The Economic Future of Nuclear Power

Presentation to the

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The Economic Future of Nuclear Power

- Study requested by Under Secretary and Director of the Office of Nuclear Energy
- What will it take for nuclear power to enter the marketplace?
- Objective analysis—not policy recommendations

White Paper Approach

- Business financial spreadsheet used to compare:
  - Nuclear, gas, and coal costs
  - Effects of assistance policies on business decisions
- Scenarios:
  - Capital costs
  - Effects of risk on required stock and bond returns
  - Plant construction time
  - Federal tax provisions
  - Other financial variables
- First versus later plants
  - First-of-a-kind engineering (FOAKE) costs
  - Learning effects on construction costs
  - Regulatory experience
- Comprehensive study of the future of nuclear power

Outline of Full Study

(available at http://www.rcfecon.com/NucEconFull.pdf)

Part One: Economic Competitiveness of Nuclear Energy

1. Levelized Costs of Baseload Alternatives
2. International Comparisons
3. Capital Costs
4. Learning by Doing
5. Financing Issues

Part Two: Outlook for Nuclear Energy's Competitors

6. Gas and Coal Technologies
7. Fuel Prices
8. Environmental Policies

Part Three: Nuclear Energy in the Years Ahead

9. Nuclear Energy Scenarios: 2015*
10. Nuclear Energy Scenarios: Beyond 2015

Background Studies

*Focus of today's presentation

Peer Review: Provided Up-to-Date Information

- Industrial Leaders
  - Legal
  - Technical
  - Financial
- National Laboratory
- Department of Energy

Nuclear Energy Scenarios: 2015

- Key Findings
- New Nuclear Plants if No Policy Assistance
- Nuclear Assistance Policies
- Greenhouse Prospects
- Later Nuclear Plants
- Summary: The Major Influences on the Cost of Nuclear Energy

Key Findings

Key Findings

- Without federal financial policies, the first new nuclear plants coming on line will have a levelized cost of electricity (LCOE) that ranges from $47 to $71 per megawatt-hour (MWh), compared to $33 to $41 for coal-fired plants and $35 to $45 for gas-fired plants

- Once engineering costs are paid and the first few plants have been built, the 4th or 5th new nuclear plants could have costs as low as $33 per MWh

- Federal financial policies combining a 20% investment tax credit and an $18 per MWh production tax credit for 8 years could lower first-plant nuclear costs to $25 to $45 MWh

New Nuclear Plants if No Policy Assistance

Nuclear Generation Costs for 1st Plants, $ per MWh

	Overnight Cost			
	$1,200 per kW		$1,800 per kW	
5-year construction period				
	Plant Life		Plant Life	
	40 years	60 years	40 years	60 years
85% Capacity	**47**	47	62	61
7-year construction period				
	Plant Life		Plant Life	
	40 years	60 years	40 years	60 years
85% Capacity	53	53	**71**	70

Coal-Fired Generation Costs

	Overnight Cost			
	$1,182 per kW		$1,460 per kW	
	Coal Price, $ per MMBtu			
	1.02	1.23	1.02	1.23
	Generation Cost, $ per MWh			
2-yr construction	**33**	35	36	39
3-yr construction	34	36	37	40
4-yr construction	35	37	37	**41**

Gas-Fired Generation Costs

	Overnight Cost			
	$500 per kW		$700 per kW	
	Gas price, $ per MMBtu			
	3.39	4.25 & varying over forecast[a]	3.39	4.25 & varying over forecast[a]
	Generation Cost, $ per MWh			
1-yr construction	**35**	42	37	44
2-yr construction	35	42	38	**45**

[a] EIA forecast. Beginning with a price forecast of $4.25 per MMBtu in 2015, a peak of $4.51 is reached in 2021, from which the forecast falls to $4.48 by 2025, at which level it remains for the remainder of the plant life.

Range of Costs

- 1st Nuclear: $47/MWh to $71/MWh
- Gas-fired: $35/MWh to $45/MWh
- Coal-fired: $33/MWh to $41/MWh

Nuclear Assistance Policies

Costs for 1st New Nuclear Plants With a Combination of Policies, $ per MWh

(20% ITC, $18/MWh PTC for 8 years)

	Overnight Cost			
	$1,200 per kW		$1,800 per kW	
5-year construction period				
	Plant Life		Plant Life	
	40 years	60 years	40 years	60 years
85% Capacity	**25**	25	37	37
7-year construction period				
	Plant Life		Plant Life	
	40 years	60 years	40 years	60 years
85% Capacity	31	30	46	**45**

Greenhouse Prospects

- The results have assumed no additional fossil emissions controls
- Carbon controls would change the competitive balance

Fossil Cost per MWh With and Without Greenhouse Gas Policies ($)

	Current Environmental Policies	Greenhouse Gas Policy
Coal-fired	33 - 41	83 - 91
Gas-fired	35 - 45	58 - 68

Note: 1st plant Nuclear cost/MWh with no policy assistance 53 - 71

Nth plant Nuclear cost/MWh with learning only 42 - 58

Later Nuclear Plants

- Preceding results are for initial plants
- Costs for later plants would be reduced by:
  - Pay-down of FOAKE costs
  - Learning effects reduce construction costs
  - Favorable regulatory experience

Later Nuclear Plants: Factors Contributing to Cost Reduction

- Pay-down of $300 per kW in FOAKE costs
- Cost reduction from learning of 3 to 5 percent for plant doubling
- Favorable construction and regulatory experiences:
  - Financiers accept 5-year construction time for planning purposes
  - Risk premium of 3 percentage points above coal and gas construction eliminated
  - Debt-equity ratios rise from 50-50 to as high as 70-30

Generation Costs of Later Nuclear Plants: Learning, Shorter Construction Time, Reduced Risk Premium, and Increase in Debt Ratio

Plant	Scenario				Initial Overnight Cost					
					$1,200 per kW		$1,500 per kW		$1,800 per kW	
	FOAKE Costs, status	Construction Time	Risk Premium	Debt Share of Financing	Cost Reduction from Learning					
					3%	5%	3%	5%	3%	5%
					LCOE ($ per MWh)					
1	*Already paid on $1,200 plant.*	*7 years*	*3%*	*50%*	53	53	62	62	71	71
2	*All paid*	*7 years*	*3%*	*50%*	51	51	51	51	60	59
3	*All paid*	*5 years*	*3%*	*50%*	45	44	45	44	52	51
4	*All paid*	*5 years*	*Gone*	*50%*	36	35	36	35	41	40
5	*All paid*	*5 years*	*Gone*	*60%*	**34**	**33**	**34**	**33**	**38**	**37**
7	*All paid*	*5 years*	*Gone*	*70%*	**32**	**31**	**32**	**31**	**36**	**35**

The Major Influences on the Cost of Nuclear Power

- Risk Premium
- Construction Time
- Overnight Costs