	-
Deferred expenses and recharges	51.5	5.3	-
	<u>797.9</u>	<u>303.9</u>	<u>448.1</u>
<i>Operating expenditure</i>			
Materials, services and staff costs	320.2	307.8	386.4
Bank fees and expenses	81.4	59.8	#
Depreciation	38.8	130.4	#
Provisions and other charges	107.1	6.3	#
	<u>(547.5)</u>	<u>(504.3)</u>	#
Income from investments	10.5	4.8	#
Profit/(loss) before interest and exchange differences	260.9	(195.6)	#
Interest	(642.9)	(759.9)	#
Exchange differences	(4.9)	30.6	#
(Loss) for the year	(386.9)	(924.9)	#

Source: Eurotunnel.

TABLE 4.6 Eurotunnel: combined balance sheet

	£ million	
	At 31 December	
	1994	1995
<i>Fixed assets</i>		
Concession fixed assets	9,452.9	9,395.2
Other fixed assets (including investments)	8.3	4.7
	<u>9,461.2</u>	<u>9,399.9</u>
Net current assets/(liabilities) (excluding net borrowings)	2.9	(114.5)
	<u>9,464.1</u>	<u>9,285.4</u>
Net borrowings*	(7,720.8)	(8,804.3)
Provisions for liabilities and charges	(3.5)	(14.6)
Shareholders' funds	<u>1,739.8</u>	<u>466.5</u>

Source: Eurotunnel.

	£ million	
	Cost	Net book value
<i>Tunnel infrastructure:</i>		
Tunnels	4,494.6	4,485.9
Fixed equipment	2,295.5	2,218.6
Other fixed assets	242.4	194.1
	<u>7,032.5</u>	<u>6,898.6</u>
<i>Fixed assets used principally by Le Shuttle operation:</i>		
Rolling stock	1,259.8	1,205.5
Terminals and related land*	1,300.6	1,291.1
	<u>2,560.4</u>	<u>2,496.6</u>
Total concession fixed assets	9,592.9	9,395.2

Source: Eurotunnel.



Eurotunnel Debt Instruments

			06/94 issuance of senior debt and amendment of junior debt credit agreement													
	11/87 junior debt agreement	11/90 amendment on junior debt	Amendment on junior debt	New senior debt												
Borrowing limit	£5b (£4b for the main credit and a £1b line of credit)	Additional £2.1b (£1.8 b from the syndicate and £300m from the European Investment Bank)	No additional junior debt but revision of the credit agreement due to the issuance of senior debt	£743m												
Amortization	From 11/95 to 11/05	Extension of the repayment schedule Regular schedule : From 11/96 to 11/10. Alternative schedule: From 11/00 to 11/12.		From 08/00 to 02/06												
Fees	Front-end fees (Arrangement + underwriting + participating): 25 bp + 7/8 % Commitment fee : 1/8 % per year charged on undrawn part. Eurotunnel indicates semi-annually the amount it projects to draw : if the amount drawn is lower than the projected amount, the commitment fee is ¼ % per year on the difference; if the amount drawn is higher than projected, the new commitment fee is 5/16 % per year on the difference.	<u>High commissions on the additional £18b :</u> Arrangement fee : 25 bp Commitment fee : 1 % per year on additional funds if the bank has participated to the loan in the same proportion that in 1987; 2% per year if the bank has increased its participation. <u>Increased commissions (compared to the 1987 credit agreement) on the amount drawn over £40b:</u> Participation fee : + 25 bp for the amount drawn over £4b. Commitment fee : this fee is increased (details non available) for the amount drawn over £4b.	Similar to the 1990 revised credit agreement Additional fee (roughly £10,500 per lender) to compensate decreased security following the issuance of senior debt.	Front-end fees : 150 bp + £1m Agency fee: £200,000 per year Commitment fee : 1 % per year charged on undrawn part.												
Spread	<u>Spread on main credit (£4b)</u> To completion date : 125 bp After completion : 100 bp (125 bp if after the completion date repayments by Eurotunnel fall short of the predicted repayment schedule) <u>Spread on line of credit (£1b)</u> To completion date : 175 bp After completion date : 125 bp (150 bp if after the completion date repayments by Eurotunnel fall short of the predicted repayment schedule)	Increased spreads varying according to the amount drawn. New margins per year are as follows: <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>To completion</th> <th>After completion</th> </tr> </thead> <tbody> <tr> <td>Up to £4b</td> <td>150 bp</td> <td>125 bp</td> </tr> <tr> <td>Between £4b and £6.3 b</td> <td>175 bp</td> <td>150 bp</td> </tr> <tr> <td>Between £6.3b and £6.8b</td> <td>250 bp</td> <td>225 bp</td> </tr> </tbody> </table> If after the completion date, repayments by Eurotunnel do not respect the regular schedule: applicable margin increased by 12.5 bp.		To completion	After completion	Up to £4b	150 bp	125 bp	Between £4b and £6.3 b	175 bp	150 bp	Between £6.3b and £6.8b	250 bp	225 bp		Spread: 2.5 % per year reducing to 2% per year after June 1997 provided that at least 85% of the 1993 warrants have been exercised
	To completion	After completion														
Up to £4b	150 bp	125 bp														
Between £4b and £6.3 b	175 bp	150 bp														
Between £6.3b and £6.8b	250 bp	225 bp														



Eurotunnel Income Statement Data

Eurotunnel Profit and Loss Accounts 1988 to 1999 (£m)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Turnover												
Turnover and other income	1	6	5	11	8	3	31	299	448	456	618	627
Own work capitalised	54	220	506	547	781	846	716					
Deferred expenses and recharges (note 1)					11	46	51	5	35	75	48	27
	<u>55</u>	<u>226</u>	<u>511</u>	<u>558</u>	<u>800</u>	<u>895</u>	<u>798</u>	<u>304</u>	<u>483</u>	<u>531</u>	<u>666</u>	<u>654</u>
Operating costs (excl. depn.)	(82)	(106)	(246)	(169)	(177)	(251)	(402)	(374)	(379)	(341)	(345)	(321)
Depreciation	(14)	(54)	(94)	(92)	(50)	(47)	(146)	(130)	(147)	(126)	(137)	(123)
Operating costs (incl. depn.)	<u>(96)</u>	<u>(160)</u>	<u>(340)</u>	<u>(261)</u>	<u>(227)</u>	<u>(298)</u>	<u>(548)</u>	<u>(504)</u>	<u>(526)</u>	<u>(467)</u>	<u>(482)</u>	<u>(444)</u>
Operating profit/(loss)	(41)	66	171	297	573	597	250	(200)	(43)	64	184	210
Interest (note 2)	41	(65)	(171)	(297)	(575)	(599)	(637)	(724)	(642)	(675)	(399)	(304)
Exceptional item (note 3)											279	296
Net profit/(loss)	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>(2)</u>	<u>(2)</u>	<u>(387)</u>	<u>(924)</u>	<u>(685)</u>	<u>(611)</u>	<u>64</u>	<u>202</u>



Eurotunnel Cash Flow Data

Eurotunnel Cash Flows 1988 to 1999 (£m)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
FINANCE												
Issue of share capital			573	3	3	10	909	56				150
Bank loans	175	887	1,278	1,140	1,604	1,672	795	345	(1)		(8)	(178)
	<u>175</u>	<u>887</u>	<u>1,851</u>	<u>1,143</u>	<u>1,607</u>	<u>1,682</u>	<u>1,704</u>	<u>401</u>	<u>(1)</u>	<u>0</u>	<u>(8)</u>	<u>(28)</u>
INVESTMENT												
Fixed assets	(624)	(1,011)	(1,331)	(1,051)	(1,238)	(843)	(453)	(66)	(39)	(28)	(57)	(58)
OPERATIONS												
Operating cash flow	31	44	165	(139)	(108)	(165)	(333)	101	115	201	356	315
Interest (note 2)	31	(38)	(181)	(328)	(555)	(670)	(657)	(657)	(35)	(135)	(210)	(252)
	<u>62</u>	<u>6</u>	<u>(16)</u>	<u>(467)</u>	<u>(663)</u>	<u>(835)</u>	<u>(990)</u>	<u>(556)</u>	<u>80</u>	<u>66</u>	<u>146</u>	<u>63</u>
INCREASE/(DECREASE) IN CASH	<u>(387)</u>	<u>(118)</u>	<u>504</u>	<u>(375)</u>	<u>(294)</u>	<u>4</u>	<u>261</u>	<u>(221)</u>	<u>40</u>	<u>38</u>	<u>81</u>	<u>(23)</u>

Source: Eurotunnel financial statements 1988 to 1999



Eurotunnel Balance Sheet

Table 5

Eurotunnel Balance Sheets 1988 to 1999 (£m)

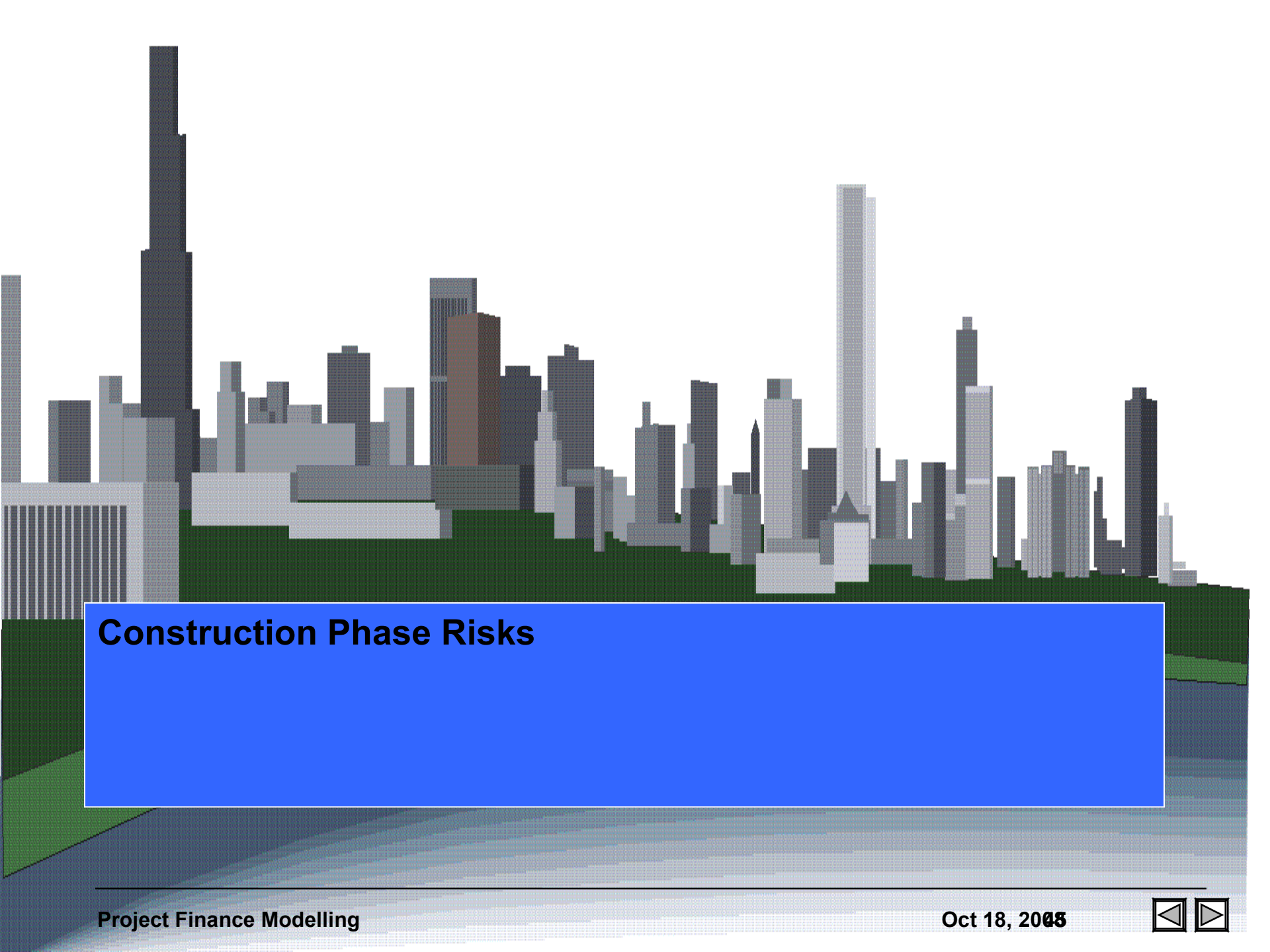
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fixed assets (note 1)	995	1,953	3,399	4,878	6,757	8,453	9,461	9,400	9,284	9,191	9,108	9,041
Net current assets (note 2)	180	130	584	237	(4)	(14)	301	(35)	9	29	84	51
	<u>1,175</u>	<u>2,083</u>	<u>3,983</u>	<u>5,115</u>	<u>6,753</u>	<u>8,439</u>	<u>9,762</u>	<u>9,365</u>	<u>9,293</u>	<u>9,220</u>	<u>9,192</u>	<u>9,101</u>
Issued share capital	467	467	752	753	755	761	1,318	1,371	1,371	469	195	231
Share premium	556	556	844	846	849	852	1,204	1,207	1,207	1,207	1,401	1,771
Reserves (note 3)	(25)	(26)	(9)	(43)	(363)	(246)	(782)	(2,112)	(2,084)	(1,340)	(534)	121
Shareholders' funds	<u>998</u>	<u>997</u>	<u>1,587</u>	<u>1,556</u>	<u>1,241</u>	<u>1,367</u>	<u>1,740</u>	<u>466</u>	<u>494</u>	<u>336</u>	<u>1,062</u>	<u>2,131</u>
Loans and overdrafts	177	1,086	2,396	3,559	5,512	7,072	8,022	8,899	8,799	8,884	8,130	6,961
	<u>1,175</u>	<u>2,083</u>	<u>3,983</u>	<u>5,115</u>	<u>6,753</u>	<u>8,439</u>	<u>9,762</u>	<u>9,365</u>	<u>9,293</u>	<u>9,220</u>	<u>9,192</u>	<u>9,101</u>



Eurotunnel Capital Structure

- Just before the commercial opening of the tunnel in November 1994, the company presented a typical project capital structure with a leverage ratio (total debt on total assets) of 80%.
- A few months later, it became apparent that the firm would be unable to continue to service all of its interest payment obligations and accordingly on September 14, 1995, Eurotunnel suspended the payment of interest on existing junior debt (which represented 96% of total debt).
- This suspension of interest payments had the effect under the credit agreement of triggering a standstill, initially running to March 14, 1997, and which has been extended to December 14, 1997.





Construction Phase Risks

Delay in Construction – Nuclear Plants

- Consequences of Delay
 - Delay revenue recognition
 - Increase Interest During Construction
 - May limit back-end revenues in concession
- Example – US Nuclear Plants
 - Plants took more than 10 years to build when interest rates were very high
 - Plants were 95% complete for many years
 - IDC was often more than the “direct” cost of construction
 - Caused billions in write-offs.
 - Partially caused by Three-mile Island Accident
 - Plants cost from \$4,000/kW to \$8,000/kW – comparable coal plants was about \$1,500/kW.



Technical Failure – New Combined Cycle Electricity Plants

- An example of technical failure is the ABB combined cycle plants that were used in the merchant industry. These plants had excessive vibration and did not meet heat rate performance estimates.
- Demonstrates preference for conventional technology (even though there have been remarkable improvements in heat rates and efficiency)
- Standard and Poor's comments
 - As equipment suppliers modify proven designs to expand the performance envelope to give greater output and improved efficiencies, the resulting higher operating temperatures and pressures can result in increased wear and maintenance.
 - This has been a potential problem with gas-fired power generation technology recently, despite manufacturer expertise. These design modifications can adversely affect reliable performance and O&M budget requirements over time. Some scaled-up gas turbine generator designs, for instance, have met initial test parameters, but have seen problems during operations, such as premature failure or excessive vibration, which have required design modifications.



Examples of Issues that Cause Delay in Construction

- Enron Corp.'s well publicized, experience in India with the state of Maharashtra's opposition to the Dahbol project illustrates how effective and expensive local opposition to a project can be.
- Pipeline projects can face delays waiting on right-of-way acquisitions or the conclusion of condemnation proceedings.
- Air permits for power plants and the steps necessary to secure them are another source of project delays.



Preference for Conventional Technologies – Standard and Poor's (Reference)

- New technologies or scaled-up versions of previously proven designs may have adverse affects
 - The record of similar technologies, the complexity of the design change, and the expertise and support committed by the equipment manufacturers can mitigate scale-up risk.
 - Problems with conventional technology
 - ✓ Plant becomes obsolete
 - ✓ Reduces incentive to improve performance
 - ✓ High IRR expectation is not realistic



Examples of Preference for Conventional Technology – Standard and Poor’s (Reference)

- Industrial, mining, communications, or transport projects should employ commercially proven technology and designs that will minimize future operating problems.
 - Toll road should use materials commensurate with soil and ambient weather conditions and expected traffic flows.
 - A merchant power plant that anticipates selling power into a competitive power market should be using technology that ensures high reliability, high productivity, and low operating costs.
 - Design should specify the use of premium-grade materials and equipment in areas of the project that are historically problematic, subject to harsh operating environments, or critical to reliability.



Technology Risk

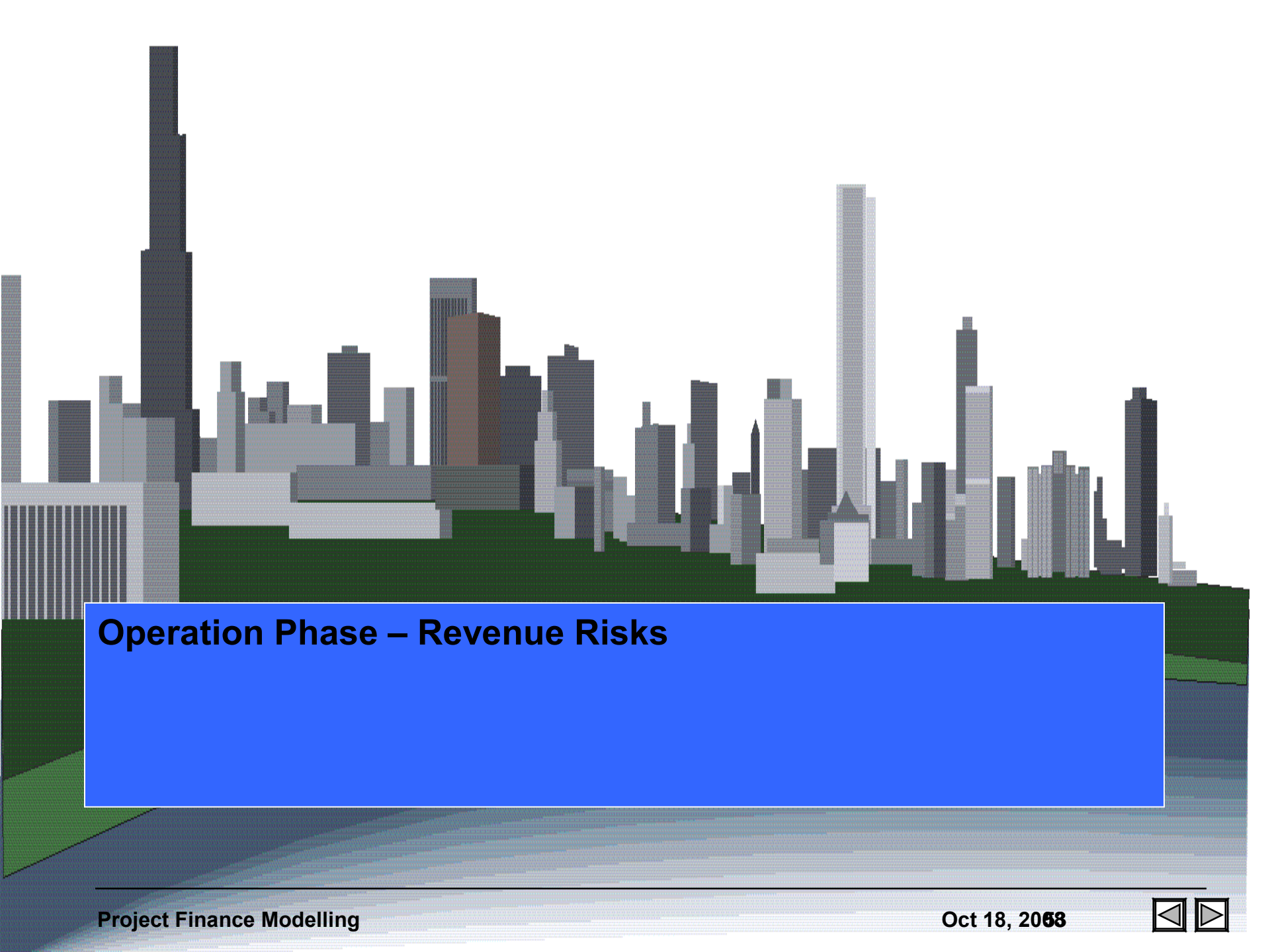
- Project Financing is seldom applied to new technology.
- Can take technology risk if:
 - Known and proven technology is used;
 - The facilities are projected to remain technologically competitive; and
 - Plant/project life is longer than the funding life;
- Project financiers do not want to be 'first' to bank a project with new technology.
 - If an untried technology is incorporated into a new project, most financiers will require extra support.
 - ✓ Liquidated damage provisions after the plant is complete
 - ✓ Added insurance
 - ✓ Sponsor guarantee
 - Covenants will be required to ensure that the borrower applies generally accepted operating practices and obeys the applicable laws including environmental regulations. (the "prudent operator" clause).



Reserve Risk - Briax

- Reserve risk is analogous to technology risk. Whereas an electric plant may not meet the capacity or heat rate specifications, resource transactions (oil and mining) have risk associated with reserve estimates.
- Reserves are estimated by definition although the geology and simulation is advanced.
- Rely on reserve reports which depend on the price of the product. These can be improved with more testing and the analysis is different for oil and mining (mining is generally more precise)
- The Briax fiasco demonstrates how bankers can rely on reserve reports without checking details.





Operation Phase – Revenue Risks

Contract versus Commodity Price

- Risk analysis has similarities in contract versus non-contract transactions
 - Similarities
 - ✓ Need to assess economic viability in either case because of incentives to abrogate contract if the plant is uneconomic
 - ✓ Some suggest that contracts are not a good idea because of long-term problems.
 - Differences
 - ✓ Must assess the credit quality of the off-taker
 - ✓ Small risks become large in transaction with many contracts
 - ✓ Heat rate degradation
 - ✓ Plant availability
 - ✓ Contract penalties
 - ✓ Interest rate changes



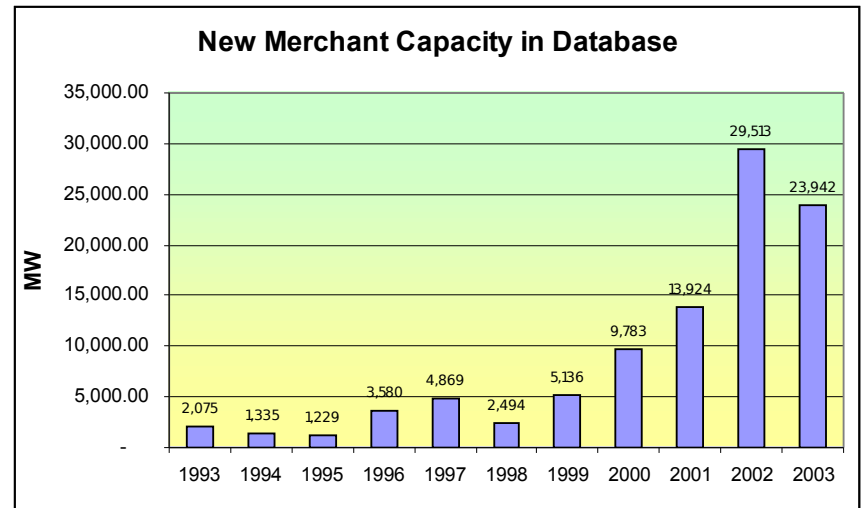
Revenue and Market Risk

- Market Risk involves forward prices and volumes. Examples:
 - Demand ceases
 - Sales are lost due to quality problems in producing output
 - Contracts can be canceled exposing a project to market prices
 - A project may not have contracts and be dependent on commodity prices



Merchant Plant Activity

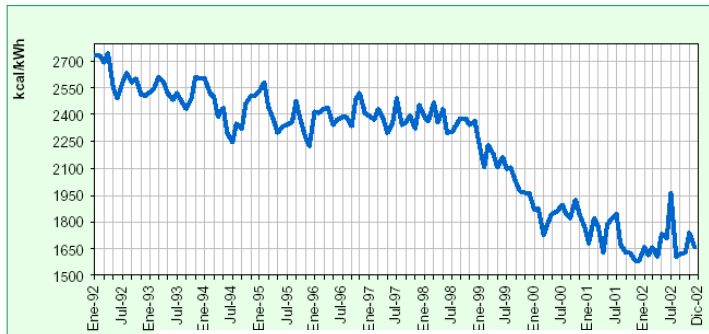
- “...in the US, private companies that own merchant plants have lost of more than \$100 billion in market capitalization.”
- Banks are “now highly reluctant to take merchant risk of any kind... and they are skeptical about long-term purchase or tolling contracts that in any way are considered to be out of the money.”
- “Merchants will have to redesign their business models. Those players that have 80-90 percent of their capital in the form of debt won't survive. The ratings agencies have said that such debt-to-capital ratios must be in the 50-50 range to earn investment grade status so that the cost of borrowing is reasonable.”
- The merchant plant activity has been very high.



Argentina Example of Merchant Problems

- In Argentina, plant efficiency, over-capacity and increased hydro generation caused financial problems with projects.

Evolución Histórica de los Consumos Específicos
 Historical Heat Rate Evolution
 Evolução Histórica dos Consumos Específicos

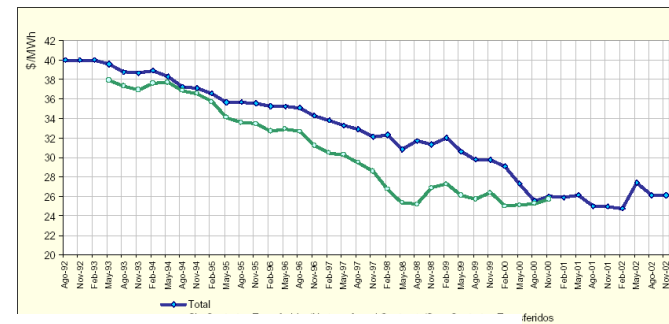


Potencia Instalada por Tipo y Región (MW)
 Installed Capacity per Type and Zone
 Potência Instalada por Tipo e Região

AREA	TV	TG	CC	DI	TER	UN	HID	TOTAL	DEM dia Máx
CUY	120	90	374	0	584	0	788	1372	739
COM	0	578	742	0	1320	0	4485	5805	544
NOA	261	323	829	4	1417	0	180	1597	954
CEN	227	297	64	0	588	648	914	2150	1039
GBA	2110	255	3409	0	5774	0	0	5774	5855
BAS	1530	316	845	0	2691	357	0	3048	1508
LIT	242	40	0	0	282	0	945	1227	1558
NEA	25	123	0	0	148	0	1710	1858	505
MEM	4515	2022	6263	4	12804	1005	9022	22831	12703
MEMSP	0	196	63	0	259	0	519	778	649(*)

Potencia Instalada= Potencia Efectiva de Agentes Generadores y Cogeneradores
 (*): Demanda Máxima SIP= 827 MW

Precio Estimado Medio Monómico de Contratos Distribuidores y Gumas
 Estimated Mean Monomial Contract Prices for Distributors and Major Large Users
 Preço Estimado Médio Monômico de Contratos Distribuidores e Gumas



Argentina Example – AES Panera

- Combined Cycle Plant (830 MW)
- Sponsors: AES and CEA; Plant Cost \$448 Million
- Financing
 - Equity \$154 Million: 34%
 - IDB – A Loan \$ 66 Million: 15%; 14.5 Year
 - IDB – B Loan \$ 66 Million: 15%; 12.5 Year
 - JEXM Direct \$ 81 Million: 19%
 - JEXM Comml \$ 81 Million: 19%
- No long-term Contracts
- Plant Operation – 1999
 - High DSCR's – 2.31 in first 5 years
 - Trapped Cash
 - Cash Sweep Mechanisms
 - Forward Looking Financial Ratios
 - 12 Month Debt Service Reserve



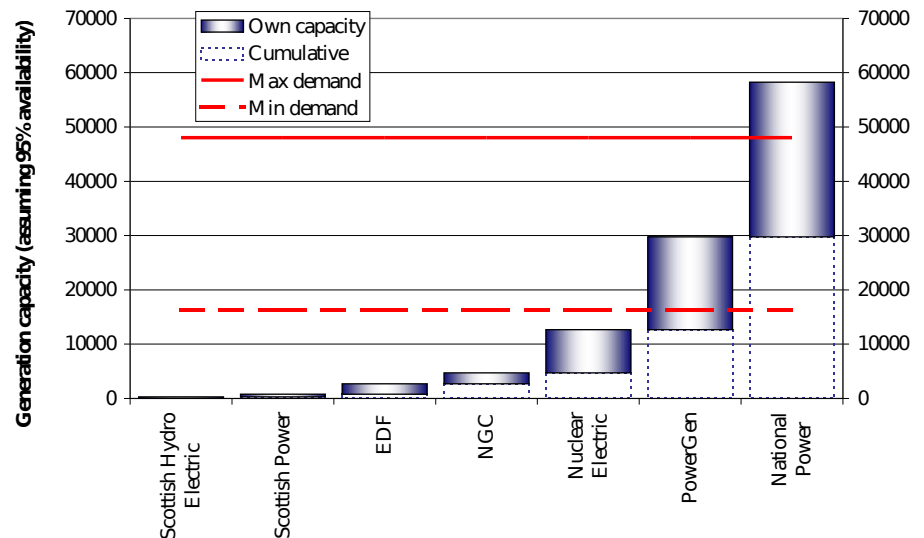
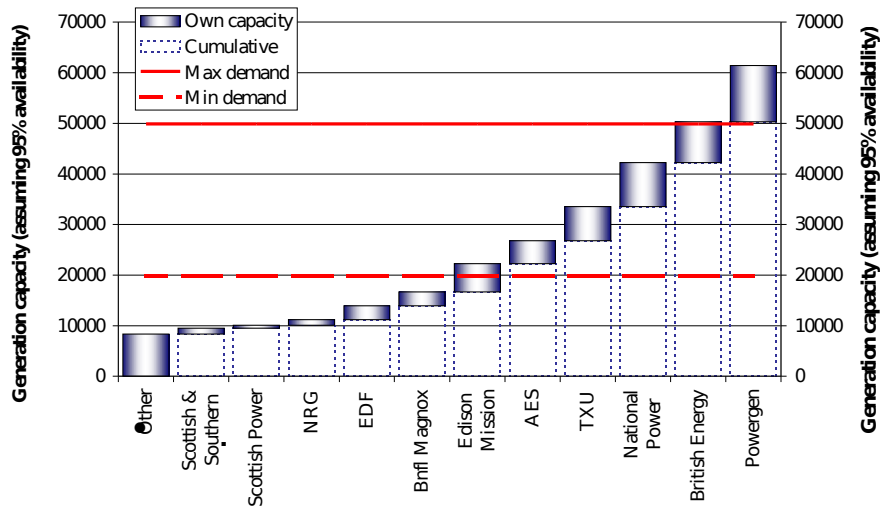
Commodity Prices Merchant Electricity Plant Financing in UK

- Before Financial Meltdown
 - Leverage -- 75-80%
 - Debt tenor -- 20 years
 - Credit spread -- 150-200 basis points
 - Equity IRR – 13%-15%
- After Meltdown
 - Leverage 50%
 - Debt tenor 10 Years
 - Credit spread 250 basis points
 - Equity IRR – 16%

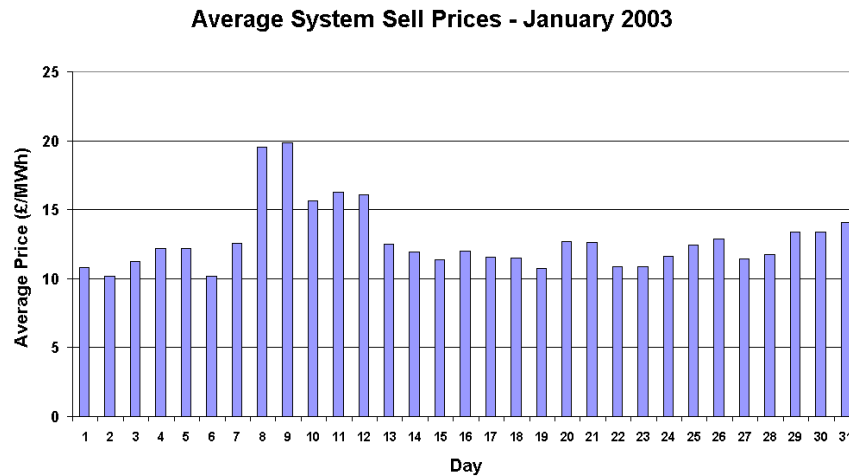
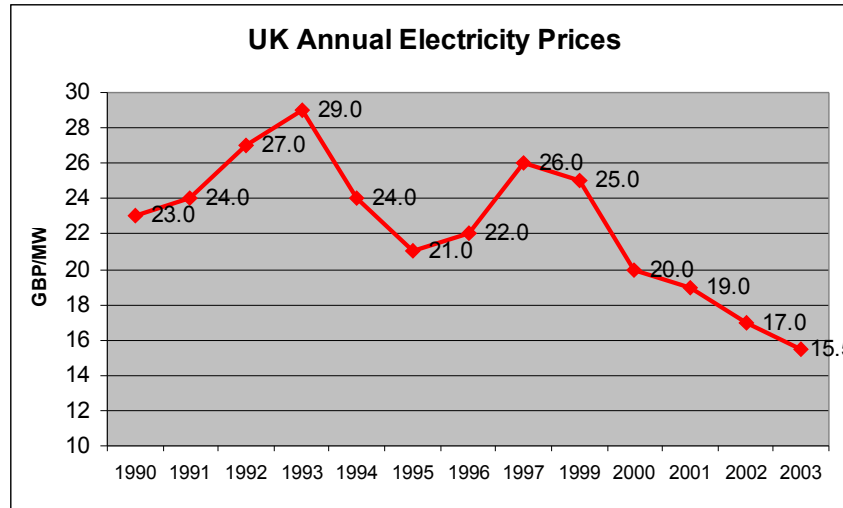


Market Concentration in UK 1990 and 2000

- The problems for banks exposed the sector boil down to one thing: overcapacity. There is calculated to be roughly 22% overcapacity and it is therefore not surprising that prices have slumped so spectacularly. Prices are now around 17 to 18 per MWH, down 40% from levels prior to NETA's introduction.
- The atomisation of the generation sector was a function of new entrants and forced sales and pricing power was lost before NETA was introduced.



Electricity Prices



Comparison of Construction Costs and Financing

Count	Parent Company	Project Name/ Regio	Commercial Operation as MPP	MW	Project Typ	Project Co	Cost per M	Arrangers /Lender	Debt Rat
UK	AES	Barry	1998	220	Greenfield	\$ 225.00	\$ 1.023	IBJ	90.0%
UK	PowerGen	Connah's Quay Power Sta	1996	1420	Greenfield				
UK	PowerGen, ESBI	Corby	1994	400	Greenfield				
UK	InterGen	Coryton	2002	795	Greenfield	\$ 465.80	\$ 0.586	CSFB, SG,	70.0%
UK	PowerGen, Siemens	Cottam Development Cent	1999	400	Greenfield				
UK	Entergy	Damhead Creek	2000	800	Greenfield	\$ 563.00	\$ 0.704	WDR/UBS	
UK	Innogy	Didcot-B	1997	1400	Greenfield				
UK	NRG Energy, El Paso	Enfield	1999	396	Greenfield	\$ 353.23	\$ 0.892		
UK	Centrica	Glanford Brigg	2002	240	Acquisition				
UK	BP-Amoco, Arco	Great Yarmouth	2001	400		\$ 367.65	\$ 0.919	SG, ABN A	87.5%
UK	Octagon Energy	Hickleton Power Plant	2000	6	Greenfield	\$ 3.79	\$ 0.631		
UK	NRG Energy	Killingholme	1999	665	Acquisition	\$ 664.00	\$ 0.998	Bank of Arr	65.0%
UK	Centrica	King's Lynn	2001	705	Acquisition				
UK	Scottish and Southern Energy	Peterhead Power Station	2000	660	Restructured	\$ 333.33	\$ 0.505		
UK	InterGen	Rocksavage	1998	780	Greenfield	\$ 575.00	\$ 0.737	CSFB	
UK	Centrica	Rooscote	2003	229	Acquisition	\$ 37.50	\$ 0.164		
UK	Calpine	Saltend	2001	1200	Acquisition	\$ 800.00	\$ 0.667	WDR	90.0%
UK	Scottish and Southern Energy	Seabank	2001	760	Greenfield	\$ 641.18	\$ 0.844		
UK	Scottish Power	Shoreham	1999	400	Restructured	\$ 320.00	\$ 0.800		93.5%
UK	Centrica, Humber Power	Stallingborough Plant	1999	1260	Greenfield				
UK	London Power Co.	Sutton Bridge	2000	790	Greenfield	\$ 793.00	\$ 0.695	Merryl Lynd	87.2%
UK	Enron	Teesside	1993	1875	Greenfield	\$ 1,200.00	\$ 0.640		



Commodity Prices and Cyclicalty

- Commodity price risk exhibits, to different degrees, cyclicalty, seasonality, and volatility.
 - Some industries, such as pulp and paper, petroleum, and mining, may see pricing depressed for several years at a time, only to be followed by several years of high prices.
 - Demonstrate an ability to weather low cycles that will inevitably impose themselves on the project through the term of the debt.
 - "Back cast" analysis that considers how low commodity prices have been over the past 10 to 20 years may be helpful.

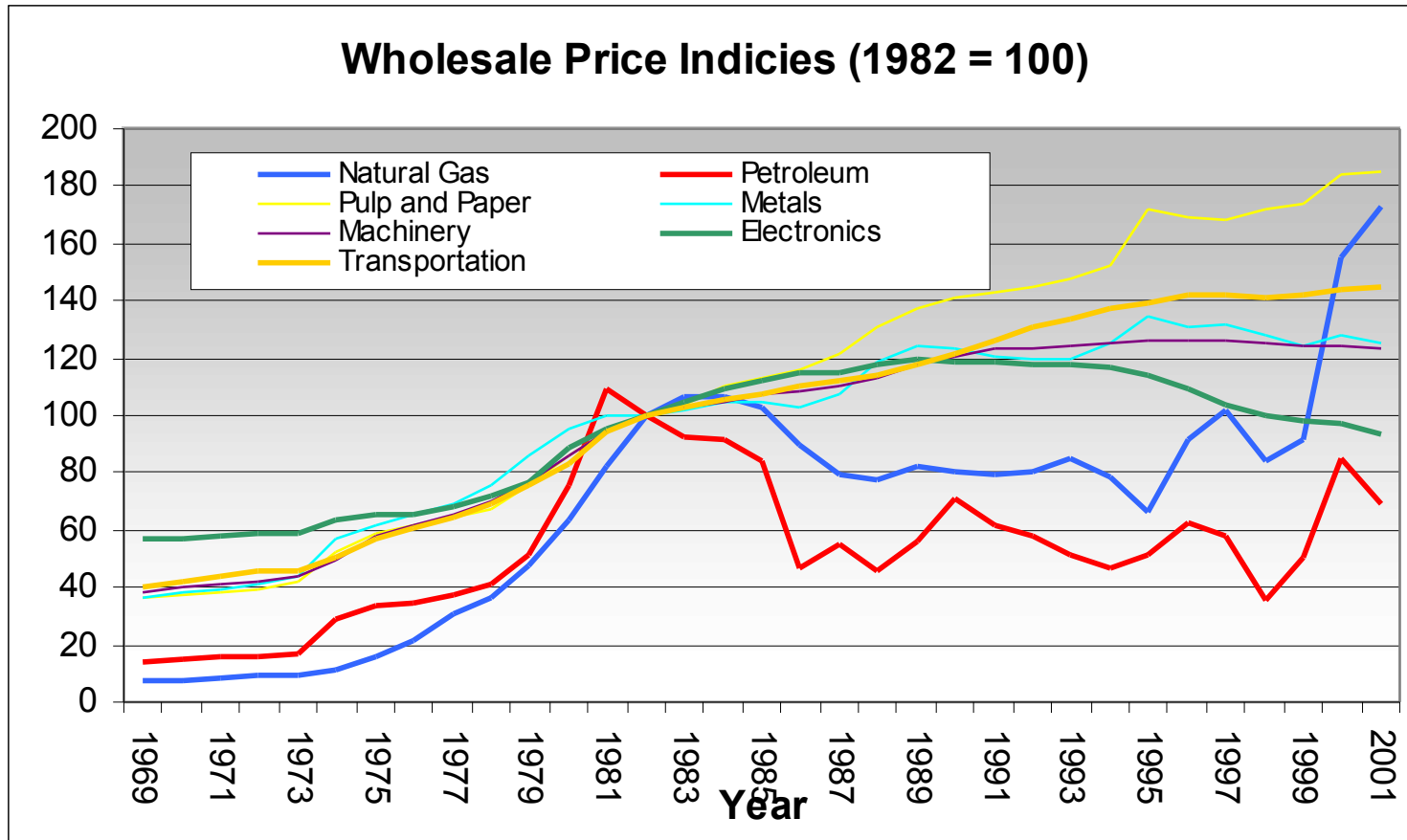


Commodity Price Risk

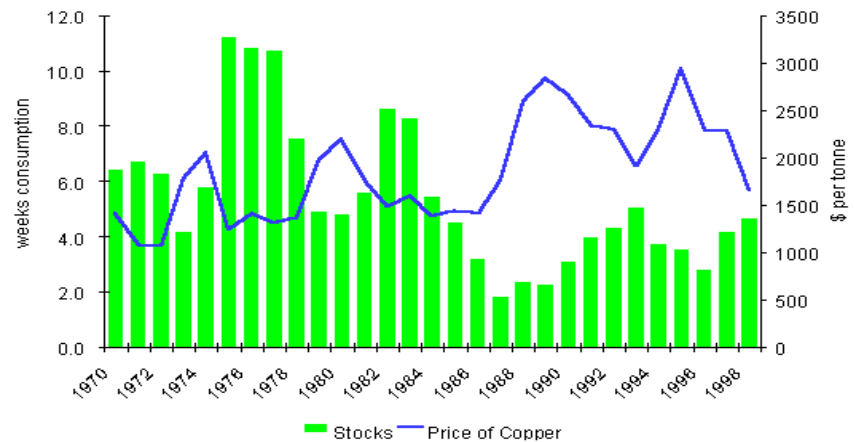
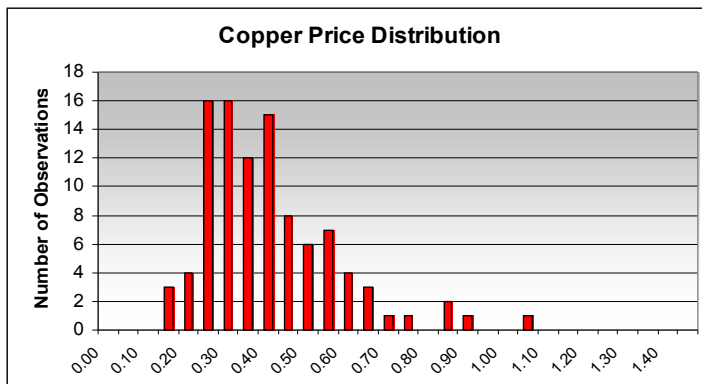
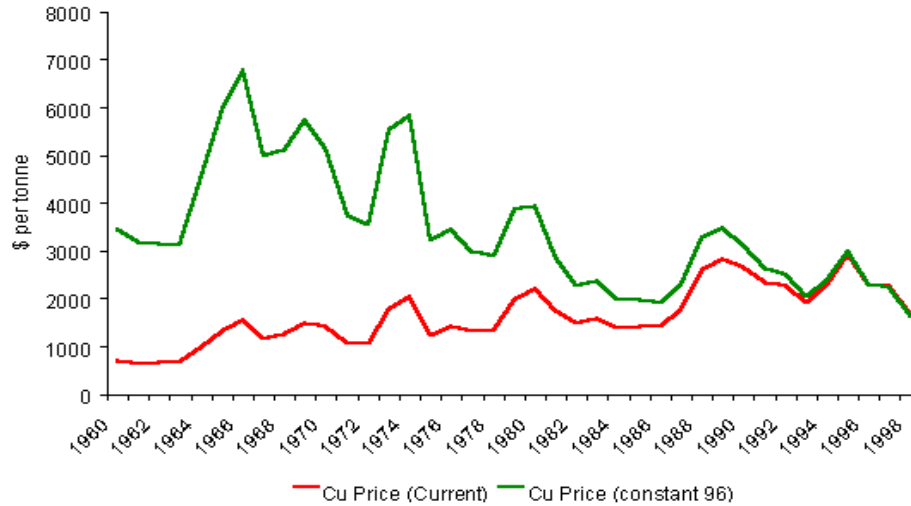
- Projects expose lenders to commodity price risk when the value of project product or the cost of a major input is determined by international commodity markets.
- Commodity price risk is increasing as fewer buyers are willing to execute long-term, fixed price contracts for products or services.
- As a result, commodity pricing dominates unhedged project risk. Commodity price risk can also affect a project's credit strength if a competing commodity sees a price decrease, which causes a subsequent drop in demand for the project's output.
 - High electricity prices, in the face of declining natural gas prices, for instance, will eventually cause consumers to switch to natural gas for heating and cooking.



Volatility and Trends in Different Prices



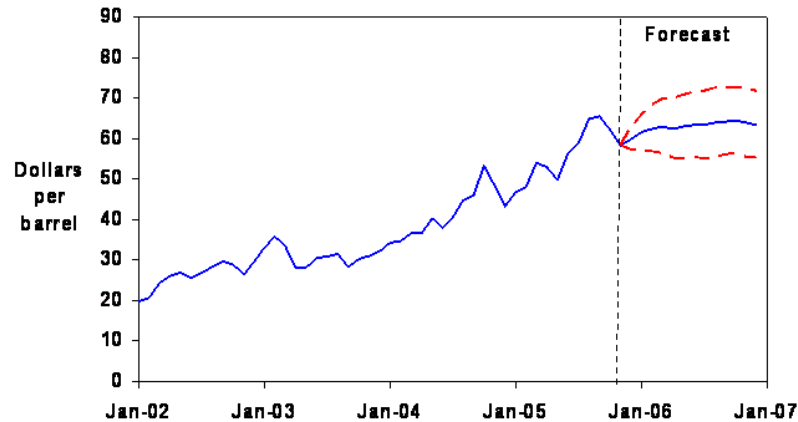
Real Copper Prices – Declining Trend and Volatility



Oil Price

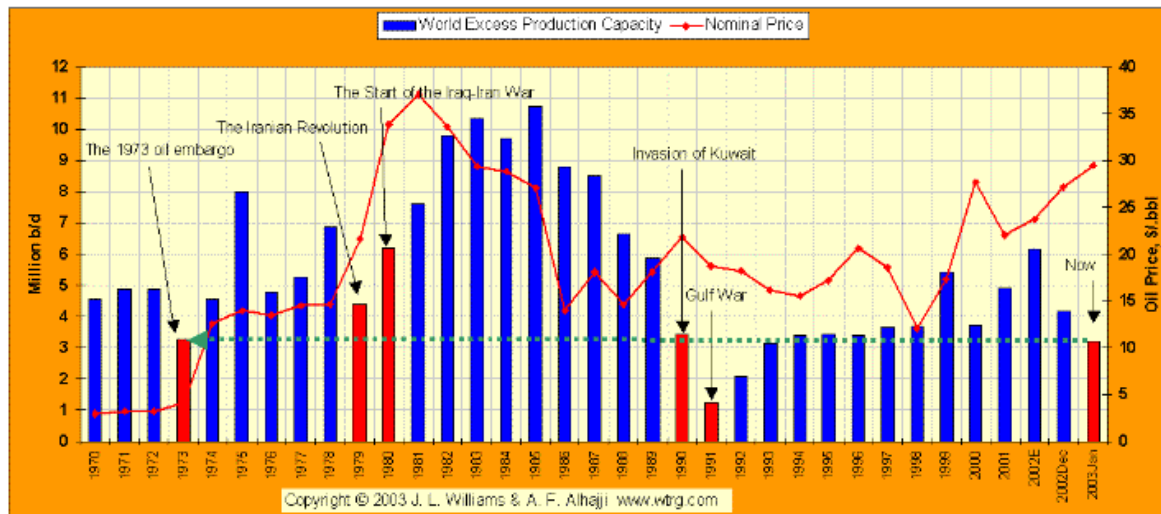
See the retrieve price file to acquire various prices

Figure 1. West Texas Intermediate Crude Oil Price (Base Case and 95% Confidence Interval*)



*The confidence intervals show +/- 2 standard errors based on the properties of the model.

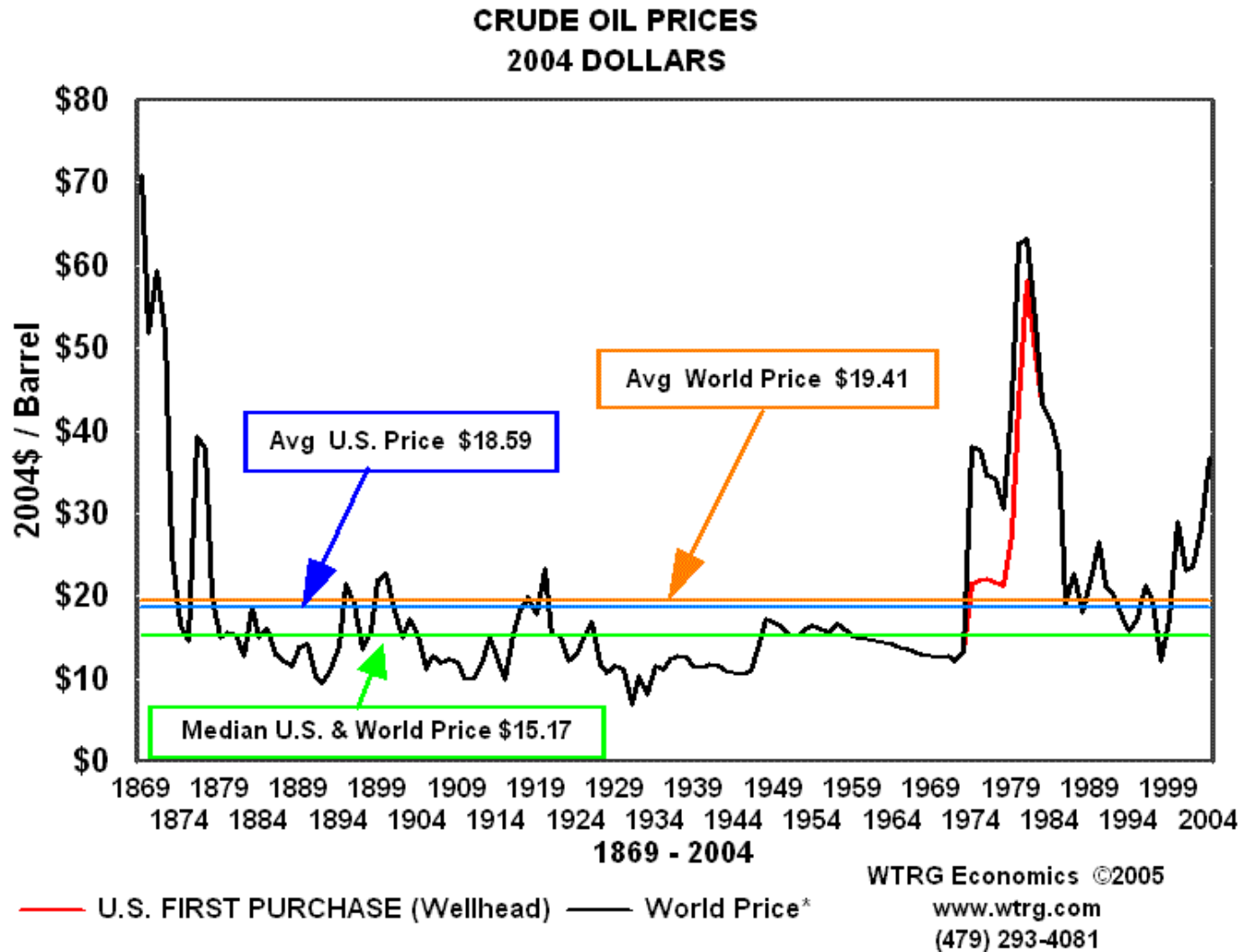
Short-Term Energy Outlook, December 2005



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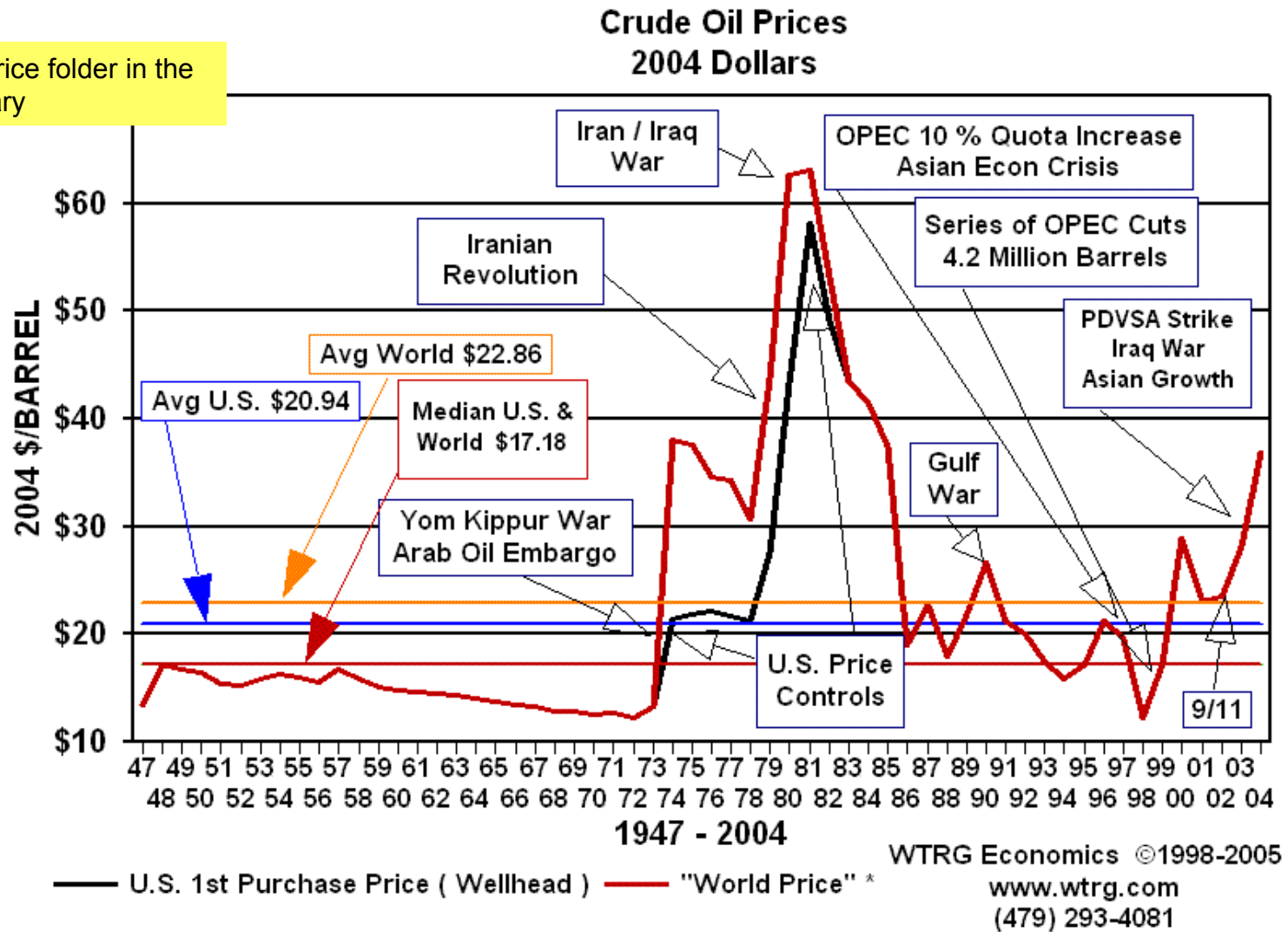


Oil Price Long-Run Prices

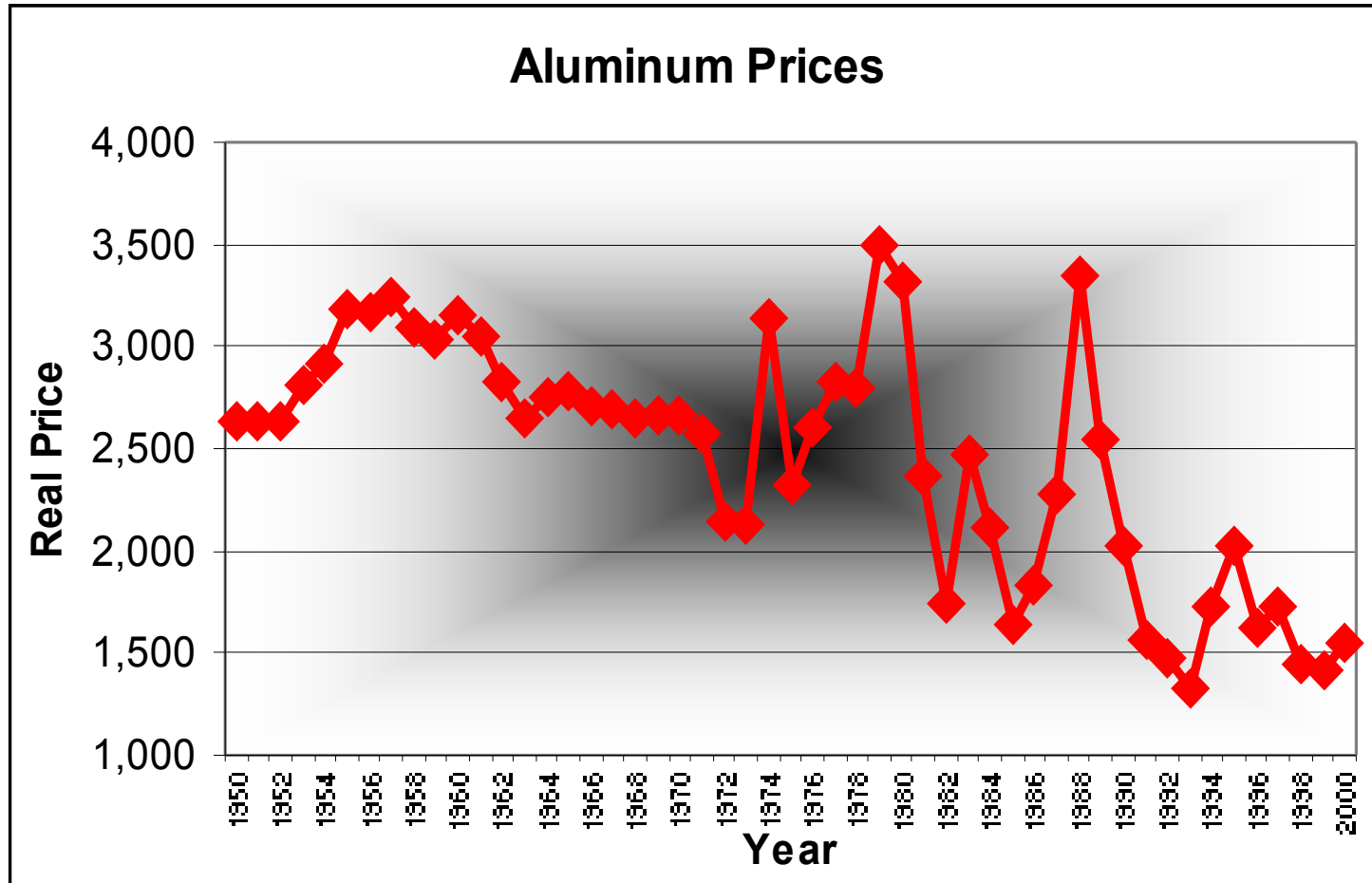


Oil Price History

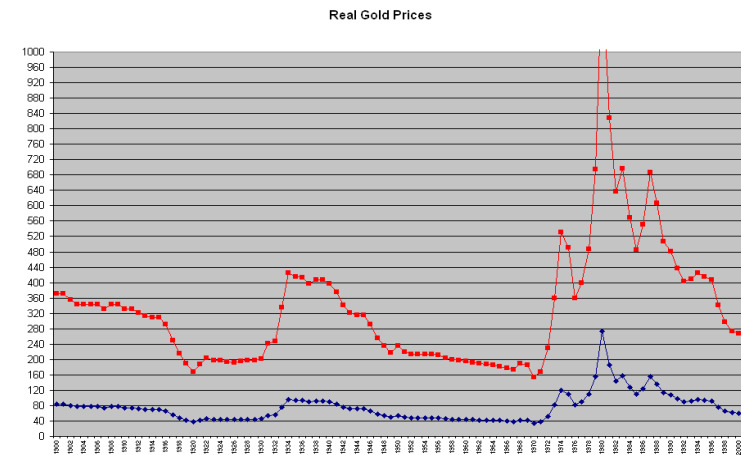
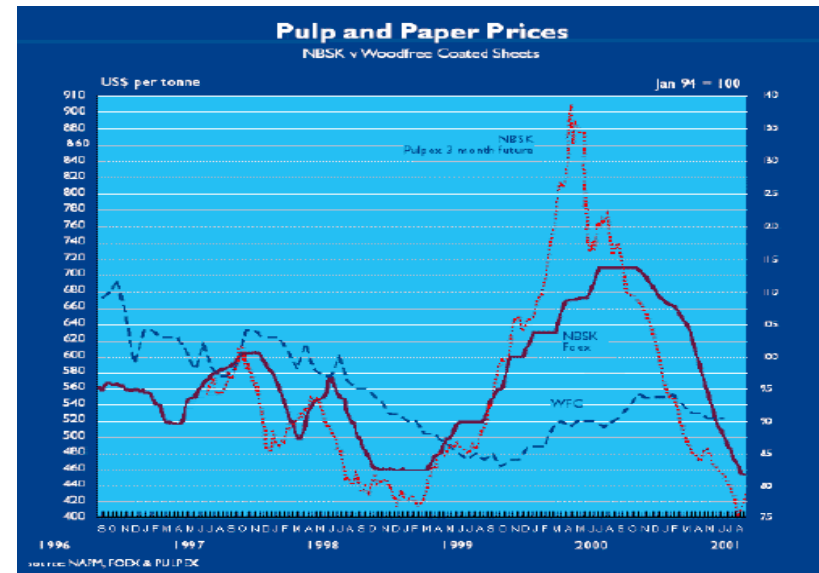
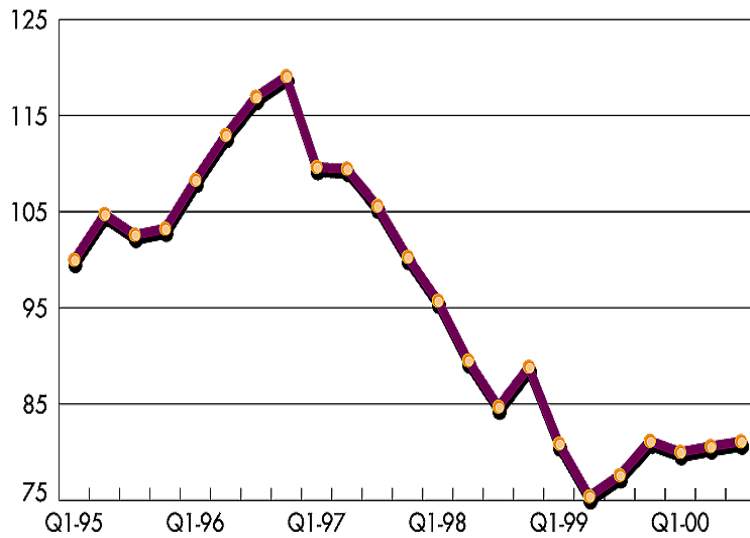
See the oil price folder in the financial library



Real Aluminum Prices – Declining Trend and Mean Reversion

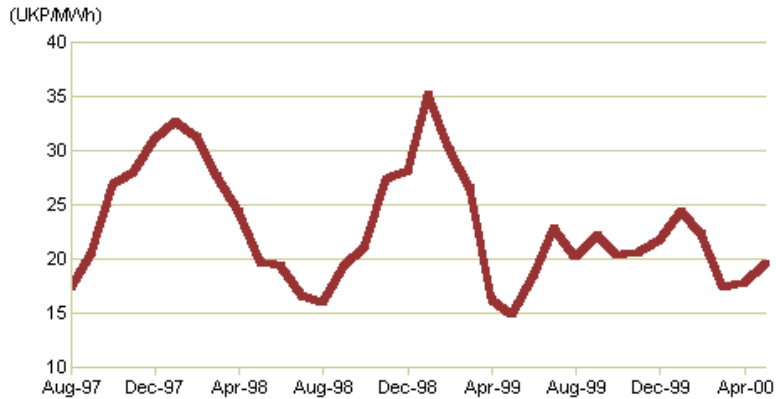


Computer Wafer, Paper and Gold Prices



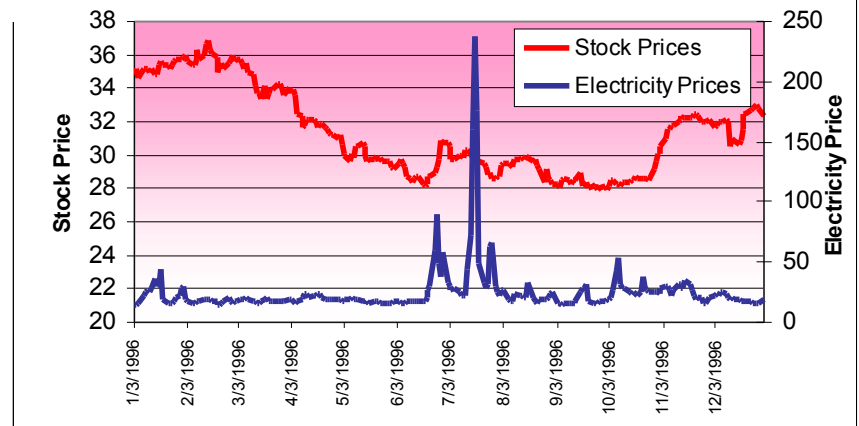
Electricity Prices and Stock Prices – Mean Reversion

Chart 4
U.K. System Marginal Electricity Prices

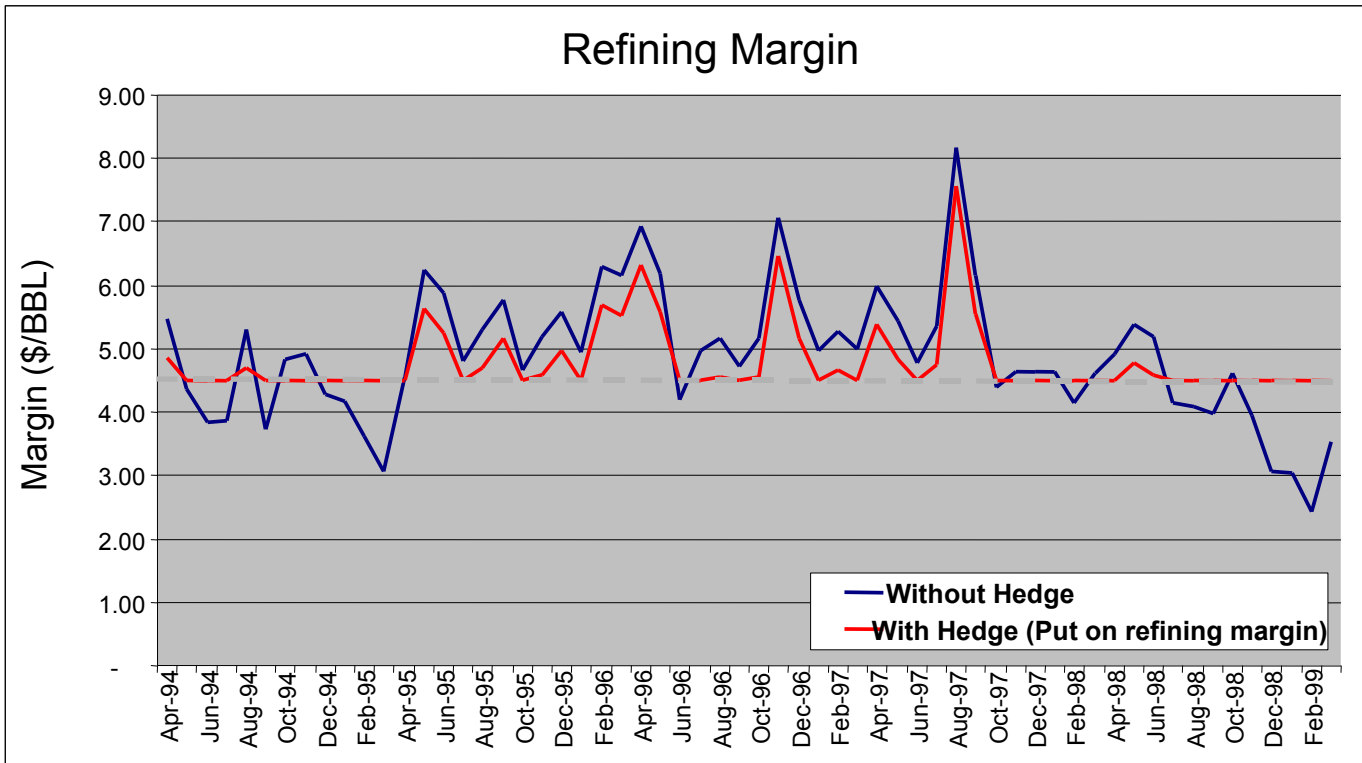


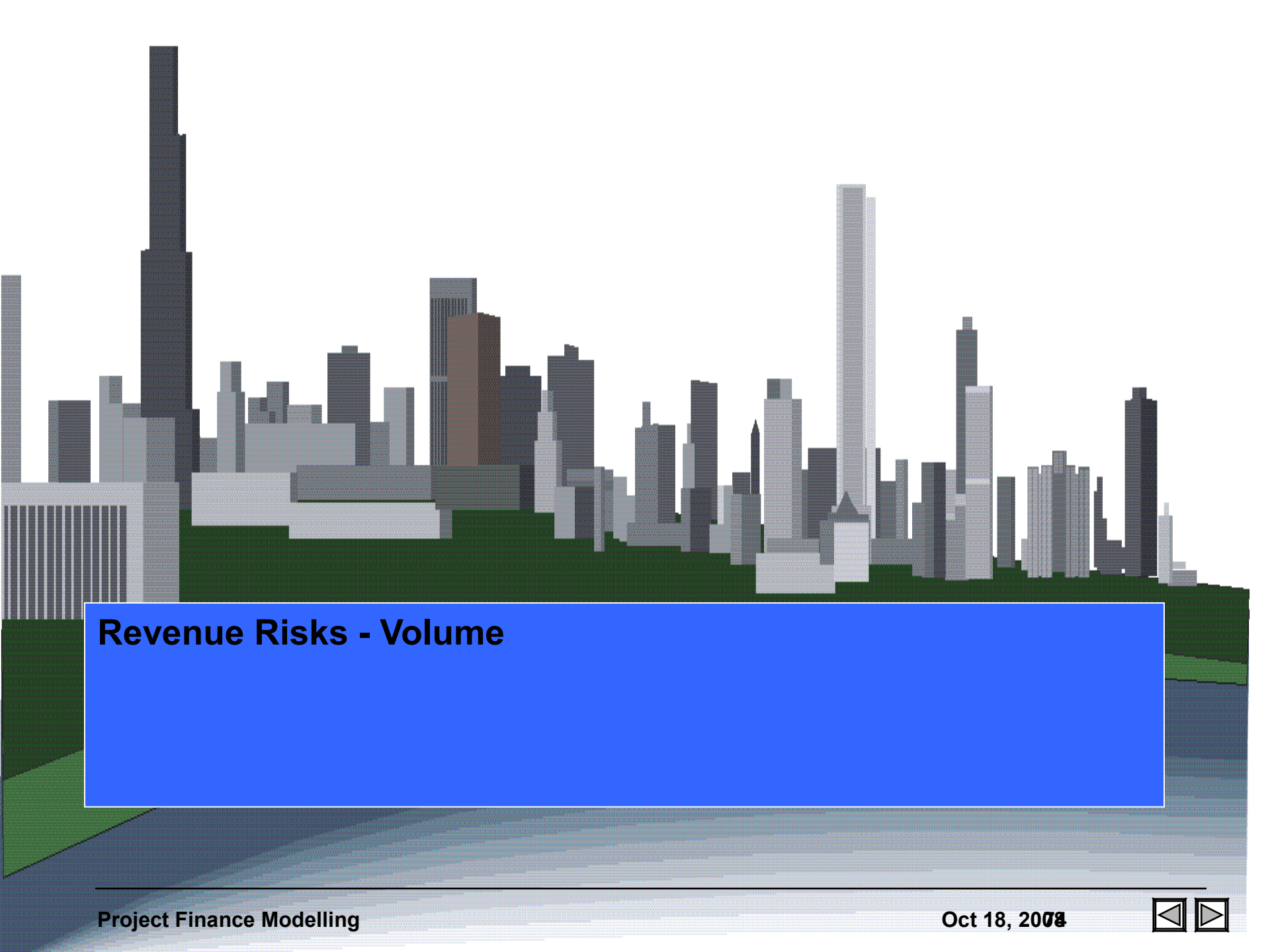
Source: Statistical Digest

Daily Stock Prices and Electricity Prices



Refining Margins





Revenue Risks - Volume

Volume Risk in Tollways – Traffic Studies

- Independent studies are used to measure expected and minimum throughput for tollway, port, railway, or other land transportation project.
- Issues to be evaluated include:
 - The monopoly position
 - competing roads, railways etc
- Projects holding concessions for the provision of basic services such as water, toll roads, airports and other transport services will have to provide services at fees competitive to other alternatives.
- That expensive tolls for bridges and roads have the effect of diverting traffic to more time-consuming, but cheaper alternative routes, illustrates this risk.



Volume and Interest Rate Risk -- Mexico Tollways

- Project Cost: \$2.4 billion; Sponsor: Government of Mexico
- An unsuccessful toll road program, with government having to bail out the concessionaires and in effect re-nationalize the roads.
- Between 1989 and 1994 the government awarded 52 concessions to build 5,500 km of private toll roads at combined cost of \$13 billion, or roughly 5% of GDP. But the ambitious program was soon shown to be a failure. The private sponsors had little choice but to finance them with expensive short-term floating-rate debt that led to some of the world's highest tolls. The Mexico City-Acapulco road, for example, cost the peso equivalent of 30 cents a mile, or more than ten times the cost of the New Jersey Turnpike in the U.S.
- The high prices left traffic volumes far short of projections, especially since Mexican law required free alternative roads be available next to each new toll road. With low revenues and 26% cost overruns, the three main operators soon ran into trouble meeting their debt obligations, then saw the situation grow worse with the December 1994 peso crisis that caused local interest rates to rise to more than 100% a year. The August 1997 restructuring program bailed out the 23 most troubled concessions, with the government agreeing to take over operations, reduce tolls by 15% for cars and 30% for trucks, and issue new bonds to cover the operators' remaining debt obligations.



Volume Risk - Risk that Production Cannot be Maintained

- Capacity must be turned into volume and if volumes cannot be produced significant problems occur:
- Examples:
 - Electricity
 - ✓ Forced outage rates
 - ✓ Scheduled Maintenance
 - Resources (Oil, Gas and Mining)
 - ✓ Rule of thumb for proven reserve life needs to be more than twice the loan life and for petroleum
 - ✓ 150% of the loan life for other resources.
 - ✓ What is “proven” and producible required an independent reserve report.



Productivity Risk

- Another threat to a project may be the development and entry of new technologies that radically change the industry structure and the basis for competition and sustainability. While it has always been difficult to predict the next successful technology in any industry, the potential for new technologies to disrupt traditional industries may be greater in some sectors than others.
 - For instance, the development of wireless technology over the past 10 years has transformed the global telecommunications industry.



Technical/Construction Risk (Reference)

- Technical risk is pervasive during both pre- and post construction phases, while *the possibility of sponsors coming to the aid of a troubled project is elusive.* Moreover, many lenders do not adequately evaluate the risk when making investment decisions.
- The engineering and design review focuses on
 - the suitability of the choice of technology and design for the project's requirements.
 - whether the construction contractor can successfully translate the design into a well operating project on time and within budget.



Example of Technical Obsolescence – Iridium

- Feasibility Studies based on incorrect assumptions
 - \$880 million bridge financing
 - 66 Low earth orbiting satellites
 - International charges \$4-7 per minute
 - Handsets cost \$3,000 each
- Subscribers did not materialize
- Problems with satellites



Cost Risk – Standard and Poor’s (Reference)

- Cost risks apply to labor and materials inputs, productivity, and operating expenses (“Opex”)
- Cost risk includes the effect of inflation.
- Typical cash flows will show 7-10 key items of costs with the remaining cost categories usually amounting to only 5-10% of Opex
- An adequate O&M budget and major maintenance funding commensurate with the technology are mandatory. Standard & Poor's expects that O&M plans for new technologies or significantly scaled-up versions of proven technologies provide additional contingency for unexpected operating results. The budget estimates must be based on a detailed schedule of plant maintenance and planned overhauls.



Cost of Production

- Whether a contract exists or not, the position of the project in terms of cost of production relative to all the other producers of the given product is important.
- Generally, a project in the lower half or lower third of the cost curve (sorted costs of other producers) is adequate.

A project's competitive position relative to its peer group is a principal credit determinant. Given that most projects produce a commodity, such as electricity, ore, oil or gas, or some form of transport, low-cost production relative to the market is essential for an investment-grade rating.

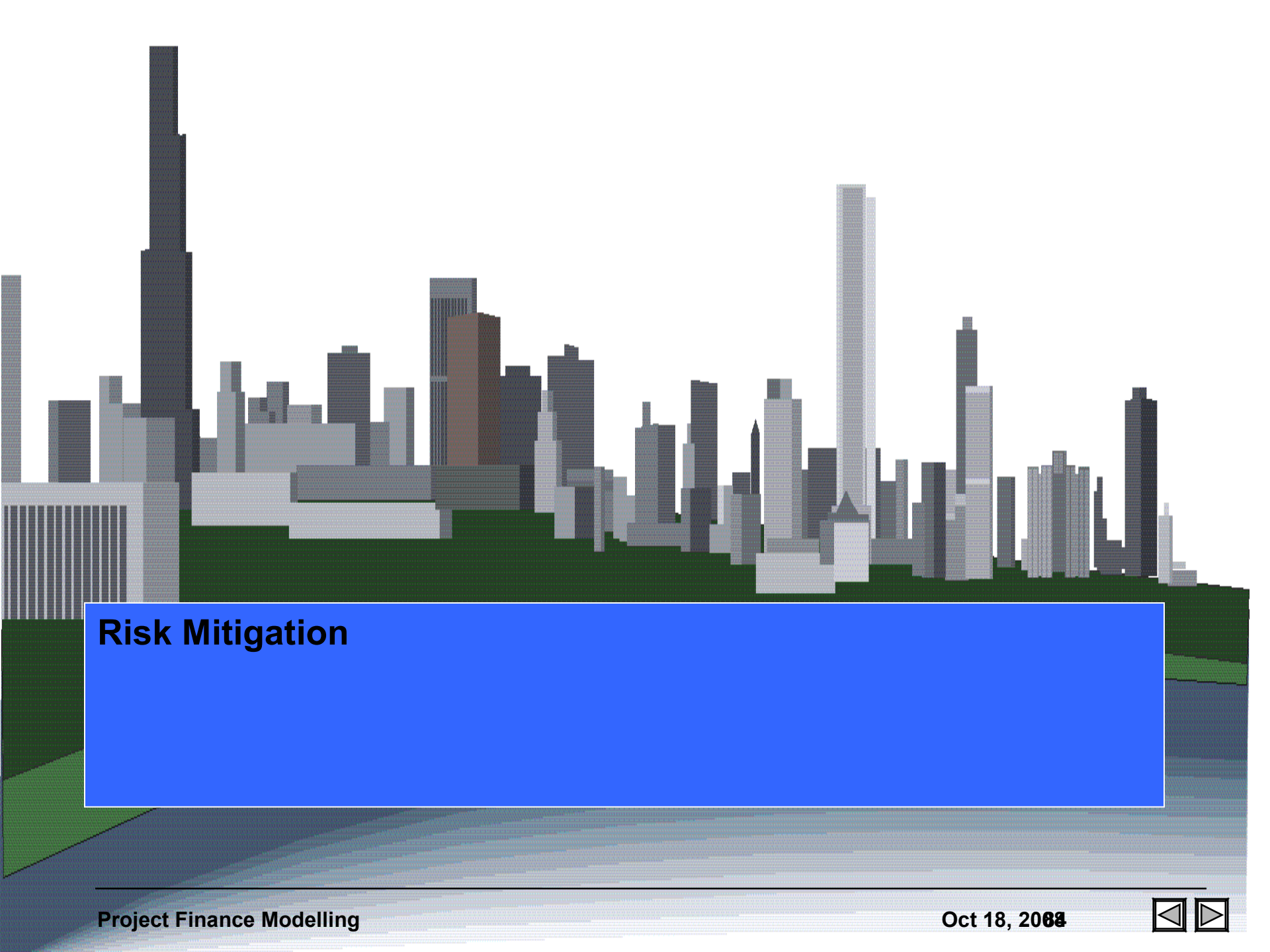
High costs relative to an average market price, absent mitigating circumstances, will almost always place lenders at risk. To the extent that a project can "decommoditize" its product and obtain higher pricing, either through locational advantages, contractual agreements, or by differentiation in service and quality, it may achieve a higher rating, all else being equal.



Raw Material Risk

- Because projects are, by definition, generally single site, limited product businesses, they are potentially at greater risk than a less restricted corporation.
- Most projects take a single raw material and convert it to a single, higher value-added product; hence, the supplier may be critical to a buyer's business.
- The cost of the input usually drives the project's competitiveness.
- If only a few firms dominate the supply of a critical factor of production relative to the number of potential customers, a project, absent mitigating factors, could be at higher risk because the supplier is in a better position to dictate terms of sale.
- Projects that rely on fixed and dedicated transportation systems, such as pipelines or rail lines, to deliver necessary inputs, may have few substitutes available.





Risk Mitigation

Risk Mitigation and Checklist

- This section discusses mitigation of risk in a similar order as the discussion of project risks above:
 - Mitigation of construction risk with EPC contracts and Insurance
 - Mitigation of revenue and operating cost risk with contracts
 - Mitigation of market risks through hedging and other techniques
- In analyzing risks, a technique often used is to list the risk category, the specific risks of the project in each category and the mitigation of the risks.
 - Funders' approach is that risks should be allocated to those best able to bear them, e.g.:
 - ✓ Authority
 - ✓ Sub-contractors (construction / FM)
 - ✓ Insurance
 - ✓ Project company's investors
 - ✓ And last of all to the funders



Risk Checklist

- The checklist in the adjacent table illustrates the notion of analyzing different risks and then mitigate the risk

Exhibit 1.1: Checklist for a successful project financing

	Yes	No	Not applicable
1. A credit risk rather than an equity risk is involved.			
2. A satisfactory feasibility study and financial plan have been prepared.			
3. The cost of product or raw material to be used by the project is assured.			
4. A supply of energy at reasonable cost has been assured.			
5. A market exists for the product, commodity, or service to be produced.			
6. Transportation is available at a reasonable cost to move the product to the market.			
7. Adequate communications are available.			
8. Building materials are available at the costs contemplated.			
9. The contractor is experienced and reliable.			
10. The operator is experienced and reliable.			
11. Management personnel are experienced and reliable.			
12. New technology is not involved.			
13. The contractual agreement among joint venture partners, if any, is satisfactory.			
14. A stable and friendly political environment exists; licences and permits are available; contracts can be enforced; legal remedies exist.			
15. There is no risk of expropriation.			
16. Country risk is satisfactory.			
17. Sovereign risk is satisfactory.			
18. Currency and foreign exchange risks have been addressed.			
19. The key promoters have made an adequate equity contribution.			
20. The project has value as collateral.			
21. Satisfactory appraisals of resources and assets have been obtained.			
22. Adequate insurance coverage is contemplated.			
23. Force majeure risk has been addressed.			
24. Cost over-run risk has been addressed.			
25. Delay risk has been considered.			
26. The project will have an adequate ROE, ROI and ROA for the investor.			
27. Inflation rate projections are realistic.			
28. Interest rate projections are realistic.			
29. Environmental risks are manageable.			
30. Compliance with US Foreign Corrupt Practice Act of 1977 (FCPA).			
31. Protection from criminal activities such as kidnapping and extortion.			
32. A commercial legal system protecting property and contractual rights.			



S&P Risk Checklist

1. Evaluate project contracts that, along with the project's physical plant, serve as the basis of the project enterprise;
2. Assess the technology and performance of the project enterprise;
3. Analyze the competitive position of the project;
4. Determine the risk that counterparties present to the project enterprise;
5. Appraise the project's legal structure; and
6. Evaluate the financial risks that may affect forecast results.



General Discussion Risk Management (Reference)

- The essence of risk management lies in maximizing the areas where we have some control over the outcome and minimizing the areas where we have absolutely no control over the outcome.
- Risk managers must be thoroughly familiar with a variety of financial markets, with the intricacies of the trading process, and with financial and statistical modeling.
- Risk management integrates fixed-income markets, currency markets, equity and commodity markets. In each of these, financial instruments must be decomposed into fundamental building blocks, then reassembled for risk measurement purposes.
- Philippe Jorion, “Value at Risk”



Project Finance and Risk Management

- One of the principal advantages of project finance often cited is that a project finance structure allocates risk to parties willing to accept and manage the risk.
- This notion is not that risk transfer can somehow reduce risk by itself. Rather, if risks are transferred to parties who can control risk then operating efficiency will be improved.
 - For example, if revenue, cost and debt contracts are associated with an investment, risks of construction cost over-runs can be transferred to developers, operation and maintenance risks are transferred to contractors, price risk is transferred to an electric utility company and interest rate risk can be transferred to a bank.
 - The transfer of risk is beneficial to the extent that it improves incentives related to the basic economic drivers of plants - reduced capital expenditures, a better cost structure, more plant output, fewer maintenance outages and so forth.

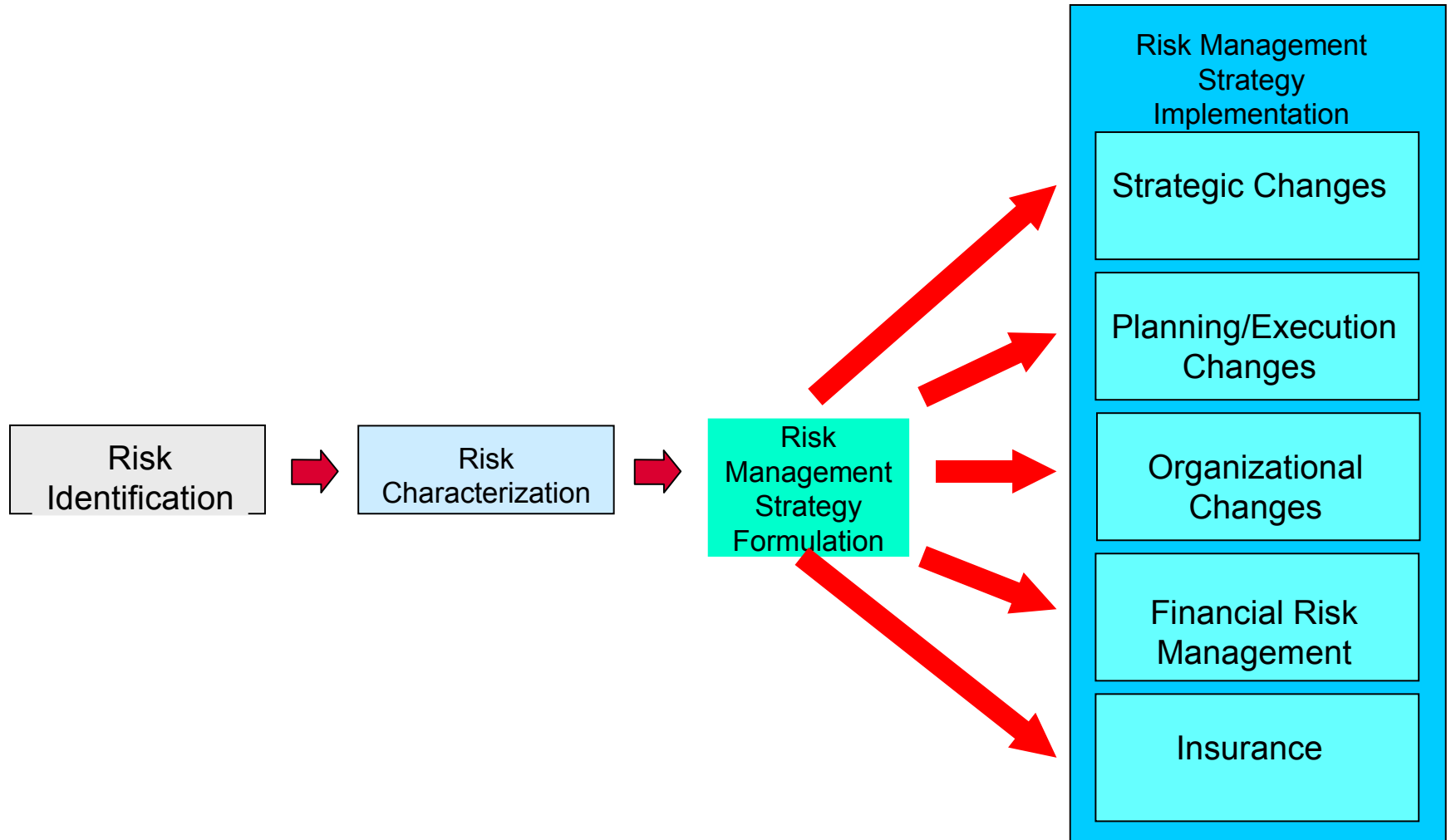


Project Finance and Allocation of Risk

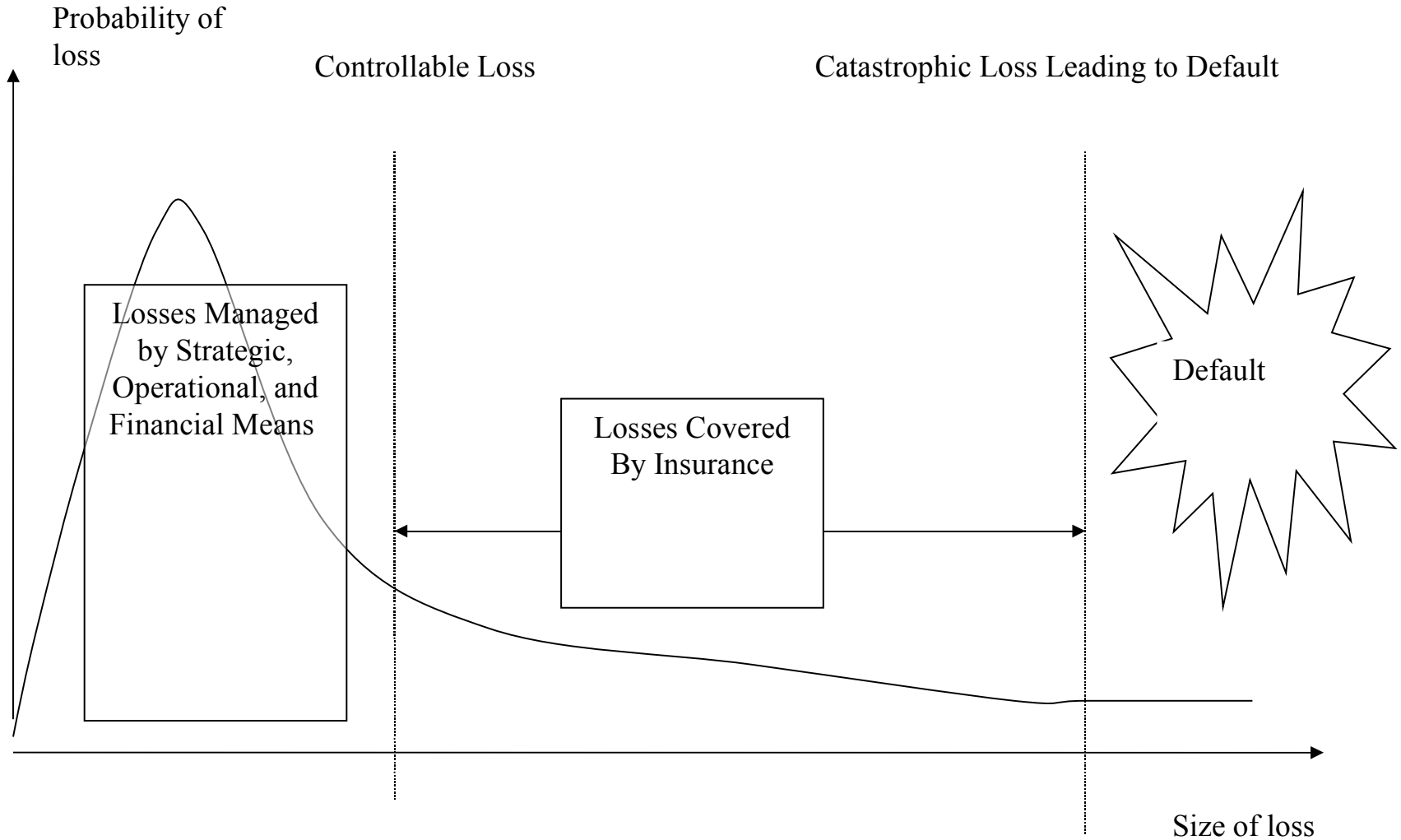
- Often, the risks associated with a project are so great that it would not be prudent for a single party to bear them alone. Project financing permits the sharing of operating and financing risks ...in a more flexible manner than general credit...
- Because of the contractual arrangements that provide credit support for borrowing, the project company may be able to achieve significantly higher financial leverage than the sponsor ... if it financed the project entirely on its own balance sheet.
- Other advantages include achieving economies of scale, reduced cost of capital, reduced cost of resolving financial distress and keeping a project off of a sponsor's balance sheet.



Risk Identification, Measurement and Mitigation



Insurance (Reference)



Interactions between risks and value chain processes (Reference)

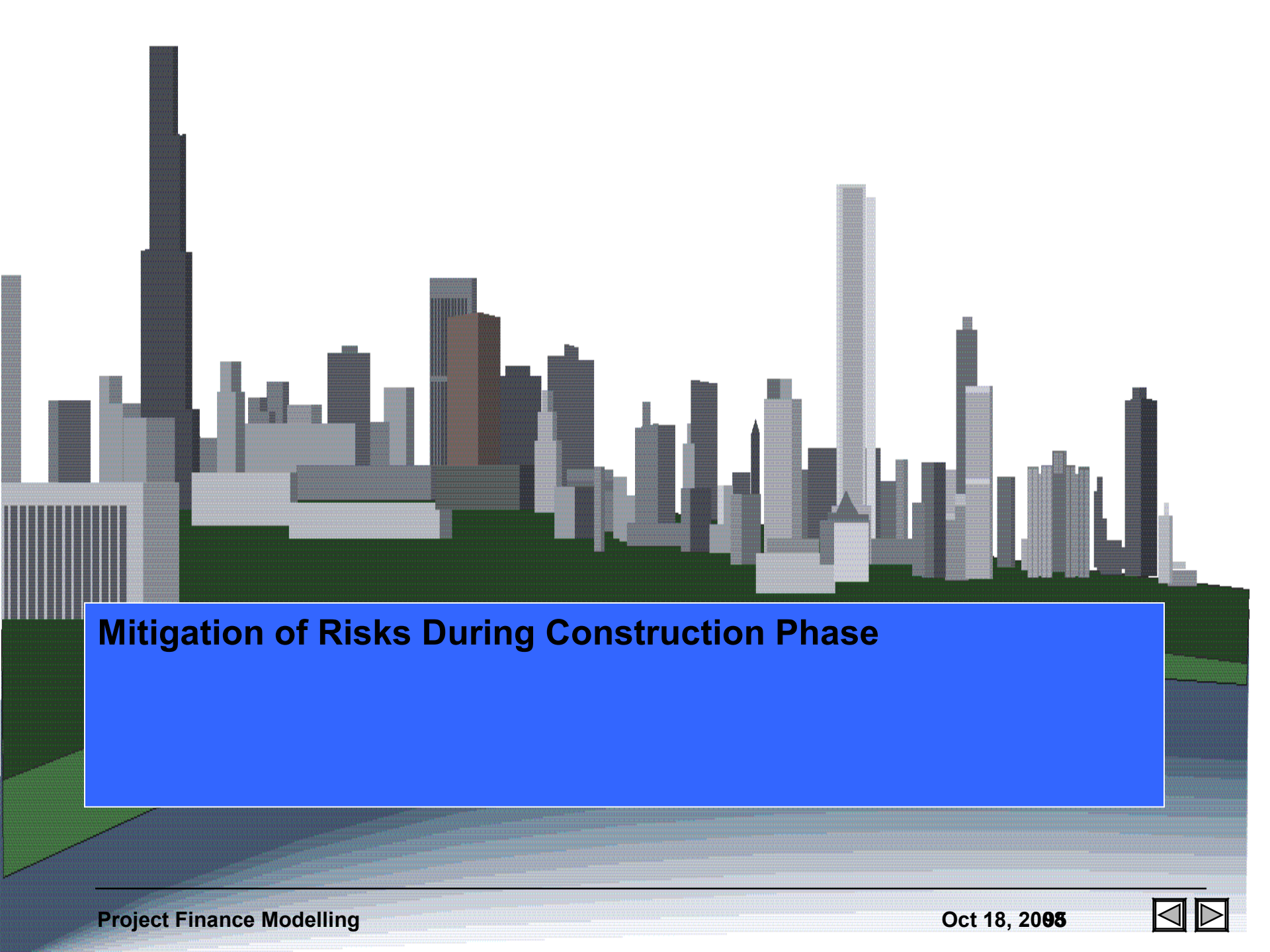
	Sourcing	Manufacturing	Marketing and Sales	Distribution and Logistics	Support
Quantity	- Component shortfalls impact production, hurting sales, and potentially damaging reputation for service and reliability.	- Poor capacity planning constrains production output. - Poor production planning result in production constraints or excess inventory.	- Poor demand forecasts result in either missed revenue opportunities, or excess inventory throughout the supply chain.	- Poor supply chain design and execution leads to excess inventory. - Poor inventory positioning prevents products from reaching customers, hurting revenue.	- Poor warranty forecasting leads to under stocking spare parts. This causes poor customer satisfaction and loss of market share.
Price	- Unexpected price volatility in procured components increases revenue and profit variability.	- Excess capacity increases production costs.	- Poor pricing decisions hurt market share, resulting in foregone profit margins, or excess inventory.	- Poor supply chain design and execution increase the need for expediting, thus increasing logistics costs.	- Poor support network design and execution increase expediting, causing higher logistics costs.
Quality and Serviceability	- Low-quality purchased parts impact manufacturing yields, hurting sales. Also affects customer satisfaction and reputation, and increase warranty and support costs. -Selecting suppliers with poor or erratic service affects production, reducing revenue and damaging reputation.	- Low yields can constrain production output, reducing revenue. -Poor quality affects customer satisfaction and reputation, and increases warranty and support costs. - Poor quality affects obsolescence, and creates obstacles for marketing and sales	-Certain sales processes work well for certain customer segments, but are too costly to address other segments. Revenue and profit decline.	- Poor supply chain design or execution results in poor serviceability, reducing customer satisfaction, and limiting ability to fulfill service models such as VMI and JIT.	- Poor quality of support execution affects customer satisfaction, damaging firm's reputation.



Examples of Strategic Risk Management (Reference)

	Leverage	Diversification	Hedging	Execution
Supply Chain Design	<ul style="list-style-type: none"> • Modify using changes in production technology • Modify by outsourcing production 	<ul style="list-style-type: none"> • Geographical diversification to reduce hazard risk • Political unit diversification to reduce political risk and tax risk • Geographical diversification to reduce labor price risk 	<ul style="list-style-type: none"> • Natural hedging of foreign exchange risk • Matching inbound and outbound supply chain capacity and flexibility • Matching supply chain capacity to marketing capability 	<ul style="list-style-type: none"> • Value Chain Restructuring • Alternative supply chain interactions • Supply chain designed to reduce cycle time and inventory • Supply chain simplification to reduce complexity risk
Strategic Sourcing Strategy	<ul style="list-style-type: none"> • Increase by selecting vendors requiring capacity commitments • Reduce by consolidating spend to improve flexibility terms 	<ul style="list-style-type: none"> • Vendor diversification to reduce supply, price and quality risk • Vendor diversification to reduce hazard risk 	<ul style="list-style-type: none"> • Hedge demand volatility with supply-demand matching • Natural hedging of foreign exchange risk 	<ul style="list-style-type: none"> • Single source selected components to reduce complexity • Increase information sharing with core suppliers





Mitigation of Risks During Construction Phase

Construction Cost Over-run Mitigation: Limited Recourse and Funding of Cost Over-runs

- If cost over-runs are not covered by an EPC contract, various possibilities exist:
 - Pro-rata funding by debt and equity up to a limit, after which equity is required
 - Over-runs funded by equity up to a limit (e.g. 5%) after which funding of over-runs is pro-rata
 - Over-runs funded by subordinated debt issued by the contractor to the project.

TABLE 1 POSSIBLE RISKS AND COVERAGE DURING THE CONSTRUCTION PERIOD

Instrument	Cost overruns	Delays	Start-up and testing problems	Contractor payment defaults	Hidden defects	Force majeure
Liquidated damages	X	X	X			
Performance bonds				X		
Retainage accounts				X		
Warranties					X	
Contingency funds	X	X	X	X		X
Insurance		X				X



Mitigation of Construction - Reference

- **Delay In Service Insurance**

- This can cover completion risk either through contract work policies or start-up delay policies, which latter cover the capitalised interest bill caused by a delay.

- **Completion Guarantee**

- This requires the loan to be repaid by the Sponsor rather than the project's cash flow either in full or on an agreed repayment schedule if the project is not completed by a certain date. It is seldom used in Project Financing today.

- **Overrun Undertaking**

- In this case the Sponsors agree to provide only the overrun amounts above the pre-agreed debt and equity financing total.

- **Stand-by Facility**

- These may be contingent underwriting facilities, or indeed money in an escrowed bank account, provided to cover cost overruns perhaps from a strong parent or related companies. For example, interest may only be permitted to be capitalised to a given cumulative dollar ceiling beyond which the Sponsors must pay interest when due.

- **Deficiency/Shortfall Agreement**

- Even though the project is producing cash flows and has met a performance Completion Test, an agreed amount of Sponsor support is available to meet cash flow on Debt Service shortfalls for an agreed amount, for an agreed period post-Completion, or for an agreed obligation e.g. interest up to a limit.



Mitigation of Construction Risk - Reference

- **Completion Undertaking**

- The Sponsors put in however much money it takes to make the Project meet the Completion Test. If the test cannot be met, then there may be recourse to the Sponsors for the whole Project Financing.

- **Turnkey Contract**

- The turnkey construction contract may be formed in such a way as to provide the necessary financial support for the Completion aspect of Project Financing through healthy liquidated damages (“LDs”), Retentions, buy down payments, etc. As a rule of thumb, turnkey construction contracts add 20% to cost.

- **Equity and Debt Subscription**

- In the event of a cost overrun or a delay forcing capitalisation of interest, both the financiers and the company agree to contribute further funds, either pro-rata or in leap-frogging tranches, to meet the overrun with a ceiling on the bank’s exposure at some stage.

- **Default Agreement**

- This is a variation of Equity and Debt Subscription except for a “stand-still” period after all base financing has been provided, say 90 days, within which talks proceed between the financiers and the Sponsors to hopefully reach agreement on how to finance the increment to achieve project Completion. The commitment of both sides to proceed may be halted early if estimates show that the project will come in above the financed budget.



Strong and Weak Technology/Construction Risk

- Strong
 - Fixed-price, date-certain turnkey contract;
 - one-year-plus guarantees;
 - superior liquidated performance/delay damages;
 - highly rated EPC contractor,
 - credible sponsor completion guarantee or LOC-backed construction;
 - installed costs at/below market;
 - contracts executed.
 - IE oversight through completion, including completion certificate.
 - Commercially proven, currently used technology.
 - Rated O&M contract with performance damages.
 - Budget and schedule credible, not aggressive.
 - Thorough and credible IE report.



Strong and Weak Technology/Construction Risk

- Weak
 - Cost-plus contracts,
 - ✓ no cap;
 - ✓ weak guarantees, if any; minor liquidated performance/delay damages;
 - ✓ questionable EPC contractor.
 - Costly project budget.
 - Permits lacking and siting issues.
 - Possible local political/regulatory problems.
 - No Independent Engineering oversight.
 - Technology issues exist.
 - Budget and schedule aggressive.
 - No Independent Engineering report.



Risks Present Even with EPC Contract

- Construction contracts cannot eliminate all risk to a project. Some residual level of risk generally remains
 - force majeure
 - change-of-law events
 - Change orders
- By definition, the vendor and contractor cannot control such events.
- Better projects, especially heavily leveraged, high fixed cost ones, will seek to minimize these risks through insurance or sovereign guarantees and provisions to renegotiate tariff cost-offsetting provisions of power purchase agreements.



Financial Failure of Contractor – Stone and Webster

- Stone and Webster had been one of the oldest engineering consulting firms in the US.
- The 1999 new orders do not include an award for a 720-megawatt combined-cycle power plant expected to be booked in the first half of 2000 after completion of owner financing.
- Financial Condition
- Internal Systems Control
- Size of Single Project Relative to Size of the Company



Stone and Webster

- Stone and Webster Excerpts
- Company officials were recently notified of an unanticipated cost overrun on a key project by a major subcontractor related to estimates to complete work during the first half of 2000. As a result of this information, the Company subsequently conducted a thorough review of this project and, based on this review, recorded a provision of \$27.5 million to complete work on the project, and its 1999 financial statements were revised for such matter.
- As a result of the liquidity problems created by the unanticipated project overrun, coupled with previously reported operating losses, the Company accelerated its discussions with potential lenders and strategic partners to provide interim and long-term financing.
- During 1998, the Company recorded a loss of \$87.3 (\$53.9 after tax or \$4.18 per share) for contract related provisions, primarily due to increases in estimated costs to complete several international lump sum contracts. Management believes that it has valid contractual and equitable grounds for change orders providing additional compensation under these contracts.



Discussion of EPC Risks from Construction Company Perspective

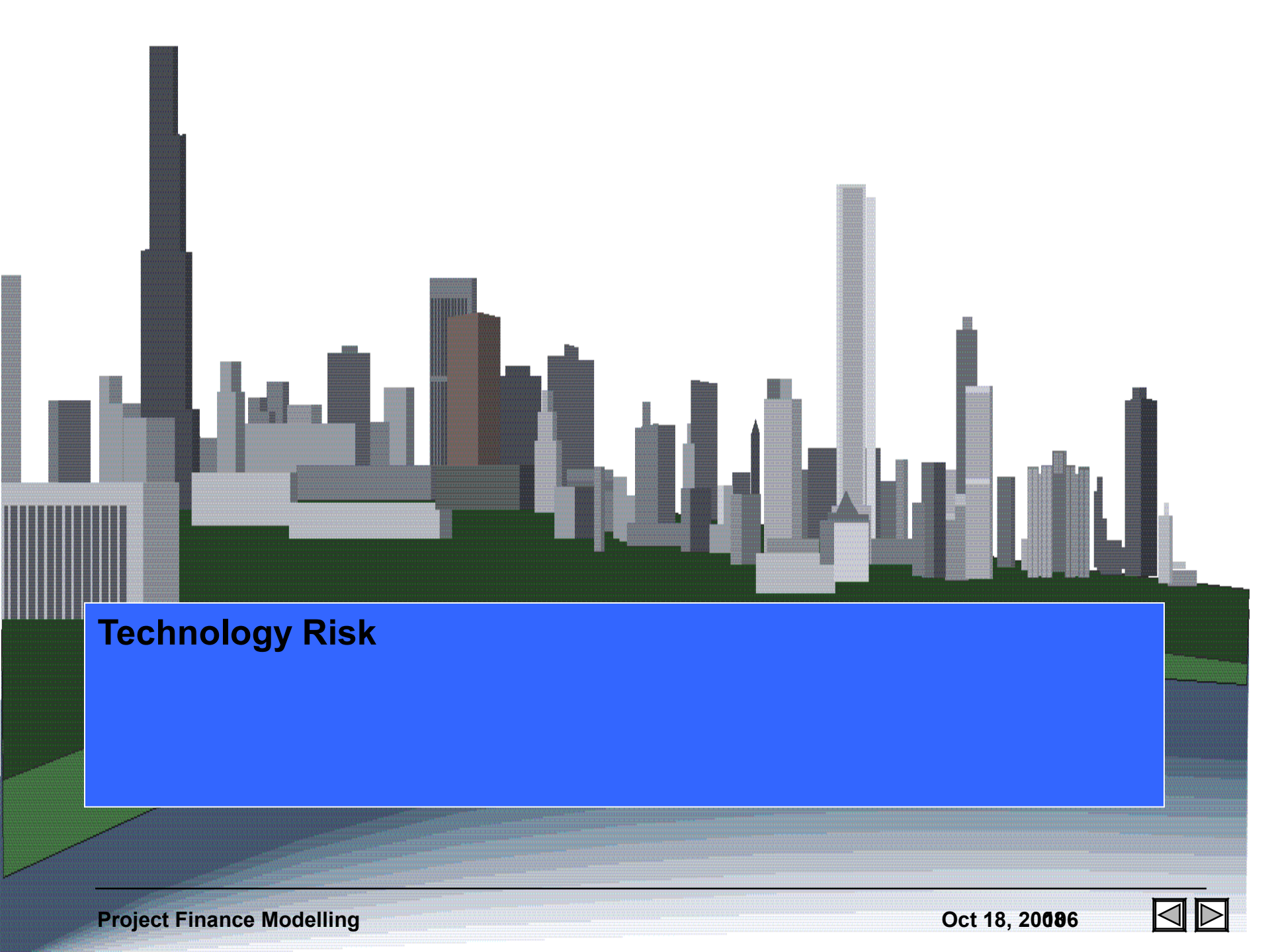
- Although approximately 80% of our contracts as of February 28, 2003 are cost-plus contracts, the remaining 20% are fixed price or unit price. A significant number of our domestic piping contracts and substantially all of our international piping contracts are fixed price or unit price. Under fixed price or unit price contracts, we agree to perform the contract for a fixed price and, as a result, benefit from costs savings and earnings from approved change orders; but we are generally unable to recover any cost overruns to the approved contract price. Under fixed price incentive contracts, we share with the customer any savings up to a negotiated or target ceiling. When costs exceed the negotiated ceiling price, we may be required to reduce our fee or to absorb some or all of the cost overruns.
- Contract prices are established based in part on cost estimates that are subject to a number of assumptions, including assumptions regarding future economic conditions. If these estimates prove inaccurate or circumstances change, cost overruns could have a material adverse effect on our business and results of our operations. Our profit for these projects could decrease or we could experience losses, if we are unable to secure fixed pricing commitments from our suppliers at the time the contracts are entered into or if we experience cost increases for material or labor during the performance of the contracts.



Evaluation of Feasibility Study and Independent Engineer Report – Standard and Poor's (Reference)

- Independent engineer's evaluation about the adequacy of contingencies for schedule and budget, and related assumptions.
 - Evaluate performance requirements and incentives for the construction contractors along with the financial and technical capacity of the contractors to perform on these contracts.
 - For newer technologies, evaluate whether the contractor has significant experience working with that technology and whether the contractor has worked in the host country.
 - A project having a legal structure that includes construction monitoring by an expert third party, such as an independent engineer, enhances construction surveillance by providing systematic oversight.
 - Monitor surveillance of work in progress with the independent engineer to establish the predictability of the remaining construction schedule.





Technology Risk

Management of Technological Risk – Liquidated Damages and Guarantees

- Technology Guarantee
 - Either the Sponsor itself or the technology developer will guarantee that the technology will work for a given period
 - ✓ For example, six months to two years after startup.
 - ✓ Twelve months is common in the power generation sector.
 - ✓ If the guarantee is not met, financial penalties could apply (although these are rarely sufficient to fully repay the loan.)
 - Problem with Technology Guarantees: Many Technology companies are weak financially and may have little substance to back such a guarantee.



Technology Risk Management Continued

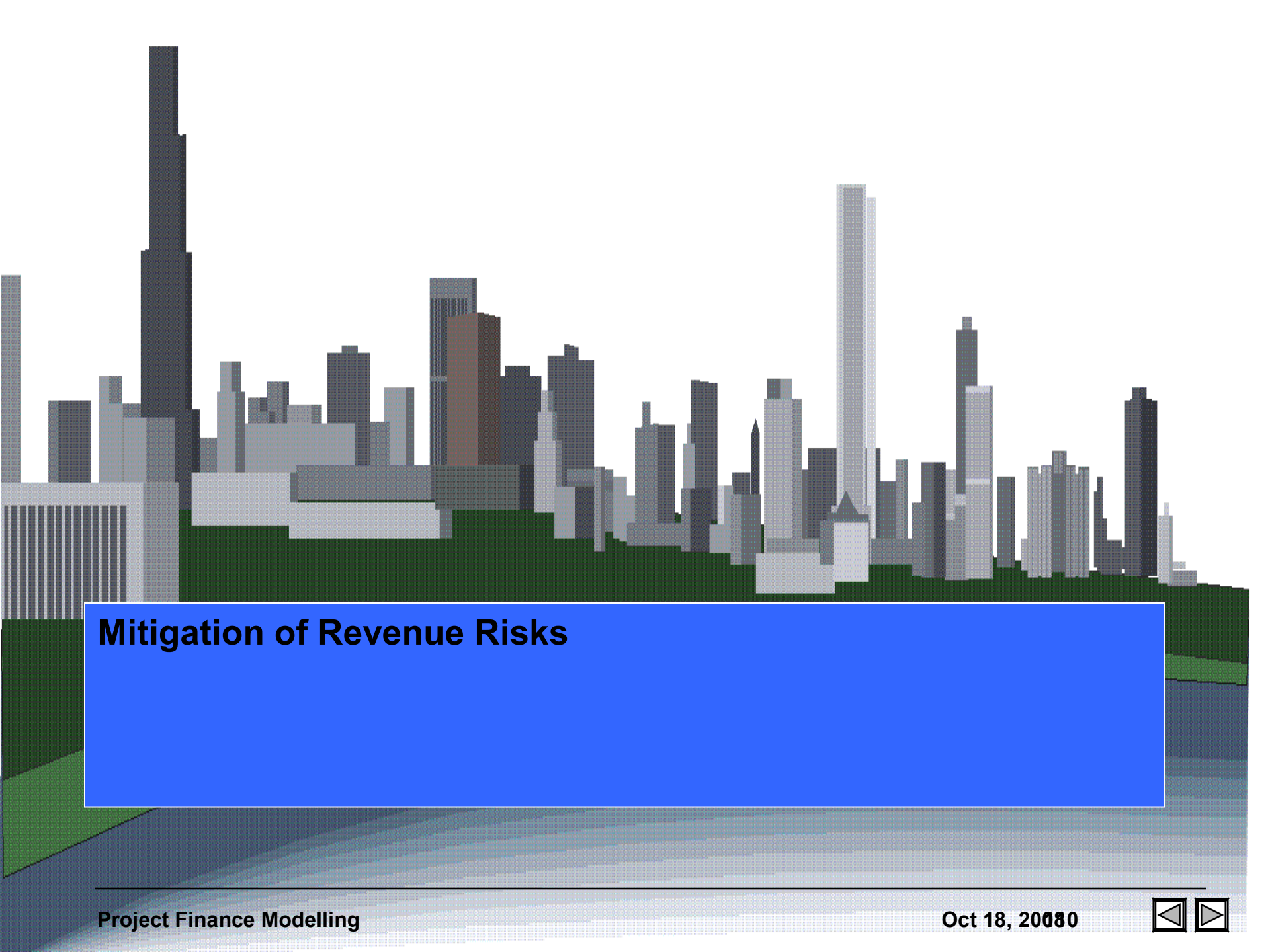
- Technology Insurance
 - Insurance cover may be raised from unconventional or conventional insurance markets. This can be expected to be difficult for brand-new technologies.
- Quality Assurance
 - An equipment supplier or technology licensor may guarantee the resultant product's specification which, to a large part, can cover the Technical component of Operating Risk. This is often seen in the industrial chemicals industry.
- Fleet Assurance
 - An equipment supplier or lessor may guarantee to replace individual items found faulty from a fleet in the neighbourhood. This may be a little difficult for a dragline, in say, Thailand, although it may be easy for a toll-booth machine installed there. Duplicate facilities and standby/backups are varieties of this approach.



Technology Risk Management

- Alternative Sourcing
 - If the technology does not work out, then the technology company undertakes to provide equipment from elsewhere (if the supplier) or arrange to use the technology elsewhere (if the plant) with no impact on cash-flows. This is rarely seen.
- Business Interruption Insurance
 - This takes effect upon project startup and can provide useful protection of the Assets or the Project Financing in the event of lost income arising from an accident. If a total loss, the banks will often want to be the loss payee under this type of insurance policy as well as the all-risks general insurance policy. This is indirect cover for the Technical Component of Operating Risk.





Mitigation of Revenue Risks

Mitigation of Revenue Risks

- Long-term PPA Contracts and Concession Agreements
- Hedging Commodity Price Exposure
 - Problem with price and quantity exposure

TABLE 2 POSSIBLE RISKS AND COVERAGE DURING THE OPERATING PERIOD

Instrument	Operating efficiency problems	Increase in routine O&M	Increase in major O&M	Market demand and pricing	Input availability	Force majeure
Take-or-pay				X		
Put-or-pay					X	
Pass-through		X		X		X
Debt service reserve funds	X		X		X	X
Maintenance reserves			X			
Cash traps	X	X		X		
Insurance						X
Tracking accounts				X		
Equity kickers				X		

Note: Table shows principal applications of instruments.



Strategic Hedging and Project Finance

- **COMMODITY SWAPS.** CSFB will make fixed cash payments, either in a lump sum now or at various dates in the future. Later, the producer makes payments that reflect the average of prevailing spot WTI or Brent prices in the future. (It is also possible for the producer to deliver physical barrels of oil, instead of cash.)
- **COMMODITY PUT OPTIONS.** The producer obtains protection now against low spot prices in the future. The purchaser can pay for the protection in a lump sum today, or in a series of futures payments.
- **COMMODITY TRIGGER PUTS.** The producer pays for protection only when he needs it. There is no need to pay premium today. Rather, a premium becomes due in the future if and only if the market tumbles even further below the protection level.
- **COMMODITY CONVERTIBLE PUTS.** The producer receives protection against low spot prices in the future, with no payment of cash today. The producer agrees now to enter into a swap if and when the market rebounds.
- **INTEREST RATE SWAPS AND CAPS.** The project can protect itself against rises in interest rates above the originally predicted levels.
- **CURRENCY SWAPS / FORWARDS / OPTIONS.** If the project is funded in one currency but the revenues are expected in a separate currency, currency hedges allow the project to close the mismatch. These products are useful in both developed and emerging markets.



Risk Analysis in AES Drax

- Revenue Risk
 - UK Electric Prices
 - Contract with TXU Europe
 - Volume – Capacity Factor Risk
- Construction Risk
 - Simulate
 - Costs of Alternative Projects
- Operating Expense Risk
 - Coal and Natural Gas Prices
 - Heat Rates
 - Other Operating Expenses



AES Drax Case

- Purchase from Innogy
 - Purchased in 1999 for \$3 Billion
 - 3,960 MW – Cost/MW of \$758/kW
- Financing
 - \$ 750 Million Equity (25%)
 - \$ 2 Billion Bank Debt
 - ✓ 15 year amortizing loan
 - ✓ 165 basis points
 - ✓ 90 basis point commitment fee
 - \$ 250 Million High Yield Bonds
- Contracts
 - 15 Year Financial Hedging Agreement with Eastern Energy (Now TXU) Investment Grade
 - Contract covered 60% of plant output
- Drax faced a financial crisis late last year after it lost its most lucrative sales contract, held with bust utility TXU Europe. The loss of the contract left Drax exposed to spot power prices which have fallen sharply since the late 1990s because of increased competition.



AES Drax Continued

- Drax Debt was Investment Grade:
 - S&P highlighted uncertainty surrounding generation prices as a concern, but stated that one of the deal's strengths was its 15 year hedging agreement: "The hedging agreement underpins a large portion of the debt service during the first seven years of the contract thereby reducing merchant risk."
- Other Transactions were more aggressive than Drax
 - Often 80% Debt Financing
 - Long Tenors
- TXU Defaulted on a payment to DRAX
 - TXU lost One Million core customers
 - Contract was Way Out of the Money
 - S&P estimates that contracts are out of the money by between GBP 500 million and GBP 1.3 billion
- Bid to buy back DRAX for 1 Billion GBP (plant was sold by same company for 1.87 GBP)



AES Drax Bond Rating Time Line

- Rating Action 19 JAN 2004 MOODY'S WITHDRAWS RATINGS ON DRAX POWER PROJECT
- Rating Action 7 NOV 2002 MOODY'S DOWNGRADES DEBT RATINGS OF INPOWER LTD AND AES DRAX HOLDINGS LTD TO Caa2, AND DEBT RATINGS OF AES DRAX ENERGY LTD TO C
- Rating Action 14 OCT 2002 MOODY'S DOWNGRADES DEBT RATINGS OF INPOWER LTD AND AES DRAX HOLDINGS LTD TO Caa1, AND DEBT RATINGS OF AES DRAX ENERGY LTD TO Ca. ALL RATINGS ARE LEFT ON REVIEW FOR FURTHER DOWNGRADE
- Rating Action 21 AUG 2002 MOODY'S DOWNGRADES DEBT RATINGS OF AES DRAX HOLDINGS LTD, INPOWER LTD, AND AES DRAX ENERGY LTD
- Rating Action 13 AUG 2002 MOODY'S PLACES Ba1 DEBT RATINGS OF AES DRAX HOLDINGS LTD AND INPOWER LTD, AND B1 RATINGS OF AES DRAX ENERGY LTD ON REVIEW FOR DOWNGRADE
- Rating Action 27 JUN 2002 MOODY'S CONFIRMS B1 RATINGS ON NOTES OF AES DRAX ENERGY LTD, MAINTAINS NEGATIVE OUTLOOK
- Rating Action 1 MAR 2002 MOODY'S PUTS AES DRAX ENERGY LTD HIGH YIELD NOTES RATED B1 ON REVIEW FOR DOWNGRADE
- Rating Action 7 DEC 2001 MOODY'S DOWNGRADES AES DRAX HOLDINGS Ltd BONDS AND INPOWER Ltd BANK LOAN FROM Baa3 TO Ba1, AND AES DRAX ENERGY Ltd NOTES FROM Ba2 TO B1
- Rating Action 20 APR 2001 MOODY'S CONFIRMS AES DRAX'S DEBT RATINGS; CHANGES OUTLOOK TO NEGATIVE
- Rating Action 25 JUL 2000 MOODY'S ASSIGNS (P)Baa3 RATING TO AES DRAX HOLDINGS LIMITED AND (P) Ba2 TO AES DRAX ENERGY LIMITED PROJECT FINANCE BONDS



AES Drax Debt Service Coverage

- Average ADSCR year 1-25.....3.05x
- Minimum ADSCR year 1-25.1.42x
- HOLDING COMPANY COVERAGES
- Average ADSCR year 1-10.3.09x
- Minimum ADSCR year 1-10....2.13x
- CONSOLIDATED COVERAGES
- Average ADSCR year 1-10.1.33x
- Minimum ADSCR year 1-10....1.20x
- Average ADSCR year 16-25...4.82x
- Minimum ADSCR year 16-25..3.03x
- Average ADSCR year 1-25.....3.09x
- Average ADSCR year 1-25.....1.48x
- CONSOLIDATED COVERAGES
- Average ADSCR year 1-10.1.21x
- Minimum ADSCR year 1-10....1.08x
- Average ADSCR year 16-25...3.98x
- Minimum ADSCR year 16-25..2.53x

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Drax Case

2 N161 Corp **YAS**
 Enter #<GO> for Detailed Analysis. Enter 99<GO> for Menu of Related Functions.
YIELD & SPREAD ANALYSIS CUSIPEC278924 PCS BGN

AES DRAX HOLDING AES9.07 12/31/25 NOT PRICED

SETTLE **10/29/03** FACE AMT **1000 M** or PROCEEDS **1,029,881.39**

1) YA YIELDS		2) YASD		RISK & HEDGE RATIOS		AES9.07 12/31/25	
PRICE	99.990000		N			workout	HEDGE BOND
YIELD	9.069 %	Wst				12/31/25 OAS	OAS
SPRD	412.00 bp	yld-decimals	3/3	Mod Dur	9.21	9.21	8.08
versus				Risk	9.489	9.482	10.556
15yr UKT 8	12/07/15	BENCHMARK		Convexity	1.40	1.43	0.87
PRICE	127.559000	Save	Delete	Workout HEDGE Amount: 897 M			
YIELD	4.949 %	sd:	10/23/03	OAS HEDGE Amount: 898 M			

Yields are: **Semi-Annual**

3) OAS SPREADS		4) ASW		5) FPA FINANCING	
OAS:	418.1	CRV#	110	VOL	15.00pt
OAS:	399.8	CRV#	155	TED:	
ASSET SWAP: (A/A)	394.1	Z-Sprd:	394.1	Repo%	3.820 (360/365) 365 Days 1
ISPRD	395.0	CRV#	155	U.K. POUND SWAP	
Yield Curve: I22		U.K. GOVT BNCHMARK		Int Income	251.94 Carry P&L
+ 419	v 22.2yr (4.876 %)	INTERPOLATED		Fin Cost	-107.78 144.16
+ 457	v 2yr (4.50)	UKT 8	1/2 12/07/05	Amortiz	1.80<-> 145.96
+ 442	v 3yr (4.65)	UKT 7	3/4 09/08/06	Forwrd Prc	99.975584
+ 427	v 4yr (4.80)	UKT 7	1/4 12/07/07	Prc Drop	0.014416
+ 425	v 5yr (4.82)	UKT 5	03/07/08	Drop (bp)	0.15
				Accrued Interest /100	2.998139
				Number Of Days Accrued	119

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 920410
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Contract Viability

- Project finance is a long-term business and long-term contracts that give advantage to one side are vulnerable
 - It is impossible to provide in advance for every event that may affect a project contract in the future.
 - An aggrieved party will take advantage of any flaw to get out of an onerous obligation.
- The underlying contract must make economic sense to both parties.



Problems with PPA's in Asia

- Some countries have encouraged joint ventures with the private sector. (China, India and Singapore)
- Some countries have part privatised through floats (IPO's) and stock market listing (Malaysia & China)
- IPP's with long term PPA's have added a substantial stock of generators to DC's (Pakistan, the Philippines, India, Malaysia, Thailand, Indonesia)
- Some PPA's featured high prices for a variety of reasons (Pakistan, India, Indonesia, Philippines)



Contract Risk and Dabhol

- Investment in a \$3 billion, 10-year liquefied natural gas power plant development project, the largest development project and the single largest direct foreign investment in India's history.
- Begun in 1992, the Dabhol power plant near India's financial capital of Bombay in Maharashtra state was to have gone online by 1997. It was supposed to supply energy-hungry India with more than 2,000 megawatts of electricity, about one-fifth the new energy needed by India each year.
- In a joint venture with U.S. companies General Electric and Bechtel, Enron created an Indian subsidiary, Dabhol Power Co. DPC, which was 65 percent owned by Enron, was to build the power plant. Enron was to develop and operate the plant. Bechtel was to design and construct it, with GE supplying the equipment.
- Enron brokered a deal with Qatar to provide the Dabhol plant 2.5 million tons of liquefied natural gas per year for 25 years, starting in 1997.



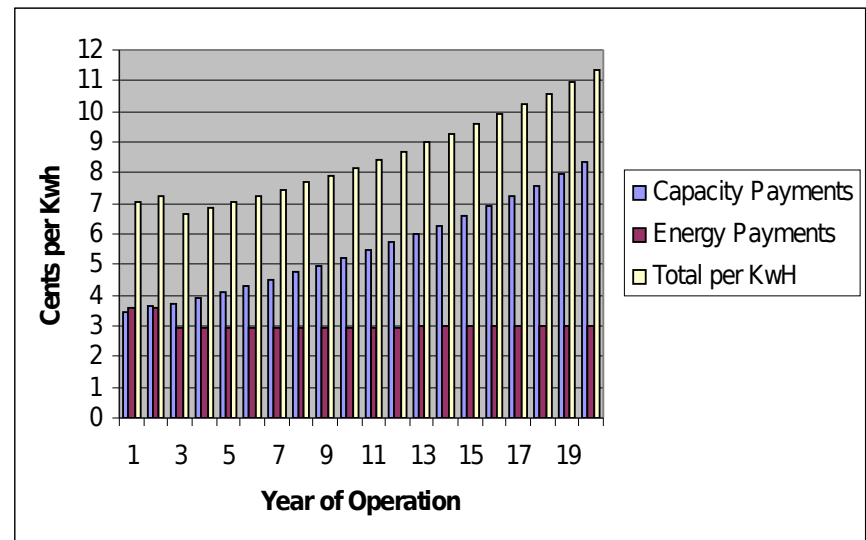
Dabhol Plant Cost

- First phase
- 695 MW plant
- Cost of \$920 M
- Construction began 1995, project to come on-line in 1997
- Second phase
- 1,320 MW capacity
- LNG re-gasification plant, storage, and harbor facilities to be built.
- Construction to begin after phase 1 completed
- Cost of \$1.88 B



Dahbol Tariffs

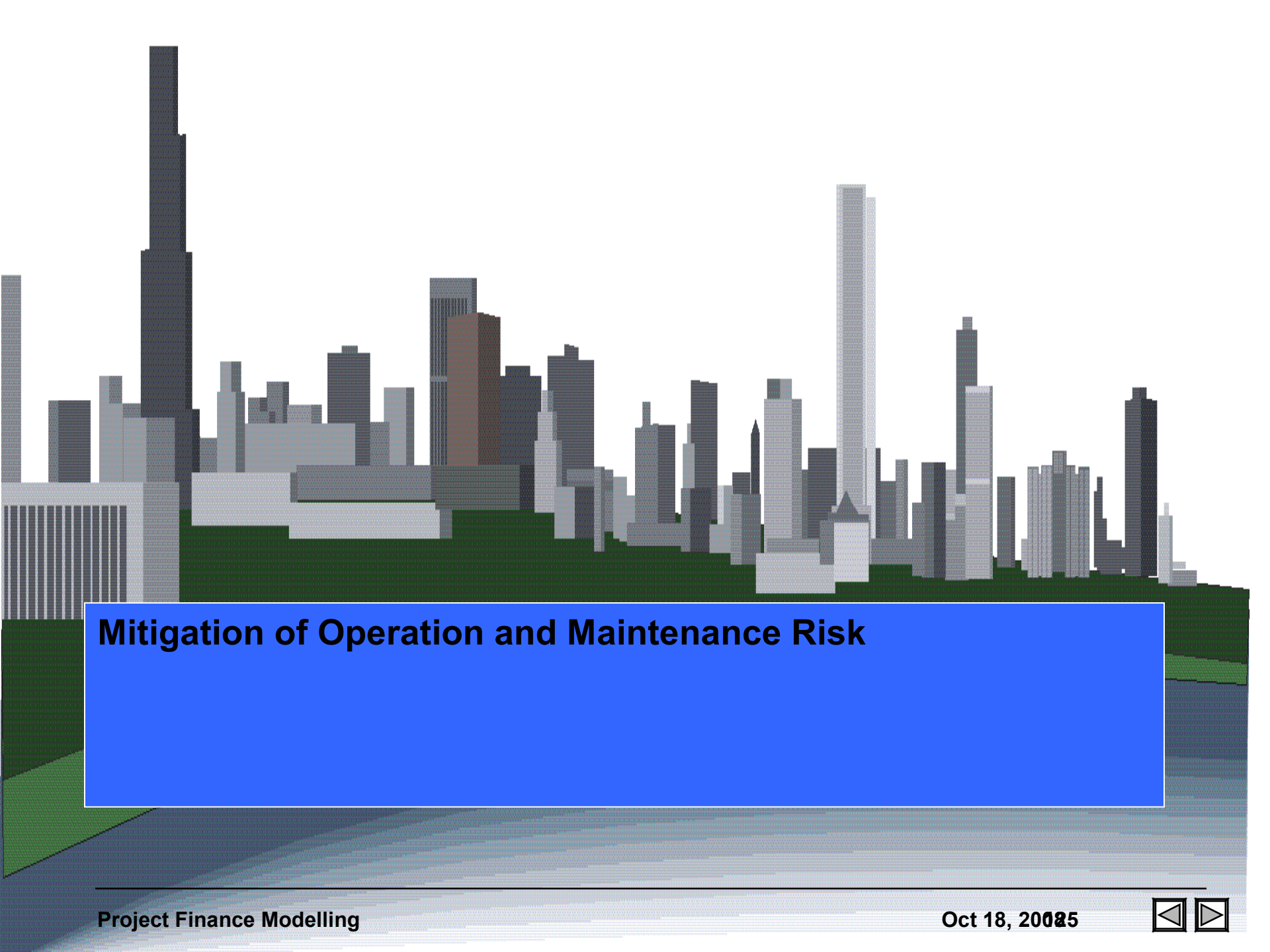
- The Tariffs were about 7 US cents per kWh. Comparable plants in the US were selling power at 3-4 cents per kWh.
- Initially ROE was 26.52%
- Renegotiated to 25.22% Pre-tax, with a 10% stake of equity to MSEB.
- Net ROE at 17.2%
- Officially the ROE allowed was up to 16%



Contract Off-taker Risk and Dabhol

- Endless disputes over prices and terms of the deal turned the venture into a symbol of what can go wrong in large-scale development projects when cultures collide.
- In April 1993, a World Bank analysis questioned the project's economic viability, citing the high cost of importing and using liquefied natural gas relative to other domestic sources of fuels. Because of those findings, the World Bank refused to provide funds for the project.
- "Price is becoming a sticky issue," the Financial Times reported. "Indian officials see the price as very high compared to domestic gas and imported and indigenous alternative fuels."
- Protesters took to the streets to support demands for changes in the plant's design and -- more broadly -- to oppose the Indian government's economic liberalization policies. Social activists, lawyers, villagers and farmers banded together in groups opposed to the Enron project.
- The devaluation meant that Dabhol's energy prices would soar to between two and five times the average price in the area.





Mitigation of Operation and Maintenance Risk

Cost Risk Management

- Sponsors projects mitigate supply risk through several strategies.
 - Some enter into commodity supply contracts (indexed to the product price) coterminous with the debt.
 - Second, transportation arrangements for the commodity should evidence a high level of dependability, with the transportation agreements again being coterminous with the debt.
 - Perhaps the best strategy uses a complete pass-through of supply costs to the purchaser. This strategy, however, places the buyer at risk of a price shock if the commodity's price should suddenly increase.



Cost Risk Management

- Projects can either hedge supply risk, or transfer it to an entity with the means and willingness to assume the project's output price risk.
- The commodity supply markets in the U.S. and the U.K., are sufficiently liquid to support credible risk management strategies.
 - A U.K.-based sponsor may partially hedge its natural gas fuel supply price risk through fixed price-volume contracts or derivative products
 - The sponsor will demonstrate the ability and experience to engage in these complex risk management strategies.



Risks Remaining in Supply Contracts (S&P)

- Although a project may contractually receive fixed payments that cover its debt obligations, project input or supply arrangements, such as for fuel, ash disposal and water, may expose the project (and bondholders) at risk as regards those contracts' price and volume arrangements.
 - If the buyer's obligation to pay a fixed price under the offtake contract is contingent on the project's availability and a disruption in fuel or other supply commodity occurs to make the project not available, if the disruption extends over a period of time with the result that the buyer is not contractually required to make fixed payments under the offtake agreement the project may not have sufficient revenues to pay debt service on the bonds.
- Another risk to bondholders arises from the potential narrowing of the spread between supply prices and project product prices.



Contract Mismatch Risk - MCV

- Once contracts have been established, it is necessary to make sure that contracts work together.
- An example of such a problem is the MCV cogeneration plant in plant – the largest IPP in the US, with a capacity of over 1,000 MW.
 - The plant was constructed from the site of a failed nuclear plant.
 - To avoid write-offs, value from a gas plant was applied against a PPA that was developed from the cost of a new coal plant
 - The coal and gas plant mismatch caused a high capacity price and a low variable price for the gas plant.
 - MCV attempted to develop gas contracts using coal price escalation, could not hedge the entire amount because of uncertain dispatch and difficulty in securing long-term commitments.
 - The plant was dispatched using the coal based variable energy charge rather than the actual gas cost.



MCV Case – Cash Flow

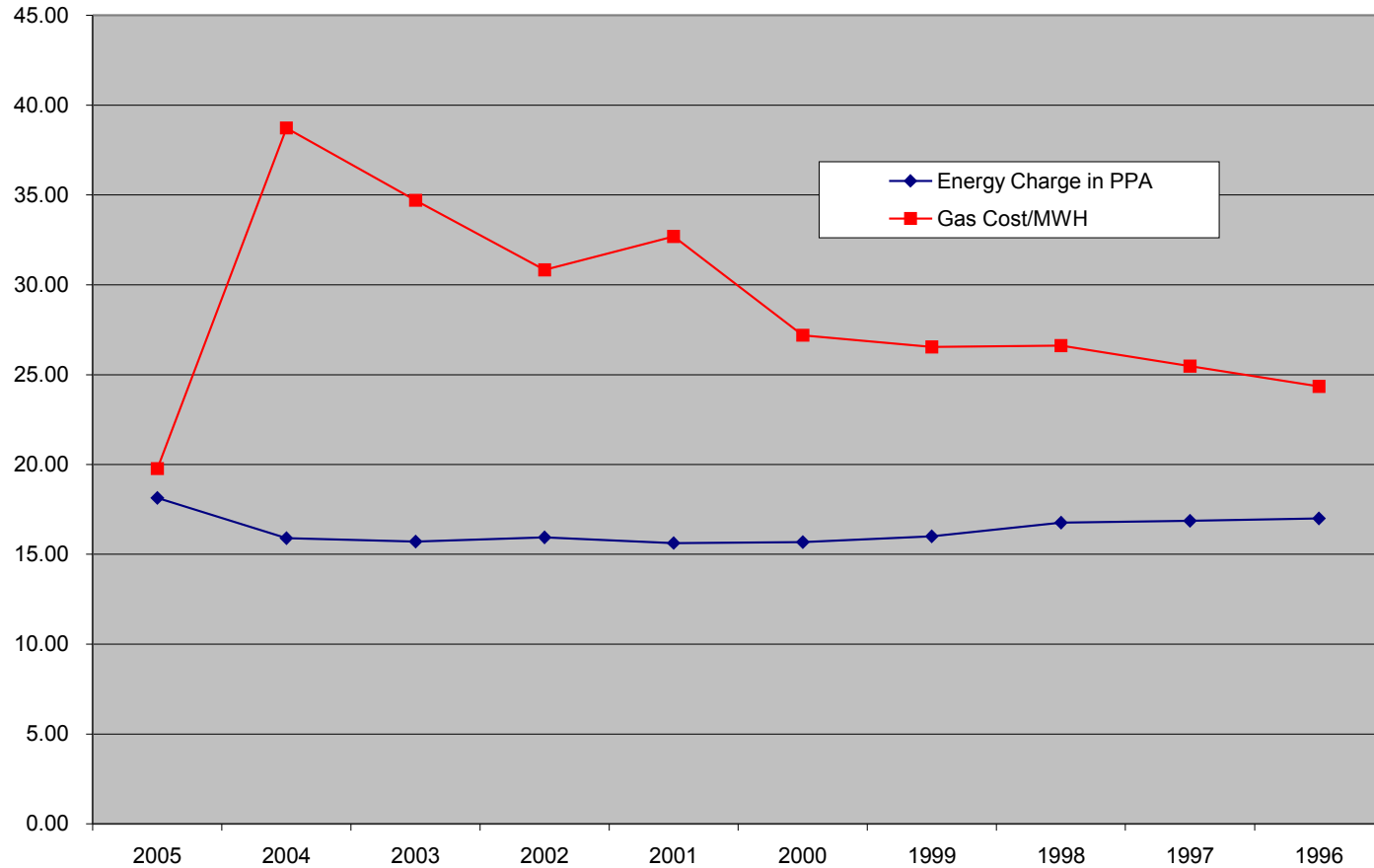
MIDLAND COGENERATION VENTURE LIMITED PARTNERSHIP
 CONSOLIDATED STATEMENTS OF CASH FLOWS FOR THE YEARS ENDED DECEMBER 31,
 0.00

	2005	2004	2003	2001
CASH FLOWS FROM OPERATING ACTIVITIES:				
Net income -loss	\$ (917,444.00)	(23,619.00)	59,791.00	48,264.00
Adjustments to reconcile net income -loss to net cash provided by operating activities				
Depreciation and amortization	74,927.00	89,925.00	90,792.00	93,835.00
Asset impairment loss	1,159,000.00	—	—	—
	(199,087.00)	20,130.00	4,906.00	55,127.00
Increase decrease in accounts receivable	(41,555.00)	(15,214.00)	(1,211.00)	(5,225.00)
Increase decrease in gas inventory	1,371.00	2,789.00	(732.00)	(415.00)
Increase decrease in unamortized property taxes	(178.00)	(388.00)	683.00	(26,587.00)
Increase decrease in broker margin accounts and prepaid expenses	(7,147.00)	(5,046.00)	(4,778.00)	—
Increase decrease in derivative assets	2,228.00	3,841.00	(8,704.00)	8,414.00
Increase decrease in prepaid gas costs, materials and supplies	52,621.00	25,775.00	(712.00)	(43,704.00)
Increase -decrease in accounts payable and accrued liabilities	173,390.00	15,096.00	4,517.00	—
Increase in gas supplier funds on deposit	(2,681.00)	(5,271.00)	(3,377.00)	(7,082.00)
Increase -decrease in other non-current liabilities	(907.00)	(1,197.00)	311.00	245.00
Net cash provided by operating activities	<u>294,538.00</u>	<u>106,821.00</u>	<u>141,486.00</u>	<u>122,872.00</u>
CASH FLOWS FROM INVESTING ACTIVITIES:				
Plant modifications and purchases of plant equipment	(31,704.00)	(20,460.00)	(33,278.00)	(30,530.00)
Maturity of restricted investment securities held-to-maturity	318,192.00	674,553.00	601,225.00	538,327.00
Purchase of restricted investment securities held-to-maturity	(269,697.00)	(674,208.00)	(602,279.00)	(539,918.00)
Net cash provided by -used in investing activities	<u>16,791.00</u>	<u>(20,115.00)</u>	<u>(34,332.00)</u>	<u>(32,121.00)</u>
CASH FLOWS FROM FINANCING ACTIVITIES:				
Repayment of financing obligation	(76,548.00)	(134,576.00)	(93,928.00)	(155,632.00)
Net cash used in financing activities	<u>(76,548.00)</u>	<u>(134,576.00)</u>	<u>(93,928.00)</u>	<u>(155,632.00)</u>
NET INCREASE -DECREASE IN CASH AND CASH EQUIVALENTS	<u>234,781.00</u>	<u>(47,870.00)</u>	<u>13,226.00</u>	<u>(64,881.00)</u>
CASH AND CASH EQUIVALENTS AT BEGINNING OF PERIOD	<u>125,781.00</u>	<u>173,651.00</u>	<u>160,425.00</u>	<u>206,298.00</u>
CASH AND EQUIVALENTS AT END OF \$	360,562.00	125,781.00	173,651.00	141,417.00



Contract Mismatch

PPA Charge and Gas Cost



MCV – Contract Risk

MIDLAND COGENERATION VENTURE LIMITED PARTNERSHIP
 CONSOLIDATED BALANCE SHEETS AS OF DECEMBER 31,
 0.00

	2005	2004
ASSETS		
CURRENT ASSETS:		
Cash and cash equivalents	360,562.00	125,781.00
Accounts and notes receivable — related parties	30,514.00	54,368.00
Accounts receivable	108,393.00	42,984.00
Gas inventory	16,138.00	17,509.00
Unamortized property taxes	18,238.00	18,060.00
Derivative assets	241,135.00	94,977.00
Broker margin accounts and prepaid expenses	20,294.00	13,147.00
Total current assets	795,274.00	366,826.00
PROPERTY, PLANT AND EQUIPMENT:		
Property, plant and equipment	2,479,071.00	2,466,944.00
Pipeline	21,432.00	21,432.00
Total property, plant and equipment	2,500,503.00	2,488,376.00
Accumulated depreciation -Note 3	(2,276,089.00)	(1,062,821.00)
Net property, plant and equipment	224,414.00	1,425,555.00
OTHER ASSETS:		
Restricted investment securities held-to-maturity	90,915.00	139,410.00
Derivative assets non-current	186,336.00	24,337.00
Deferred financing costs, net of accumulated amortization of	5,385.00	6,467.00
Prepaid gas costs, spare parts deposit, materials and supplies	15,554.00	17,782.00
Total other assets	298,190.00	187,996.00
TOTAL ASSETS	1,317,878.00	1,980,377.00
LIABILITIES AND PARTNERS' EQUITY		
CURRENT LIABILITIES:		
Accounts payable and accrued liabilities — related parties	16,651.00	12,772.00
Accounts payable and accrued liabilities	118,663.00	69,921.00
Gas supplier funds on deposit — related parties	44,353.00	—
Gas supplier funds on deposit	148,650.00	19,613.00
Interest payable	45,057.00	47,738.00
Current portion of long-term debt	63,459.00	76,548.00
Total current liabilities	436,833.00	226,592.00
NON-CURRENT LIABILITIES:		
Long-term debt	878,638.00	942,097.00
Other	805.00	1,712.00
Total non-current liabilities	879,443.00	943,809.00
TOTAL LIABILITIES	1,316,276.00	1,170,401.00
COMMITMENTS AND CONTINGENCIES -Notes 8 and 9		
TOTAL LIABILITIES	1,316,276.00	1,170,401.00
PARTNERS' EQUITY	1,602.00	809,976.00
TOTAL LIABILITIES AND PARTNERS' EQUITY	1,317,878.00	1,980,377.00

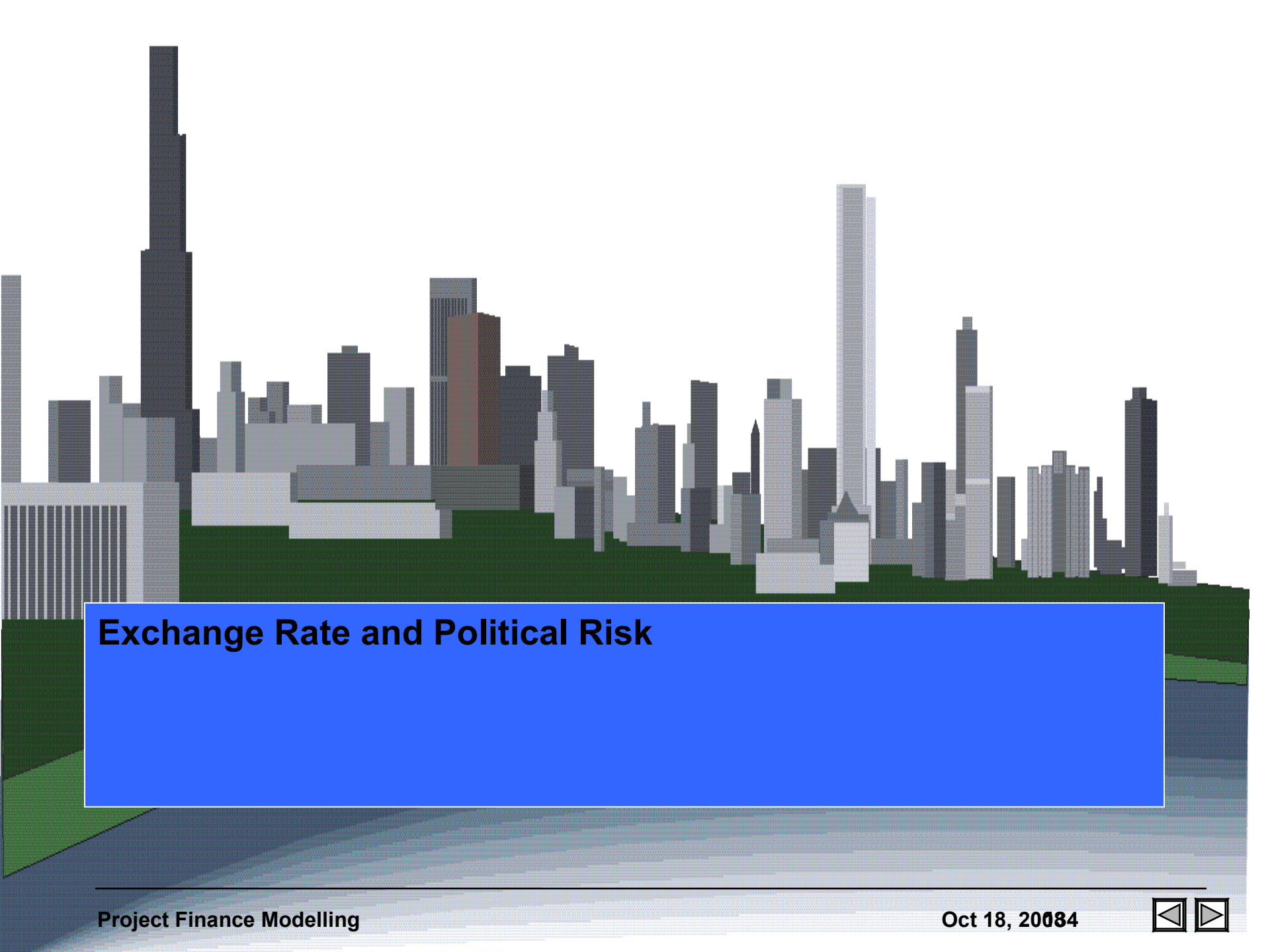
Note the decline in equity and in plant assets upon restructure to solve the contract mis-match problem



Example of Risk Management

- Central Dock Sud
 - Electricity merchant plant in Argentina
 - Developed gas supply contract that varies when electricity prices change
 - ✓ Required target level for electricity price and natural gas price
 - ✓ When electricity price is a certain amount below target, reduce the natural gas price using a formula.





Exchange Rate and Political Risk

Political Risk - Introduction

- Projects are long-term and immobile
 - Long-term investments require sustained political support
 - Do not want to become a political football
- Political viability is analogous to commercial viability
 - Must be beneficial to a country
 - High rate of return can increase risk
- Standard Political Risks
 - Currency convertibility
 - Expropriation of the project by the state
 - Political violence



Political and Country Risk

The legal and political regime in which a project operates can have profound effects on its ability to repay investors.

- Tax, environmental, labor, insolvency and secured lending laws (or lack thereof).
- Contract enforceability.
- Sovereign risk, primarily as currency transfer and convertibility risk, is also an issue because non-recourse projects have no call on their sponsors' balance sheets if host-country exchange control laws subsequently affect project cash flows across national boundaries.

Legal systems in developing countries often fail to provide the rights and remedies that a project or its creditors typically require for the enforcement of their interests.



Political Risks

- Basis for political risk
 - Change of law risk
 - ✓ Changes in law because of new legislation. These may be passed on to the off-taker in the PPA or concession contract
 - Quasi political risk
 - ✓ Contract disputes
 - ✓ Dividing line between commercial and political risk is blurred
- Mitigate with:
 - Political risk insurance
 - Direct loan insurance



Currency Convertibility

- Often do not raise financing in the currency of the project (e.g. cannot raise Caribbean dollars from local banks). Then must convert revenues collected from the project to another currency.
- If country runs into difficulties (such as Zimbabwe) , then cannot convert the currency and remove from the country. Here the local currency is forbidden to be converted into another currency.
- Mitigate by:
 - Analysis of macroeconomic risks
 - Use of enclave projects with off-shore accounts to collect revenues from commodity. (Problem that may cause other actions from host country).



Change in Law

- General principle that party most able to affect the risk should take the risk means that government off-taker should take the risk.
 - In construction period, the EPC passes to project company who in turn passes on to PPA or Concession contract.
 - Problem with change in tax rates – argument that is general risk of doing business.
 - Mechanics of changing tariffs
 - ✓ Direct change
 - ✓ Interest cost



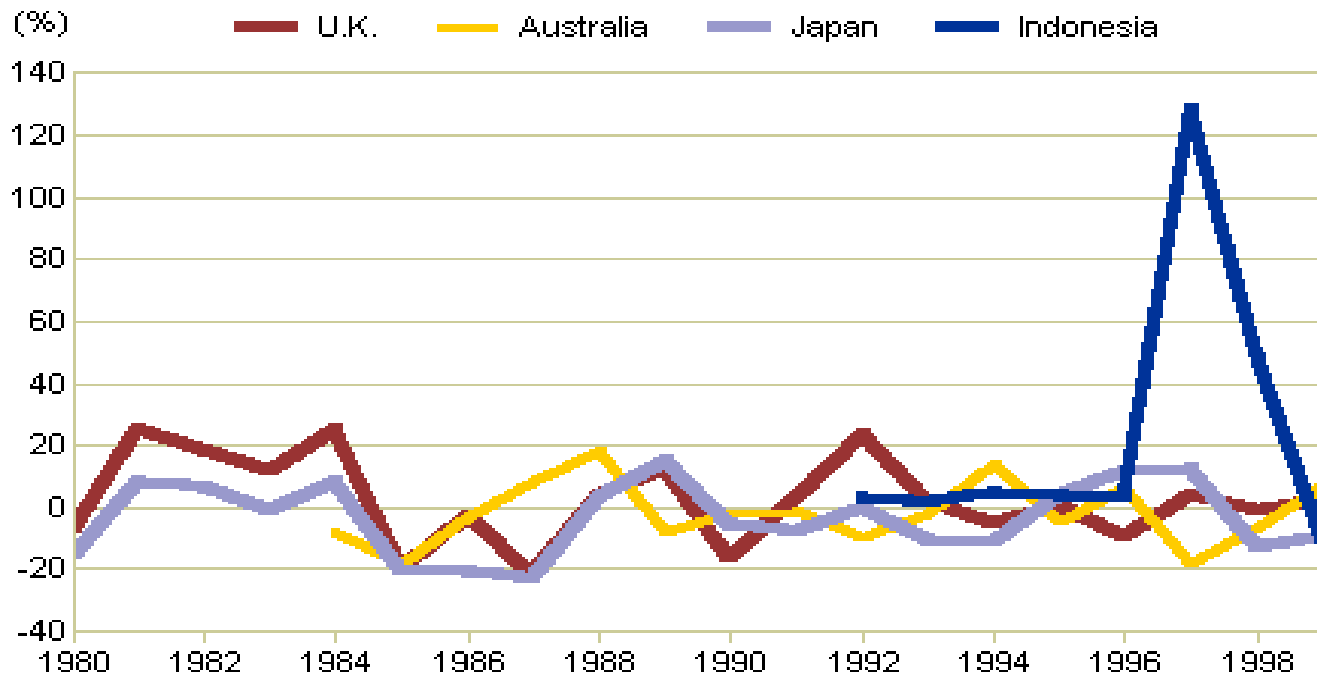
Piercing the Sovereign Veil

- In some rare instances where projects have foreign ownership that is key to the project's operations, the ability to earn a hard currency by exporting a commodity with minimal domestic demand, and other risk-mitigating structures, a project rating may exceed the sovereign rating.



Catastrophic Foreign Exchange Risk

Chart 8
Foreign Exchange Rates Against US\$



Source: Bloomberg



Example of Catastrophic Devaluation – PT Pation

- An offtaker or contractor authority who is taking exchange rate risk by indexing the tariff against a foreign currency probably cannot pass on the this indexation after a major devaluation to the local end-users of the product.
- The effect was seen in the Asian crisis of 1997 and in Turkey in 2001, where power purchase contracts under long-term PPA's had linked tariffs to the foreign currencies. When the power purchasers home currencies suffered huge devaluations, they had obligations under the PPA to increase the tariff and make increased payments.
- These adjustments were not economically or politically realistic.
- Indexation did not work; must evaluate macro-economic data.
- OPIC has debt facility to deal with the problem in Brazil. Comes into play with devaluation and intended to pay back from purchasing power parity notion and the eventual increase in prices.



S&P on Sovereign Risk

- As a general rule, project ratings are constrained by the foreign currency rating of the country in which the project is located.
- A sovereign foreign currency rating indicates the sovereign government's willingness and ability to service its foreign currency denominated debt on time and in full.
 - The sovereign foreign currency rating acts as a constraint, because the project's ability to acquire the hard currency needed to service its foreign currency debt may be affected by acts or policies of the sovereign. For example, in times of economic or political stress, or both, the sovereign may intervene in the settlement process by impeding commercial conversion or transfer mechanisms, or by implementing exchange controls. In some rare instances where projects have foreign ownership that is key to the project's operations, the ability to earn a hard currency by exporting a commodity with minimal domestic demand, and other risk-mitigating structures, a project rating may exceed the sovereign rating.



Foreign Exchange Rate Risk

- Recent experiences in the power sector in emerging markets have dramatically illustrated how foreign exchange devaluations can undermine a project's competitive position. Many cross-border projects, particularly infrastructure projects, have revenues denominated in local currencies but have debt obligations in a different currency. The mismatch creates two potential risks.
 - ✓ If the currency exposure is un-hedged, a project could likely experience a cash shortfall sufficient to cause a default if a sudden and severe devaluation occurs.
 - ✓ The second risk occurs when project revenues are contractually indexed so as to pass on the exchange rate risk to off-takers. In this second instance, lenders run the risk that a massive devaluation will make the project's off-take so expensive in the local currency that off-takers cannot afford to purchase the output. Hence, the risk of contract abrogation may soar.



Evaluating Foreign Exchange Rate Risk

- The limitations of indexing, however, can do little to offset the threat posed by sudden and severe depreciation.
- Standard & Poor's will look to severe scenarios to test a project's robustness in speculative-grade sovereigns or in any other sovereign where the exchange rate regime may be unsustainable. The question is how much devaluation be assumed in the scenarios.



Use of Foreign Exchange Derivatives to Hedge Exposure

- Mitigation strategies such as currency swaps and forward sales, while useful in theory, tend to have limited credit value.
- As a practical matter, the maturity and availability of such instruments, particularly in emerging markets, fall short of the needs of long-term debt. Non-amortizing debt are particularly risky in emerging markets, because a sudden crisis could prevent a refinancing regardless of the pricing.



Example of Political Risk – Robbins Incinerator in US

- Law subsidized waste to energy
- Subsidy was in the form of a zero interest loan
- Budget issues at state caused the law to be over-turned
- See the Robbins prospectus
- Facility cost \$438 million and is now in bankruptcy
 - All accumulated tax credits received by ComEd due to compensation for the additional payments caused by the difference in Rider 3 and Rider 4 rates must ultimately be reimbursed to the Illinois General Fund by the Project. Such reimbursement must commence no later than the 21st' year following the commencement of Commercial Operations of the Project, and the total reimbursement payments must equal the sum of all tax credits accumulated by ComEd from the operation of the Project. The total reimbursement period must be such that all accumulated tax credits are fully reimbursed to the Illinois General Fund by the end of the actual useful life of the Project.



Multilateral Support

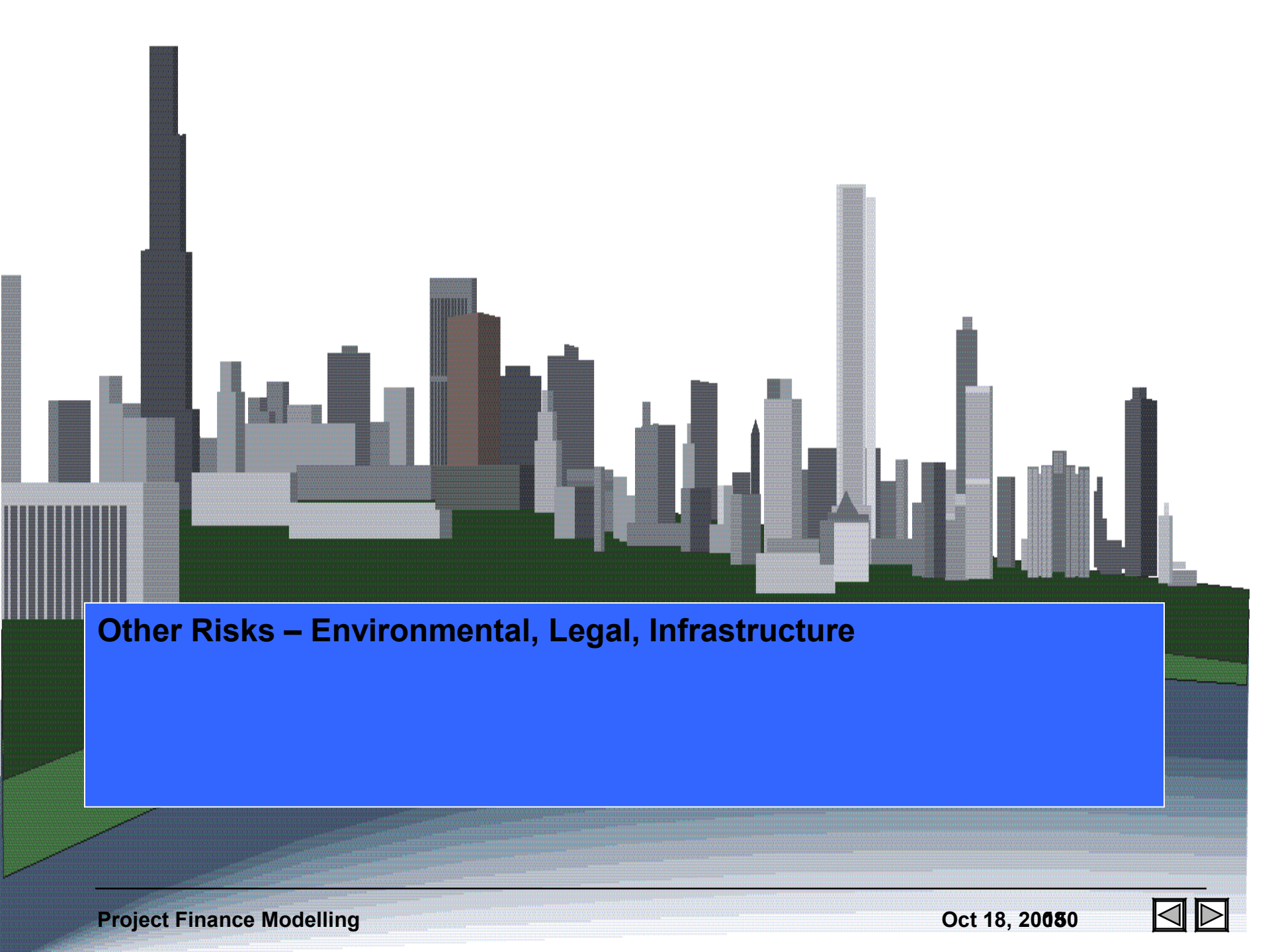
- Mitigation of Political risk by:
 - Guarantees or insurance for political risks
 - Guarantees of insurance for all risks
 - Direct Loans
- Sources of guarantees, insurance and direct loans
 - Export Credit Agencies
 - International Financing Institutions
 - Private Insurance



Management of Political Risk

- Some political risks may be covered by government-Sponsored export credit agencies (ECAs);
- Alternatively, the risks can be absorbed through insurance from groups such as Lloyds of London or private insurance sources.
- If the Project Financing parallels an MLA or ECA financing, then some (but not complete) comfort may be derived from the potential leverage from these government agencies.
- ECAs can provide very effective insurance against currency inconvertibility, creeping expropriation, and unfair calling of performance bonds.
- Usually a delay of six months is built in to the PRI defined events to ensure that the government action is not a temporary squeeze





Other Risks – Environmental, Legal, Infrastructure

Legal Risks

- Exposure to contract termination and tax increases etc from poor contracts
- Mitigation: Second opinion



Interest Rate Risks

- Exposure to increases in interest costs because of interest rate changes. Funding generally with variable rate debt.
- Mitigation
 - Interest Rate Swaps
 - Interest Rate Caps
 - Forward Interest Rates



Environmental Risk

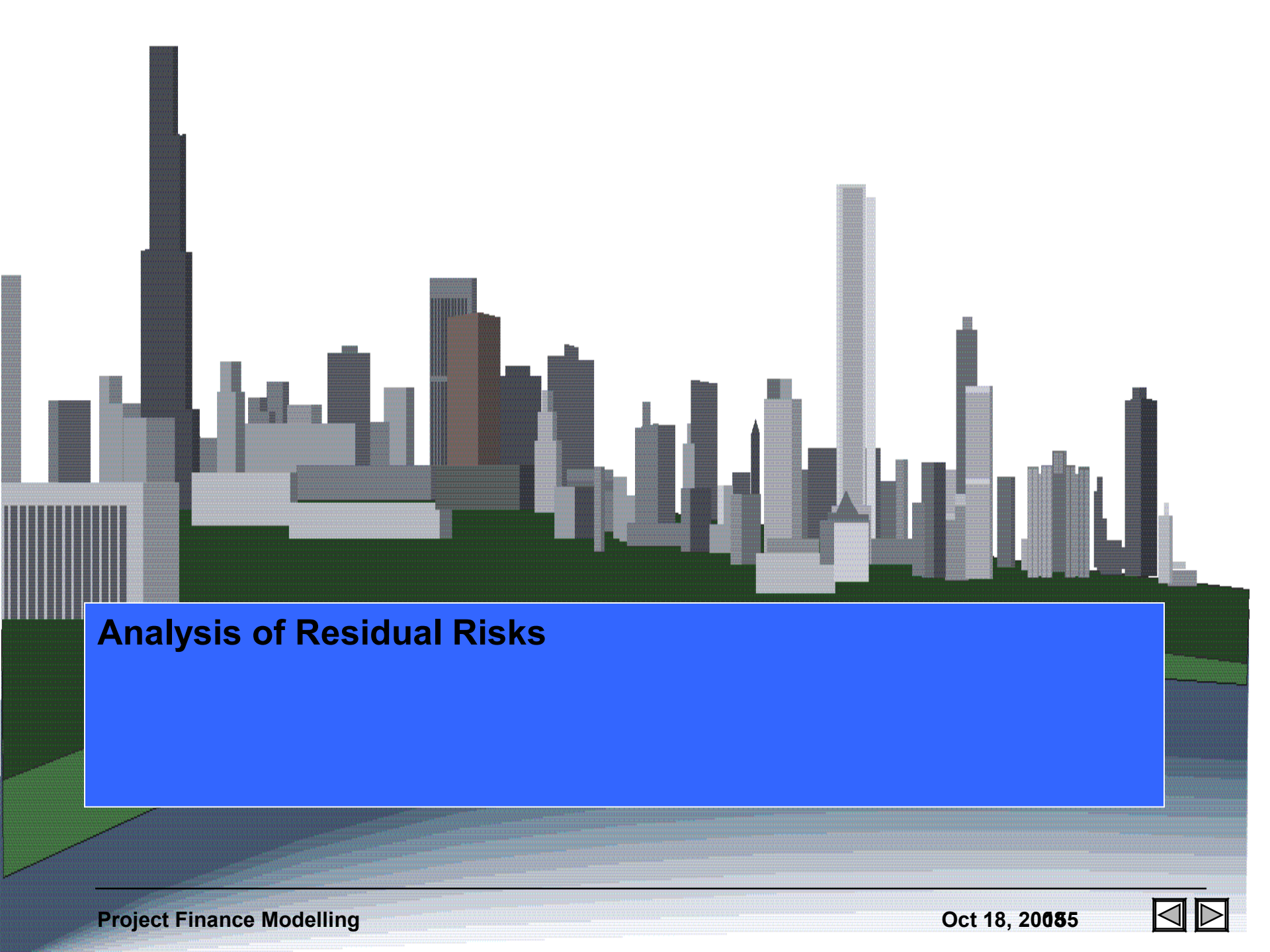
- This risk category can also arise due to location of the project e.g. near towns or highway or in proximity to wilderness, heritage, native reserve, or scenic areas.
- Mitigation
 - Insurance firms are now specializing in assessing projects for environmental event, disaster, and clean-up policies.



Infrastructure Risk

- Risk Related to Costs of Delivering Equipment
 - Transportation costs required to deliver the equipment can sometimes equal or exceed the Project's operating and capital costs.
 - Port capacity may be the limiting factor in remote projects.
 - Example: Wind power in Caribbean
- May Require Independent Certification
- Mitigation
 - Local governments may commit to develop the requisite roads and ports.





Analysis of Residual Risks

Standard and Poor's on Assumptions

- The first analytical task is to identify the project's **key drivers of success** that could adversely affect cash flow for debt service if the original project assumptions prove wrong.
- Financial projections of project finance power projects are probably *inherently skewed toward successful results...hiding the true technical and operating risks inherent in many projects...*"



Standard & Poor's on Assumptions

According to S&P, three potential problems with assumptions include:

- To what extent do predictions about the key drivers, made explicitly or implicitly, rely on overly optimistic plans and scenarios of success?
- Are predictions made symmetrically, in that the downside performance is considered as well as the upside?
- Have the forecasts neglected the statistics of the past, which, among other things, could indicate a different scenario than the one based only upon current trends or conditions?



Risk Assessment Methods with Project Finance Models

- Methods of Risk Assessment
 - Using judgmental assessments
 - ✓ Sensitivity analysis
 - ✓ Scenario analysis
 - ✓ Stress test analysis
 - ✓ Break-even analysis
 - Using mathematical analysis
 - ✓ Volatility
 - ✓ Monte Carlo simulation
 - ✓ Value at Risk



Three Risk Analysis Techniques with Project Finance Models

- Traditional methods of using a project finance model with expert judgement to assess the risk include break-even analysis, scenario analysis and sensitivity analysis:
 - Sensitivity analysis
 - ✓ Evaluates how the credit quality and value is affected by changing single variables.
 - Scenario analysis
 - ✓ Measures the ability to service debt and generate cash flow under a comprehensive set of assumptions for market prices, fuel costs, plant availability and other variables.
 - Break-even analysis
 - ✓ Tests how much worse a variable can become before a default or non-payment of debt occurs. Break-even analysis can be applied to the minimum debt service coverage ratio or the amount of debt outstanding at the end of the life of a project.



Sensitivity Analysis and Scenario Analysis (Reference)

- **Sensitivity Analysis**

- Simple sensitivities to potential changes in fuel prices, project availability, mechanical efficiency, inflation, and O&M costs usually sufficed to measure financial risk. Too simplistic and thus, may not capture a project's financial risk. Because sensitivity analysis only tests a projects' response to one variable, it ignores the multidimensional reality of business and, therefore, may ignore the full range of uncertainty. Still worse, sensitivity analysis may elevate pinhole risks, and their usual attendant dire consequences, to levels that needlessly dominate the credit analysis.

- **Scenario Analysis**

- Scenario analysis collectively considers a number of variables and their potential values that a project could face through its debt maturity. A good collection of project scenarios, when placed into the project's financial model, will explore the various, and sometimes complex, linkages and correlations among variables, such as interest rates, inflation, foreign exchange, product price, or cost of production in some industries. Assess the long-term drivers of profitability in the project's industry, as well as the specific project, and identify the critical uncertainties. Develop several scenarios based on those uncertainties, asses their relative likelihood of occurrence, and then determine how robust or weak the project is under varying economic and market conditions.



Stress Test Analysis

- Stress scenarios test the pro forma results' sensitivity to changes in key assumptions and operational parameters that explore how a project will fare under different views of the market:
 - Changes in technical parameters and performance, such as efficiency, availability, output, etc.;
 - Fuel, supplies, and other operating expenses;
 - Downside market price and demand scenarios;
 - Inflation rates, including de-inflation if appropriate;
 - Interest rate exposure for projects with floating rate debt;
 - Foreign exchange movements;
 - The effects of new technologies; and
 - Additional debt levels, as allowed by project documentation.



Rating Agency Comments on Risk Analysis with Models

- **Fitch**
- The object is to determine if the project is likely to continue to cover operating expenses and debt interest and principal payments despite unexpected stress levels. The scenarios also reveal whether there are particular variables to which the project has a greater degree of sensitivity. The evaluation of the stress scenario results is focused on the ***minimum debt service coverage*** in any single year and the average debt service coverage over the entire life of the debt. If the cash flows are unable to cover payments on project debt under certain stress scenarios, the debt service reserve or other forms of credit enhancement available to the project are applied. Thus, [sensitivity analysis] can be used to size the appropriate debt service reserve or other credit enhancements needed to avoid default under adverse scenarios. Fitch performs sensitivity analyses that stress cash flows down to a break-even level to see how the project performs under extreme hardship conditions and at what minimum power price the project can perform while covering operating costs and debt service payments.



Rating Agency Comments on Risk Analysis with Models

- **Moody's**
- Moody's believes that the appropriate analytical beginning is to determine a credible market forecast and to assess the projects break-even position relative to that market forecast. A break-even point substantially below the market forecast allows a project to absorb unexpected market fluctuations in prices and volumes which is essential to an investment grade debt security. From this analysis, one can derive the appropriate capital structure for each project individually.
- Moody's believes that a merchant plant will be subject to swings in prices as power markets develop. The better able a project is to absorb changes in prices (and changes in volumes) the higher its rating will be. Our belief is that an investment-grade-rated merchant power plant will have a break-even point, where it fully covers its debt service obligations, between 30% and 50% below ***a reasonable market forecast price***. The amount of the discount is determined by the characteristics of the market and the reasonableness of the market forecast assumptions.



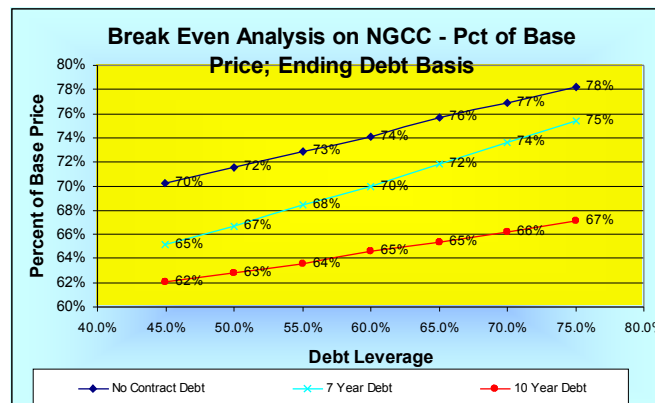
Rating Agency Comments on Risk Analysis with Models

- **Standard & Poor's**
- Where projects elect to obtain key supply inputs from spot markets, the risk of cash flow erosion may raise project credit concerns, particularly in volatile markets, such as energy and other commodities. Stronger projects will be those that can ***demonstrate a resilience to worst case cost movement scenarios as indicated by historical trends***. Historical price trends in such commodities as crude oil, petrochemical products, metals and pulp and paper can provide a basis for analysis of potential worst case price movements. Standard & Poor's will rely in part on financial scenario analysis to assess the effects of supply and cost disruptions on project economics.



Break-Even Analysis

- Break-even analysis can demonstrate how bilateral contracts affect risks. The graphs illustrate application of the break-even electricity price for three different bilateral contract cases. In one case, no bilateral contract is assumed; in a second case, a bilateral contract that covers half of the plant output for six years is assumed; and, in a third case a ten year bilateral contract that covers the entire output of the plant is assumed. Data in the graph show the percent reduction in the spot market price on non-contracted electricity generation while assuring that various sized loans can just be paid from cash flow of the project by the end of its lifetime assuming various different levels of debt leverage.
- The graph show how contracts equate to a higher level of leverage. For a certain acceptable break-even price, the risks can be mitigated either through a contract or through lower levels of leverage.



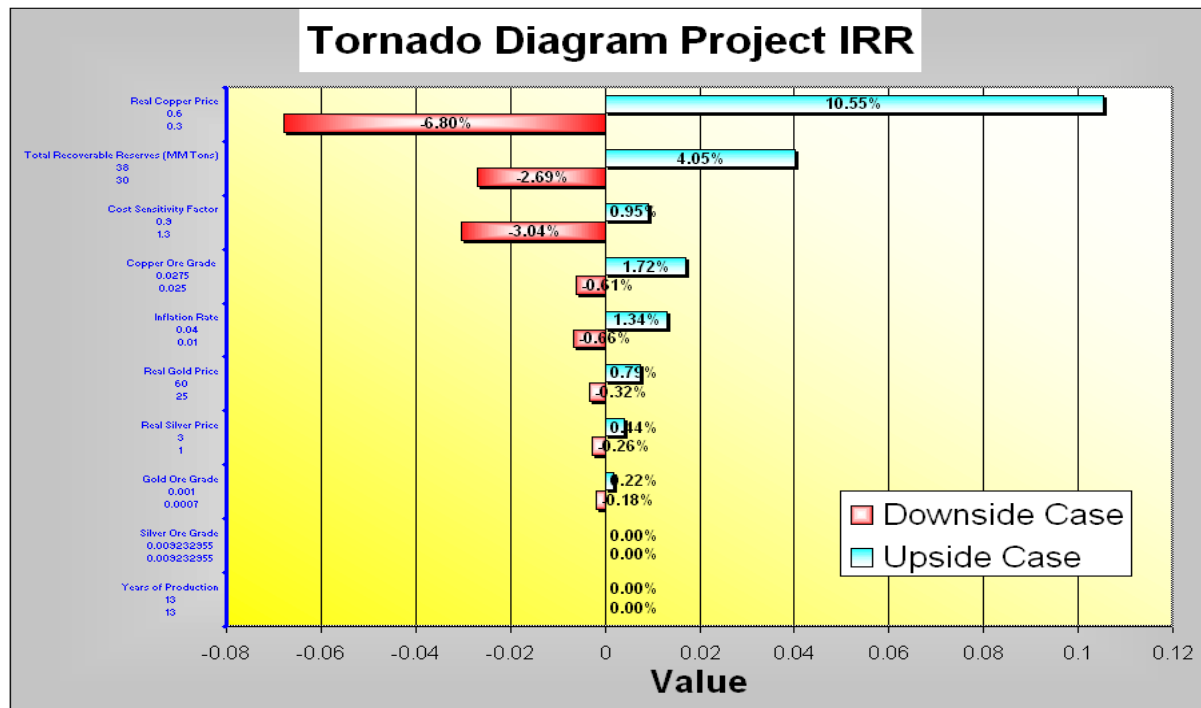
Tornado Diagrams and Sensitivity Analysis

- The tornado graph begins with a base case and measures how much prices move up or down from the base case because of the assumption change.
- The tornado diagram demonstrates which aspects of risk are most important to IRR or DSCR.
- Once the tornado diagram is complete for a case without contractual enhancements, the risk analysis can be re-done with contracts to evaluate how the enhancements affect risk.
- Examples
 - Base case IRR is 14%
 - ✓ Construction cost risk moves down by 2% or up by 3%
 - ✓ Price risk moves IRR up from base case by 4% or down by 5%
 - Base case DSCR is 1.4
 - ✓ O&M risk moves DSCR from 1.4 down to 1.2 or up to 1.5
 - ✓ Volume risk moves DSCR down from 1.4 to 1.3 or up to 1.6



Example of Tornado Diagram

- This diagram illustrates how risks can be assessed with a model. The remaining lectures and case studies will involve assessing how the risks can be reduced or allocated through contract terms.



S&P on Volatility Analysis

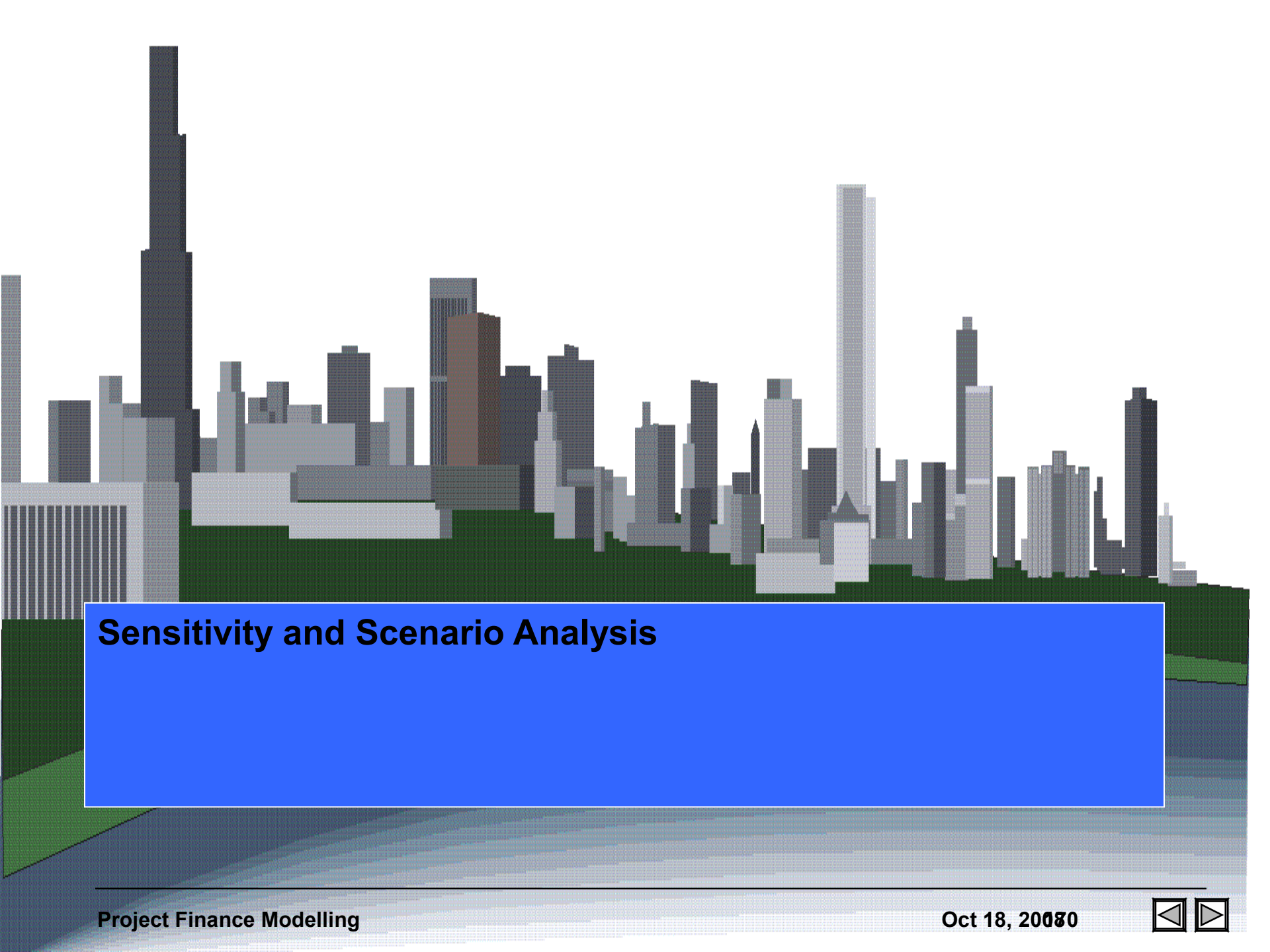
- Where historical price data exist, Standard & Poor's expects that sponsors will have assessed historical and prospective price volatility as part of their analyses.
- Project participants have developed analytic techniques such as option pricing and probabilistic modeling as tools for understanding and managing financial and operational risk.
- While such techniques can be useful for exploring market dynamics and assessing relationships among key variables, Standard & Poor's notes that the historical data needed to employ these techniques tend not to be sufficient at present to develop reliable predictions or statistically significant inferences for investment-grade transactions. Hence, given the limitations of statistical approaches, statistics will not drive the ratings methodology, but only support the analysis.



Paul Ashley on Simulation

- Given plausible assumptions for key risk drivers (for example, volatility of gas prices), the ratings are then built around simulating cash flows and debt coverage for individual projects. These simulations can then determine probability and loss distribution and directly observe the impact on cash flows and riskiness of a particular transaction structure under different market environments.
- The parameterization of the rating simulations combines market data and expert judgment in a structured way that allows transparency and consistency in risk evaluation without losing the ability to capture the specifics of a transaction structure.





Sensitivity and Scenario Analysis

Example of Summary Page with Graph

Year	0	1	2	3	4	5
Summary Financial Data						
Free Cash Flow	(12,609,137)	136,584	2,912,624	5,438,598	6,766,992	8,354,138
Equity Cash Flow	-	(1,576,593)	1,199,446	3,725,420	5,053,814	6,640,960
Net Income	(800,000)	(256,994)	399,928	2,986,744	4,379,630	6,035,138
Colocation utilization						
Base Case		35%	50%	70%	80%	90%
Low Case		30%	30%	30%	40%	40%
High Case		35%	70%	90%	90%	90%
Case Applied		35%	50%	70%	80%	90%
Managed Service Utilization						
Base Case		5%	10%	15%	20%	30%
Low Case		5%	5%	5%	10%	10%
High Case		5%	15%	20%	30%	40%
Case Applied		5%	10%	15%	20%	30%
Prices						
		Base	Sensitivity	Applied		
Colocation		20,000	100%	20,000		
Managed Service		200,000	100%	200,000		

NPV (AED M)	IRR (%)	Payback (Yrs)	Discounted Payback (Yrs)
5.5	23.1%	3.6	7.0

Financing and Valuation Assumptions

Cash Flow Growth in Perpetuity	0%
Discount factor	12%
Book Value Multiple	1.00

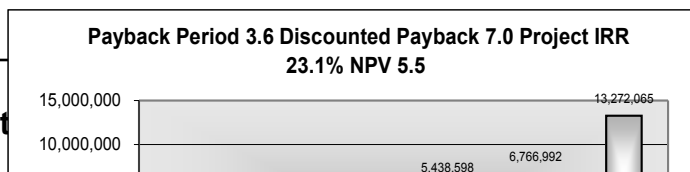
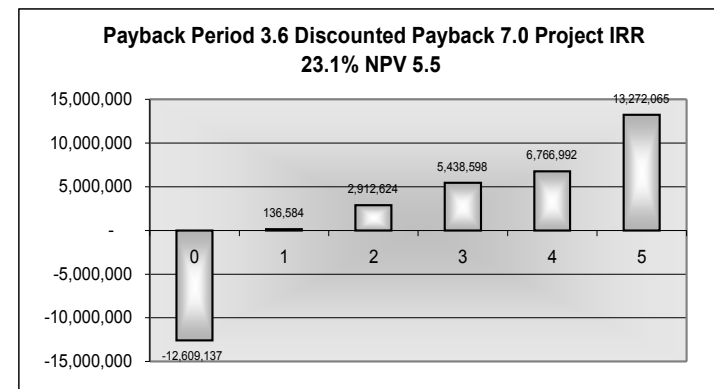
Debt Financing Assumptions

Debt Percent	100%
Repayment Period (Maturity) Per	10
Effective Interest Rate	6.00%

Cost Parameters

Hardware Percent	60%
Network Costs	1,000,000
Rental Rate	50
Additional Staff	300,000

When the inputs are change, the graph changes and the title of the graph changes. This is an effective way to present results.



Sensitivity Analysis with Variable that Changes over Time

- The prior example worked when a input number was changed. However, you often want to change a series of numbers. This is accomplished using two excel tools:
 - The View, Toolbars, Forms, Combo Box to create a list box
 - The offset command to create a series of variables.



Example with Sensitivity Analysis

Summary Financial Data

Year	0	1	2	3	4	5
Free Cash Flow	(12,609,137)	(441,934)	2,562,624	4,738,598	6,066,992	6,954,138
Equity Cash Flow	-	(2,155,112)	849,446	3,025,420	4,353,814	5,240,960
Net Income	(800,000)	(835,513)	49,928	2,286,744	3,679,630	4,635,138

Financing and Valuation Assumptions

Cash Flow Growth in Perpetuity	0%
Discount factor	12%
Book Value Multiple	1.00

Debt Financing Assumptions

Debt Percent	100%
Repayment Period (Maturity)	10
Per	1
Effective Interest Rate	6.00%
Network Costs	1,000,000
Rental Rate	50
Additional Staff	300,000

NPV (AED M): 3.0
IRR (%): 18.1%
Payback (Yrs): 2.9
Discounted Payback (Yrs): 7.0

Utilization Assumptions

Case	Year 1	Year 2	Year 3	Year 4	Year 5
Colocation utilization	35%	30%	70%	80%	90%
Base Case	30%	30%	30%	40%	40%
Low Case	35%	70%	90%	90%	90%
High Case	30%	30%	30%	40%	40%
Managed Service Utilization	5%	10%	15%	20%	20%
Base Case	5%	5%	5%	10%	10%
Low Case	5%	15%	20%	10%	10%

Utilization Assumptions : Colocation utilization Low Case Managed Service Utilization Low Case

Period 2.9 Discounted Payback 7.0 Project IRR 18.1% NPV 3.0



Create Data Tables

- The easiest way to develop sensitivity analysis is creating data tables.
- Data tables require:
 - Input driver (e.g. discount rate)
 - Range of inputs in a row or column (e.g. 5% to 10%)
 - Formula that is affected by inputs
- A set of one way tables is an effective way to demonstrate the impact of variables. For example:
 - Input variable is prices
 - Output variable is IRR, Payback, Cash Flow by Year, NPV



Example of Data Table

- In the case shown on the next page, a data table is used to show the effects of price on NPV, IRR etc.
- First, make sure when you change the variable (in this case, the price sensitivity), the NPV, IRR etc should also change.
- Next, Input the range of sensitivity analysis you want to present on a column or a row.
- Link (using the = sign) to formulas for NPV, IRR etc. This must be one up and beginning one to the right of the columns of sensitivity.
- Use the data table function from excel menus as described in the excel_instructions.ppt slides.
- Create an x-y graph to illustrate the results.



Data Table Illustration

Microsoft Excel - hasnaa_data_table.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

G34 {=TABLE(.F19)}

Year	0	1	2	3	4	5
Summary Financial Data						
Free Cash Flow	(12,609,137)	136,584	2,912,624	5,438,598	6,766,992	8,354,138
Equity Cash Flow	-	(1,576,593)	1,199,446	3,725,420	5,053,814	6,640,960
Net Income	(800,000)	(256,994)	399,928	2,986,744	4,379,630	6,035,138

NPV (AED M)	IRR (%)	Payback (Yrs)	Discounted Payback (Yrs)
2.5	18.1%	3.6	7.0

Financing and Valuation Assumptions

Cash Flow Growth in Perpetuity	0%
Discount factor	12%
Book Value Multiple	1.00

Debt Financing Assumptions

Debt Percent	100%
Repayment Period (Maturity) Per	10
Effective Interest Rate	6.00%

Cost Parameters

Hardware Percent	60%
Network Costs	1,000,000
Rental Rate	50
Additional Staff	300,000

Colocation utilization Base Case

Base Case	35%	50%	70%	80%	90%
Low Case	30%	30%			
High Case	35%	70%			

Managed Service Utilization Base Case

Base Case	5%	10%	15%	20%	30%
Sensitivity	5%	5%	5%	10%	10%
Applied	5%	15%	20%	30%	40%

Price Sensitivity

Price Sensitivity	NPV (AED M)	IRR (%)	Payback (Yrs)	Discounted Payback (Yrs)
50.0%	12.43	18%	3.6	7.0
60.0%	9.45	-100%	7.00	7.00
70.0%	6.48	-19%	7.00	7.00
80.0%	3.50	2%	7.00	7.00
90.0%	0.52	11%	7.00	7.00
100.0%	2.45	18%	3.61	7.00
110.0%	5.43	25%	3.23	3.89
120.0%	8.41	32%	2.94	3.47
130.0%	11.38	38%	2.68	3.15
140.0%	14.36	43%	2.48	2.88
150.0%	17.34	49%	2.32	2.66

NPV Sensitivity Analysis of Prices for Colocation and Managed Service

Use column number to attach variable to data table

Data table with NPV, IRR variables



Scenario Analysis

- The analysis so far does not allow one to change many variables at the same time and then examine a number of outputs.
- For example, you may want a recession case, a high productivity case, an alternative strategy case and various other cases.
 - Each case involves changing a number of different variables
 - In each case, you want to examine a number of output variables such as NPV, payback period and net income by year
 - You may want examine many different scenarios
- To perform the scenario analysis, use the combo box, the offset command, and a macro to loop through the different scenarios

~~• It would be possible to do this by hand, but the macro and offset command to mechanize the process~~



Scenario Analysis Process

- The process for scenario analysis
 - Decide on input and output variables
 - Type the titles for the input and output variables
 - Type data for the input variables
 - Insert links to output variables
 - Create macro that changes the cell link of the combo box
 - Adjust the row number in the macro



Set-up of Scenarios

The screenshot displays a Microsoft Excel spreadsheet titled "hasnaa_scenario_analysis.xls". The main data area is organized as follows:

- Summary Financial Data (Rows 4-6):** Shows cash flows from Year 0 to Year 5.

Year	0	1	2	3	4	5
Free Cash Flow	(12,609,137)	136,584	2,912,624	5,438,598	6,766,992	8,354,138
Equity Cash Flow	-	(1,576,593)	1,199,446	3,725,420	5,053,814	6,640,960
Net Income	(800,000)	(256,994)	399,928	2,986,744	4,379,630	6,035,138
- Assumptions (Rows 8-17):** Includes dropdown menus for "Colocation utilization" and "Managed Service Utilization", and various percentage-based inputs for Base, Low, and High cases.
- Prices (Rows 19-21):** Lists values for Colocation, Managed Service, and Managed Service.
- Scenario Table (Rows 23-31):** A table where each row represents a scenario (e.g., Base Case, Recession Case) and columns represent input variables like Utilization, Prices, Percent, Network Costs, and Rental Rate.

Scenario	Colocation Utilization	Managed Service Utilization	Colocation Prices	Managed Service Prices	Hardware Percent	Network Costs	Rental Rate	NPV	IRR	Payback (yrs)	Average NI
Base Case	Base	Base	20,000	200,000	60%	1,000,000	50	2.5	18.1%	3.6	2,708,889
Recession Case	Low	Low	18,000	190,000	60%	900,000	45				
High Growth Case	High	High	22,000	210,000	65%	1,100,000	55				
High Utilization	High	High	20,000	200,000	60%	1,000,000	50				
Low Utilization	Low	Low	20,000	200,000	60%	1,000,000	50				
High Cost Case	Base	Base	20,000	200,000	65%	1,200,000	55				
Low Cost Case	Base	Base	20,000	200,000	55%	900,000	45				
- Summary Metrics (Rows 2, 7, 23):**
 - NPV (AED M): 2.5
 - IRR (%): 18.1%
 - Payback (Yrs): 3.6
 - Discounted Payback (Yrs): 7.0

Annotations in the image include:

- A yellow box with the text "Type inputs for the scenarios and type outputs on one line" pointing to the input columns of the scenario table.
- Arrows pointing from the "Inputs" box to the "Links to output variables" box, indicating the flow of data from inputs to the summary metrics.
- A yellow box with the text "Links to output variables" pointing to the NPV, IRR, and Payback cells in the summary metrics row.



Input the Combo Box and Use the Offset Command to Define Inputs of the Scenarios

Microsoft Excel - hasnaa_scenario_analysis.xls

File Edit View Insert Format Tools Data Window Help

D33 fx =OFFSET(D25,case_no-1,0)

Year	0	1	2	3	4	5
Summary Financial Data						
Free Cash Flow	(12,609,137)	136,584	2,912,624	5,438,598	6,766,992	8,354,138
Equity Cash Flow	(1,576,593)	1,199,446	3,725,420	5,053,814	6,640,960	
Net Income	(800,000)	(256,994)	399,928	2,986,744	4,379,630	6,035,138

Scenario	Colocation Utilization	Managed Service Utilization	Colocation Prices	Managed Service Prices	Hardware Percent	Network Costs	Rental Rate
Base Case	Base	Base	20,000	200,000	60%	1,000,000	50
Recession Case	Low	Low	000	000	45		
High Growth Case	High	High	000	000	55		
High Utilization	High	High	000	000	50		
Low Utilization	Low	Low	000	000	50		
High Cost Case	Base	Base	000	000	55		
Low Cost Case	Base	Base	000	000	45		

NPV (AED M)	IRR (%)	Payback (Yrs)	Discounted Payback (Yrs)
2.5	18.1%	3.6	7.0

Financing and Valuation Assumptions

- Cash Flow Growth in Perpetuity: 0%
- Discount factor: 12%
- Book Value Multiple: 1.00

Debt Financing Assumptions

- Debt Percent: 100%
- Repayment Period (Maturity): 10
- Per: 1
- Effective Interest Rate: 6.00%

Cost Parameters

- Hardware Percent: 60%
- Network Costs: 1,000,000
- 300,000

Scenario Summary

Scenario	NPV	IRR	Payback (yrs)	Average NI
Base Case	2.5	18.1%	3.6	2,708,889

Annotations:

- Add a combo box with a cell link that defines a scenario number
- Link the offset definitions to input variables
- Use the offset command driven by the scenario number



Results of Scenario Analysis

Microsoft Excel - hasnaa_scenario_analysis.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

A35 fx

Year	0	1	2	3	4	5	NPV (AED M)	IRR (%)	Payback (Yrs)	Discounted Payback (Yrs)
Summary Financial Data							3.4	20.3%	3.5	7.0
Free Cash Flow	(12,579,137)	316,584	3,142,624	5,718,598	7,096,992	8,784,138				
Equity Cash Flow	-	(1,392,517)	1,433,522	4,009,496	5,387,890	7,075,036				
Net Income	(770,000)	(75,194)	631,592	3,268,263	4,710,996	6,466,341				

Scenario	Colocation Utilization	Managed Service Utilization	Colocation Prices	Managed Service Prices	Hardware Percent	Network Costs	Rental Rate	NPV	IRR	Payback (yrs)	Average NI
Base Case	Base	Base	20,000	200,000	60%	1,000,000	50	2.5	18%	3.6	3,000,399.3
Recession Case	Low	Low	20,000	200,000	60%	900,000	45	2.0	6%	7.0	1,218,995.6
High Growth Case	High	High	22,000	210,000	65%	1,100,000	55	5.4	25%	3.3	3,707,879.4
High Utilization	High	High	20,000	200,000	60%	1,000,000	50	3.7	21%	3.5	3,128,889.3
Low Utilization	Low	Low	20,000	200,000	60%	1,000,000	50	0.2	12%	2.9	1,963,185.6
High Cost Case	Base	Base	20,000	200,000	65%	1,200,000	55	1.2	15%	2.8	2,317,379.4
Low Cost Case	Base	Base	20,000	200,000	55%	900,000	45	3.4	20%	3.5	3,000,399.3
Case Applied	Base	Base	20,000	200,000	55%	900,000	45				

Run Scenarios

Results of Macro

start | Internet Expl... | Microsoft Pow... | PERSONAL.XLS | hasnaa_scenario... | Contacts - Micros... | 6:51 PM

