



## **“Déjà vu All Over Again?” Nuclear Power in Future Electric Rate Cases**

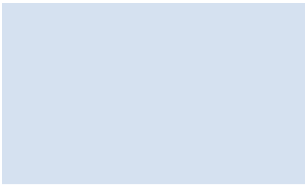
**Law Seminars International  
Managing the Modern Rate Case**

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February 14, 2006**

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# Agenda

- Overview
- Past rate case treatment of nuclear power
- Why nuclear power today?
- Key economic and regulatory issues that will affect future utility rate cases



# Overview

## Today's electric industry landscape

- Wholesale energy markets competitive in many -- but not all -- regions
  - FERC market-based rate applications determine ability of wholesale generators to sell competitively
- Continued industry “restructuring”
  - New environmental mandates
  - Re-regulation of utilities pondered to address weaknesses of retail competition
  - Markets for ancillary services developing – but complex
- New approaches to local utility regulation needed in the face of increased fossil fuel prices and price volatility
  - Recognition of the value of hedging
  - Development of competitive procurement approaches for utility load responsibility
- Natural gas may no longer be “fuel of choice”
  - Rapid increase and volatility of natural gas prices
  - Clean coal technologies under development
  - What will the future bring?

## Today's electric industry landscape (cont.)

- The nuclear industry
  - Aging nuclear fleet
  - Consolidation of nuclear plant owner-operators
  - Critical policy issues (siting, permanent waste storage) unresolved
  - Five years ago, when natural gas prices were low, marginal prospects for domestic nuclear power industry
- Recent market changes have renewed prospects for nuclear power
  - Rapid increases in fossil fuel prices and price volatility
  - Concerns over fossil fuel supplies – both natural gas and crude oil
  - Increasing concern over greenhouse gas emissions – limiting coal-fired power plant development
  - Development of third and fourth generation reactor designs
  - Increased federal involvement to spur new investment by reducing financial risk

## Nuclear power – key issues

- Reducing and allocating construction/operating risk are crucial issues
  - Reduce long licensing/construction lead-times
    - Treatment of “construction work in progress” (CWIP) costs
  - Widespread utility development and ownership unlikely
    - Development by consortiums and existing multiple plant operators who can exploit economies of scope
  - Financial risk will affect utilities’ overall cost of capital and capital structure

**In approaching new nuclear investments, regulators and investors will be highly risk averse**

## Nuclear power – implications for utility rate cases (cont.)

- For nuclear investments to be viable, utilities must avoid past rate case problems
  - Prudence challenges arising from severe cost overruns
  - After-the-fact determinations of used-and-usefulness
- State and federal environmental initiatives will influence role, relative cost, and acceptance of nuclear power
  - NRC expedited licensing process, developed in 1992
  - State-level siting certification still required
    - Rules vary by state
- Investors will want as much certainty as possible in the rate case process
  - Requires a comprehensive level of economic understanding that assesses key risks



**Past Rate Case Treatment of Nuclear Power**

## What happened to the U.S. nuclear industry?

- Industry succumbed to a mix of bad economics, bad regulation, and politics
  - One-off designs – essentially custom built plants – eliminated benefits from standardized design
  - Designers failed to realize that there might be a limit on economies of scale: plants became so big that design complexity began to increase per-unit cost
  - Design changes imposed during plant construction led to construction delays and higher capital costs
  - Deregulation of natural gas and oil prices led to significant declines in price, reducing the perceived economic advantages of nuclear power
    - In the 1990s, existence of a “gas bubble” – huge new supplies and very low prices – had generation developers focused almost exclusively on gas-fired generation
  - Lack of permanent waste storage facility
  - Nuclear power became a political symbol, rather than an energy source

**Regulatory uncertainty contributed to the demise of the nuclear industry**

## What happened to the U.S. nuclear industry (cont.)?

- Nuclear power plants built by vertically integrated utilities
  - “Delusions of grandeur” – failure to assess financial risks adequately
- Investment prudence and used-and-usefulness decisions affected the industry
  - Prudence evaluates investments based on what is reasonably known at the time a decision is made
  - Used-and-usefulness is more “after-the-fact” – did an investment decision result in a plant that was actually used to produce electricity?
  - In some cases, regulators imposed de facto “clairvoyance” standards
    - Decisions superseded by outcomes

**Some regulators/legislators introduced “economic” used-and-usefulness – was an operating plant providing energy at or below market cost?**

## What happened to the U.S. nuclear industry (cont.)?

- Regulatory/financial risks became too much for utility investors
  - Size of nuclear plant investments drove some utilities into bankruptcy
  - Fear of nuclear plant accidents after Three-Mile Island
  - Environmental and public opposition to on-site waste storage
  - Decommissioning cost risk – what would it cost and who would pay?
- Popular opposition to nuclear power resulted in legislative bans on new nuclear plants in some states
  - Legislative restrictions of on-site waste storage also enacted



## Why nuclear power today?

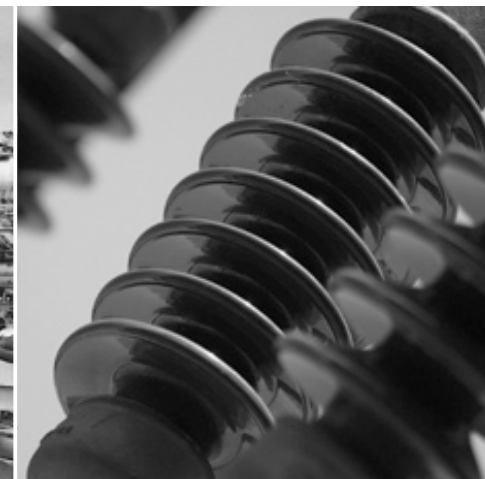
## Poised for a resurgence

- Rapid increases in fossil-fuel prices and price volatility
  - Recognition of importance of fuel diversity
- Environmental requirements
  - Anticipated federal regulations on greenhouse gas emissions
  - Individual state actions on greenhouse gases – e.g., New England Climate Change Agreement
  - Continued environmental opposition to siting coal plants – but clean-coal technology is under development/testing
- Growing need for baseload generation and capacity – cannot be met with renewable energy alone
- Industry consortia working on siting, certification of new plants
  - Goal: construction and operating license (COL) issued by NRC under streamlined certification rules developed in 1992

**Limited fossil fuel alternatives and increasing electric demand favor nuclear power**

## Nuclear generation technology advances

- Generation III+ plants (under development since 1990)
  - Goal: commercial deployment by 2010
    - Passive safety, more economical
    - BWR, PWR, and gas-cooled plants
  - NuStart consortium has selected two sites for COL
    - Grand Gulf, owned by Entergy – GE Economic Simplified Boiling Water (ESBWR) design
    - Bellafonte, owned by TVA – Westinghouse AP1000 (PWR, granted design certification in January 2006)
- Generation IV plants (under development since 1999)
  - Goal: commercial deployment by 2030
    - More economical
    - Produce minimal waste
    - Westinghouse - Intl. Reaction Innovative Secure (IRIS): small (100 – 300 MW), PWR. Modular design, everything integrated within containment vessel.



**Key economic and regulatory issues**

## Assessing the economics of new nuclear power plants in utility rate cases

- Two key issues will affect treatment in future utility rate cases
  - Who will build, own, and operate new nuclear plants?
  - How will prudence of either direct investment or signing PPAs be determined?
- Both issues involve assessing financial and business risks
  - New nuclear development will require long-term commitments
  - What is overall magnitude of risk?
    - How does that risk compare to risks of other generation alternatives?
  - How is risk distributed between developers, shareholders, and ratepayers?
- Utilities will need to provide risk-averse regulators and investors “proof” that the risk of nuclear power investments will be worth the benefit

## Examining the risks

- Construction/ownership/operation risk
  - Construction cost/risk financial hurdles – hence consortium approach that avoids “bet the company” investments
  - Long-term PPA hurdles – competitiveness, debt-equivalency issues
    - Evaluating costs and benefits of price hedges vs. resource diversity over time
    - Treatment of long-term PPA costs by regulators over time (regulatory certainty)
    - Impact of existing federal subsidies – uncertainty of continuation
  - Price-Anderson Act liability limits
  - Decommissioning cost risk
  - Competing fossil fuel technologies and prices
    - Gas prices at historic highs – spurring new exploration
      - Despite high price, gas-fired generation has low capital cost and quick start-up, which can complement development of renewable technology
    - Clean-coal technologies beginning to be demonstrated

## Examining the risks (cont.)

- The regulatory process
  - State regulatory approval process – politics, rate risks to consumers
    - Regulators want utilities and investors to bear all of the risk
    - Utilities, investors want commitment in order to proceed with development, or signing long-term PPAs
  - Effect on utility's capital structure and financial risk profile
    - Will nuclear plant ownership lead to higher cost of capital because of perceived financial risks?
    - Will it lead to lower cost of capital by reducing environmental risk exposure?
    - How will long-term PPA be viewed by ratings agencies? (debt equivalency)
  - Regulatory uncertainty must be minimized

**To avoid repeating past mistakes, establish clear regulatory guidelines**

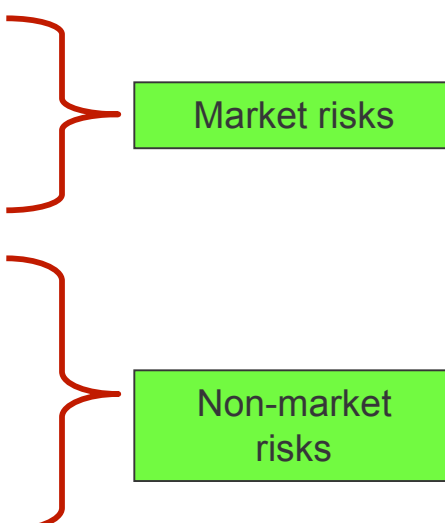
## Examining the risks (cont.)

- Key: determine overall economic viability by objectively quantifying risks
  - Really just cost-benefit analysis under uncertainty
    - Traditional utility planning tools unsophisticated, did not address risk
    - Nuclear power development involves complex risks – some of which are non-market risks (e.g. terrorism)
    - Need to compare alternatives, nuclear on a “level playing field”
  - Allow for regulatory buy-in by demonstrating impacts of specific risks of concern to regulators
    - Identify risks that really matter ... and those that don't
    - Evaluate strategies that can hedge key risks

## Examining the risks (cont.)

- The (pre) rate-case approach
  - Do this before committing to investment – avoid rate case “surprises”
  - Use sophisticated economic decision analysis tools to directly address price volatility and other risks when evaluating either direct investment or PPAs
    - More accurate approach to establishing prudence, used-and-usefulness
    - Provides quantitative assessment of “value-at-risk” for utility management
    - Can address and value non-market risks
  - Provide estimates of value of new nuclear development compared with value of alternatives (overall probability distributions)
    - All generation investments have some risk
    - Need to evaluate risks and accurately compare alternatives

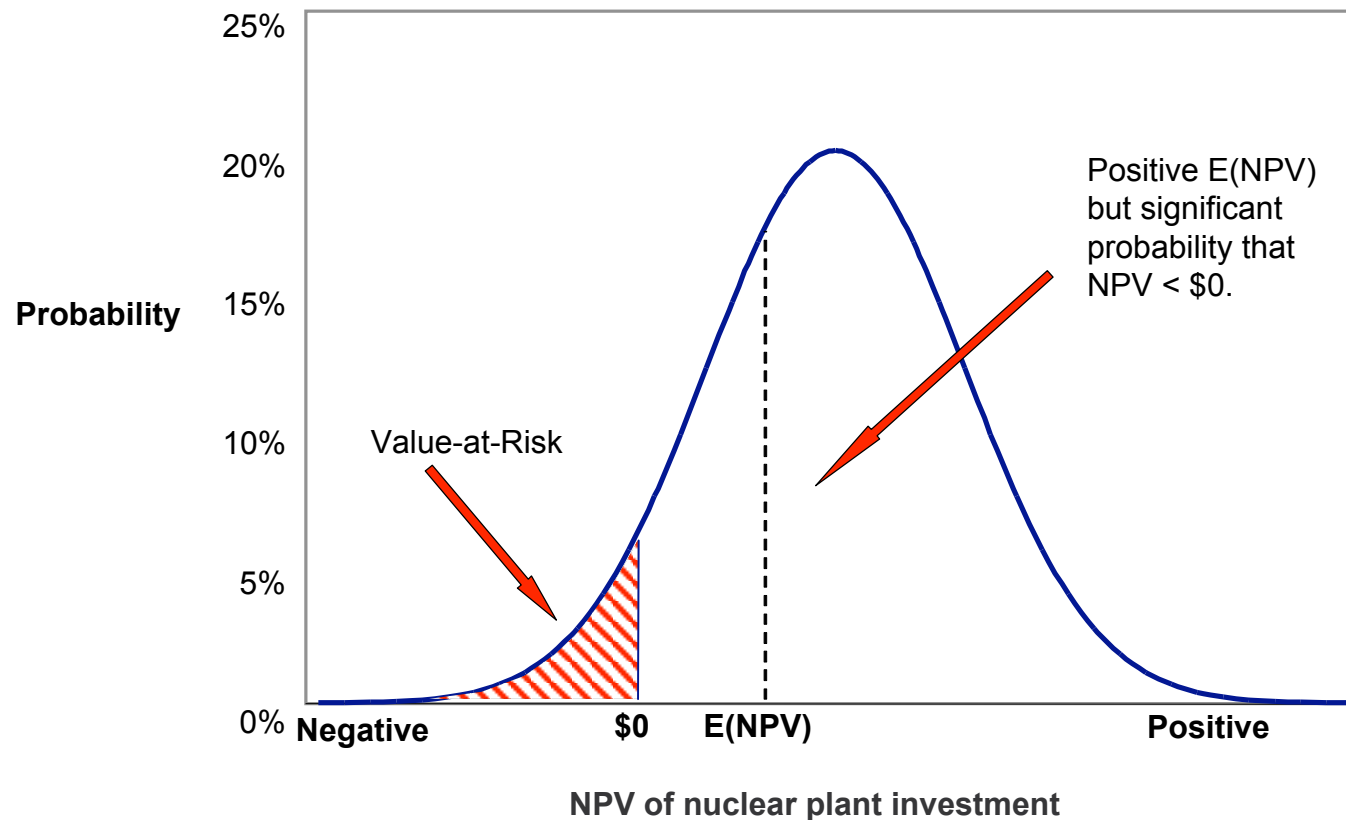
## Economic valuation under uncertainty

- Use economic modeling process to estimate probability distributions of net present value for different investments
    - Sole focus on expected values ignores crucial information about investment risk
  - Requires we identify risk drivers
    - Costs of alternative technologies
    - Fossil fuel price volatility
    - Availability risk
    - Level of government subsidies
    - Relicensing risk
    - Waste storage
    - Terrorism risk
- 
- The diagram consists of two red curly braces on the right side of the list. The top brace groups the first three items: 'Costs of alternative technologies', 'Fossil fuel price volatility', and 'Availability risk'. This brace points to a green rectangular box labeled 'Market risks'. The bottom brace groups the remaining four items: 'Level of government subsidies', 'Relicensing risk', 'Waste storage', and 'Terrorism risk'. This brace points to a green rectangular box labeled 'Non-market risks'.

**Key: provide regulators with a complete view of costs and benefits, including the impacts of specific risks**

## Economic valuation under uncertainty (cont.)

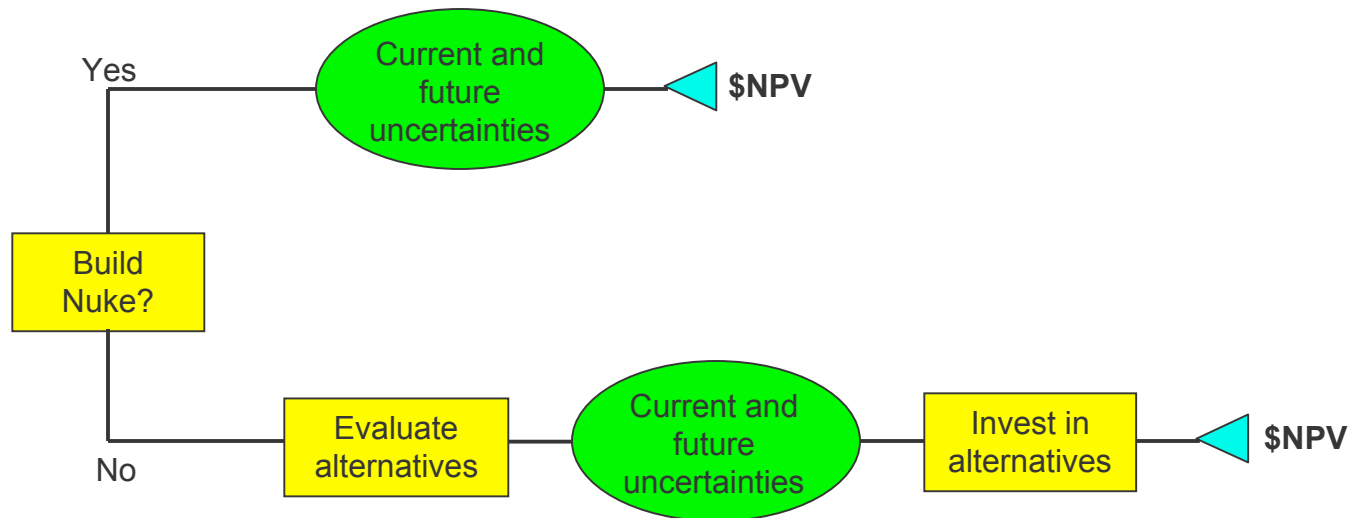
- Just looking at expected value leaves out crucial information
  - Consider likelihood that investment will have negative NPV, even though expected NPV is positive



## Economic valuation under uncertainty (cont.)

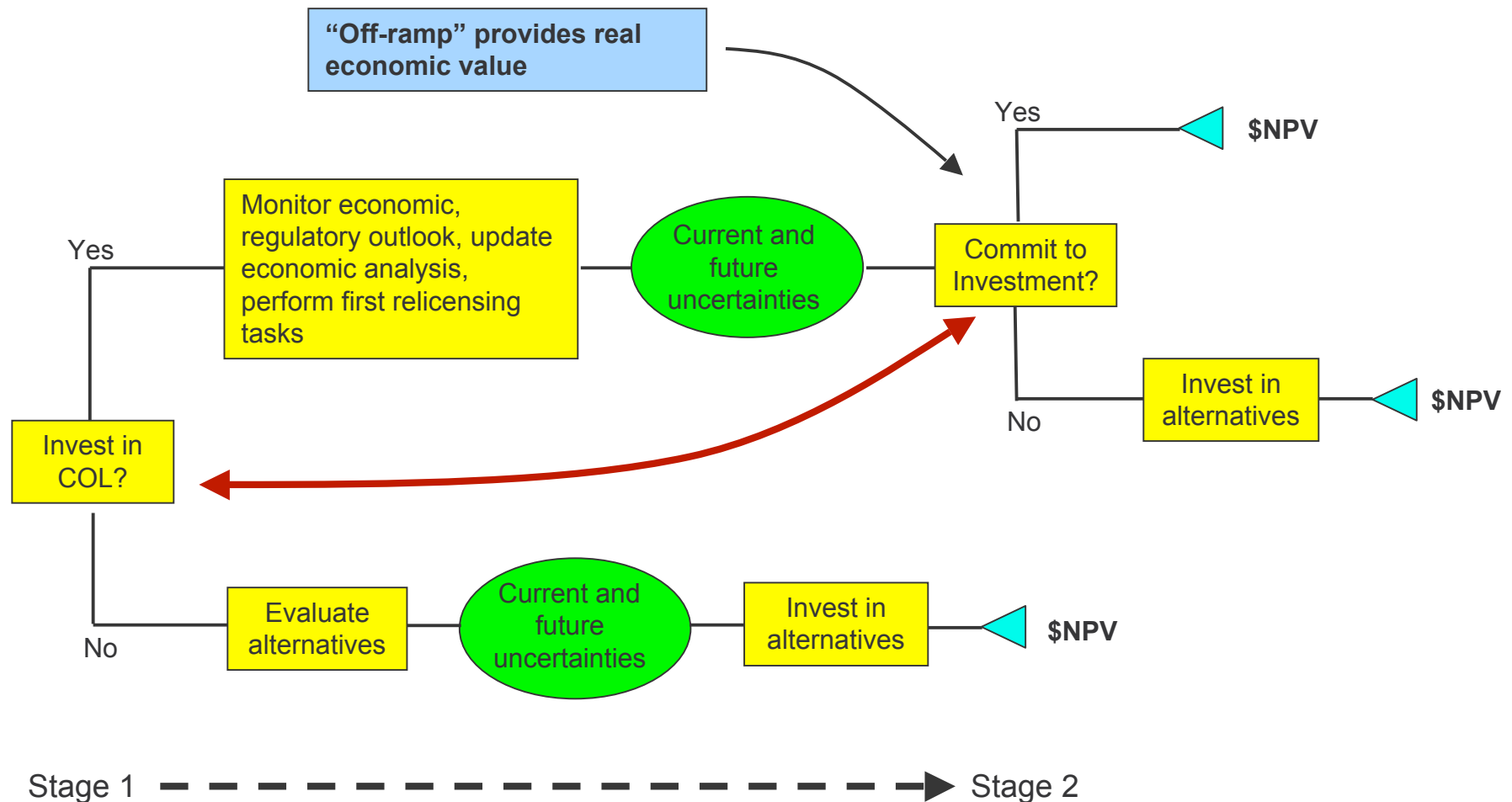
- Uncertainties can reveal benefits, as well as costs
  - Focus is usually on downside risk – but upside is critical, too
  - Fossil fuel price volatility
    - Benefits renewable, nuclear technologies
  - Greenhouse gas legislation
    - Downside risk for coal-plant owners
    - Upside risk for renewable, nuclear
- Evaluating lead times can demonstrate positive value
  - Market volatility often raises a question: abandon or stay the course?
  - NPV analysis typically cannot address this issue
  - Can evaluate “option value” associated with “off-ramps”
    - Development can include key milestones where investment can be re-evaluated
    - Called “real-options” analysis
  - Long-lead times and volatility increase real option value

## Structure of a typical, no-option analysis



This analysis can evaluate uncertainties, but presents only a "build or no" decision. No investment options

## Structure of a probabilistic, real-options analysis



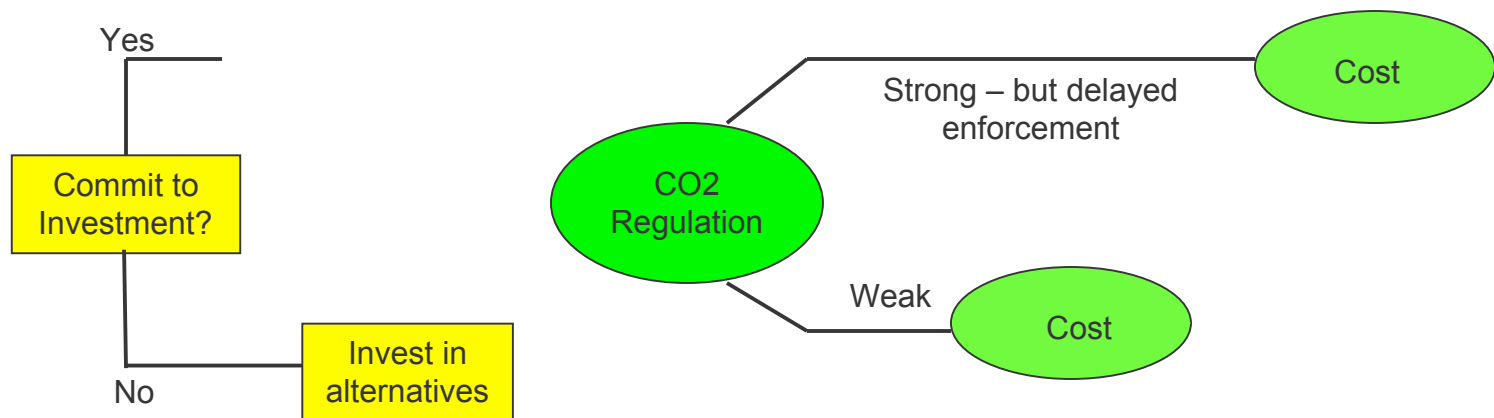
The reduction in expected cost between a "no-option" analysis and one with staged investment can be a significant fraction of total investment cost

## Economic valuation under uncertainty (cont.)

- Accounting for environmental benefits
  - Nuclear provides greater emissions reductions than non-baseload renewables (e.g. wind) since no back-up required
  - Modify renewable portfolio standards requirements to value avoided emissions
  - Economic analysis can directly determine expected benefits associated with avoided emissions resulting from
    - Existing environmental regulations (Clean Air Act)
    - Potential impacts of future environmental regulations (GHG restrictions)
- Utilities spending billions of dollars today in SO<sub>2</sub>, NO<sub>x</sub> emissions control equipment for coal-fired plants
  - Still doesn't address greenhouse gases (experimental technologies)
  - Investment at a single coal plant can exceed \$1 billion (and reduces plant operating efficiency)
    - Need to evaluate relative risks, demonstrate to regulators

## Evaluating environment risk – one framework

- One way to look at greenhouse gas regulation – break into two uncertainties
  - Timing of regulation
  - Severity (hence cost)



## Relicensing existing nuclear plants

- New nuclear plants will need to compete with existing ones
  - Aging fleet, but costs depreciated
  - Hurdles to relicensing existing plants
    - Safety concerns (e.g., containment vessel embrittlement)
    - Maintenance cost uncertainties
      - Probability of high-cost or life-ending equipment failures
  - Utilities that decide to relicense, and seek rate recovery from relicensing costs need to evaluate economics similarly

## Unresolved issues: perfection is the enemy of the good

- Permanent waste storage
  - Still no permanent waste site – Yucca Mountain remains controversial
    - Judicial requirements to ensure safety for 100,000+ years
    - Ability to assess safety in that time frame impossible
  - On-site storage is an alternative
  - Regulatory/political “shakedowns” can increase overall costs of nuclear options
    - Introduces regulatory uncertainty
  - Evaluating uncertainty of (say) greenhouse gas impacts over 100,000 years impossible
    - Assume technology can develop workable solutions in the (relative) near term
  - Not building new nuclear does not “solve” the waste storage problem

## Unresolved issues: perfection is the enemy of the good (cont.)

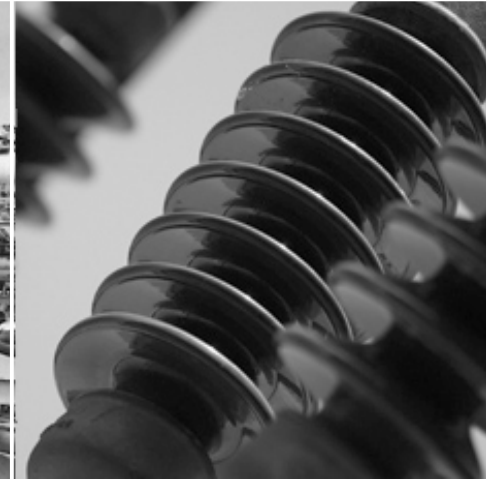
- Terrorism risk
  - Low-probability, high cost event
  - Liability issue
  - Rate case “success” requires economic evaluation of risk
- There are statistical approaches to model and value this type of risk directly
  - Can't rely on expected values
    - Similar to expected cost of a large asteroid impact. Probability is so low that expected cost tiny.
      - But, if it happens, the damages are catastrophic
  - Can use “extreme value” analysis to estimate cost and explain to regulators

## Conclusions

- Circumstances favor new investment in nuclear power
  - Environmental concerns
  - Fossil fuel supply and price concerns
  - Safer, lower-cost technologies
- Risks
  - Streamlined NRC COL regulations, but state-level siting regulations time consuming
  - Regulatory uncertainty
  - Lack of permanent waste storage facility
    - Continued debate over Yucca Mountain
  - Clean-coal technology may prove less costly
    - Opposition to coal plants likely to be lower as a result

## Conclusions (cont.)

- Key rate case issues, assuming new plants built
  - Ensure prudence is well-established before the fact, using more sophisticated economic tools that address risks comprehensively
    - After-the-fact “gotcha” regulation is costly and increases financial risk for all development
    - Get regulators involved up-front – and use sophisticated models to evaluate their specific concerns
  - Evaluate financial/supply risks associated with long-lead time construction
    - What will the world look like at completion?
    - Include development off-ramps (real-options) to reduce adverse impacts
  - Evaluate financial risks to utilities
    - Will nuclear power ownership be viewed as increasing financial risk, leading to higher cost of capital?
    - Will it lower financial risk because of reduced exposure to future environmental regulations?



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