State and Federal Subsidies to Nuclear Power: The Case of Calvert Cliffs Unit III

Presentation For

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Socialization of Nuclear Power Is Counterproductive and Inefficient

- Energy market transformation requires market transparency, thousands of small actions.
- Subsidies to nuclear new-build:
  - Likely exceed private capital put at risk.
  - Represent highly concentrated political bets.
- Cost of GHG reductions via nuclear pathway greatly exceed other options.

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Key Findings

Estimated subsidies supporting Calvert Cliffs III (Note 1)

Subsidy/wholesale value of power	77%
Subsidies, cents/kWh	5.8-8.4
Full cost of power (subsidies plus private investment), cents/kWh	9.5-12.1
Public subsidies/private investment in plant	155-226%

Cost of GHG mitigation via nuclear energy (Note 2)

	$/mt CO2-eq. reduced	**Multiple of CCX offset value**
Displacing coal	$82-118	20-30x
Displacing natural gas	$138-$199	35-55x
Displacing hydro	$84,000-124,000	23,000-34,000x
Displacing wind (Note 3)	($28,000-40,000)	8,000-11,000x

(1) Mostly relying on their own estimates; and quantifying only 7 of 23 subsidies identified.

(2) Low-end of range represents subsidies only; upper-end is total cost, including private investment.

(3) Negative values indicate subsidies per mt CO2-equivalent *increased* relative to nuclear baseline.

Lessons from Ethanol: Too Many Subsidies, Too Much Money, and Rising

- **Too many subsidies. >** 220 subsidies to ethanol and biodiesel nationwide, and growing.
- **Too much money.**
  - $70-80 billion during 2006-12; 45% or more of the retail value of the product.
  - At least $300 in subsidies per mt CO2-equivalent avoided, 80-150x the value of these offsets on the CCX; 30-55x for cellulosic.
- **Still rising.** Higher mandates (36 bgy rather than 7.5) will boost subsidies by tens of billions per year.
- **Causing great environmental damage.** Feedstock differentiation on environmental criteria mostly symbolic.
- **Lack of policy neutrality directs capital, research in wrong directions**
  - Gallons of biofuel vs. less fossil per passenger- or freight-mile.
  - All drive-train options should be in competition.
  - Integration of demand side.
  - Strip subsidies to conventional transport fuels; agricultural inputs.

Trade-offs Between Energy Options Require Price Differentiation, Not Political Games

	Ethanol	Nuclear
Political definition	Energy independence, "green" energy, displace cash flows to enemies of the US, stepping stone to really clean fuels.	The only large scale, carbon free energy resource; energy independence; clean air.
Politicized policy formulation	36 bgy renewable fuel standard; weak environmental screens under RFS; continued import tariff and VEETC.	Nuclear PTC; federal loan guarantees; P-A cap on accident insurance; construction delay insurance.
Fuel cycle strengths	Some GHG reduction; domestic resource; transport fuel.	Lower carbon; baseload; low operating costs.
Fuel cycle weaknesses	Land, water, chemical usage; monoculture; many feedstocks worsen environmental quality.	Very high capital costs; lumpy capacity with long, uncertain build times; waste, accident, proliferation risks potentially large but difficult to quantify.
Energy-neutral policy statement	Lowest cost way to reduce fossil energy per vehicle- or passenger-mile travelled.	Lowest cost per mt CO2-equivalent avoided.
Small print that really matters	Models used to calculate GHG reductions from particular feedstocks.	Models used to calculate prepayment of credit subsidy from loan guarantees; and who pays if wrong.

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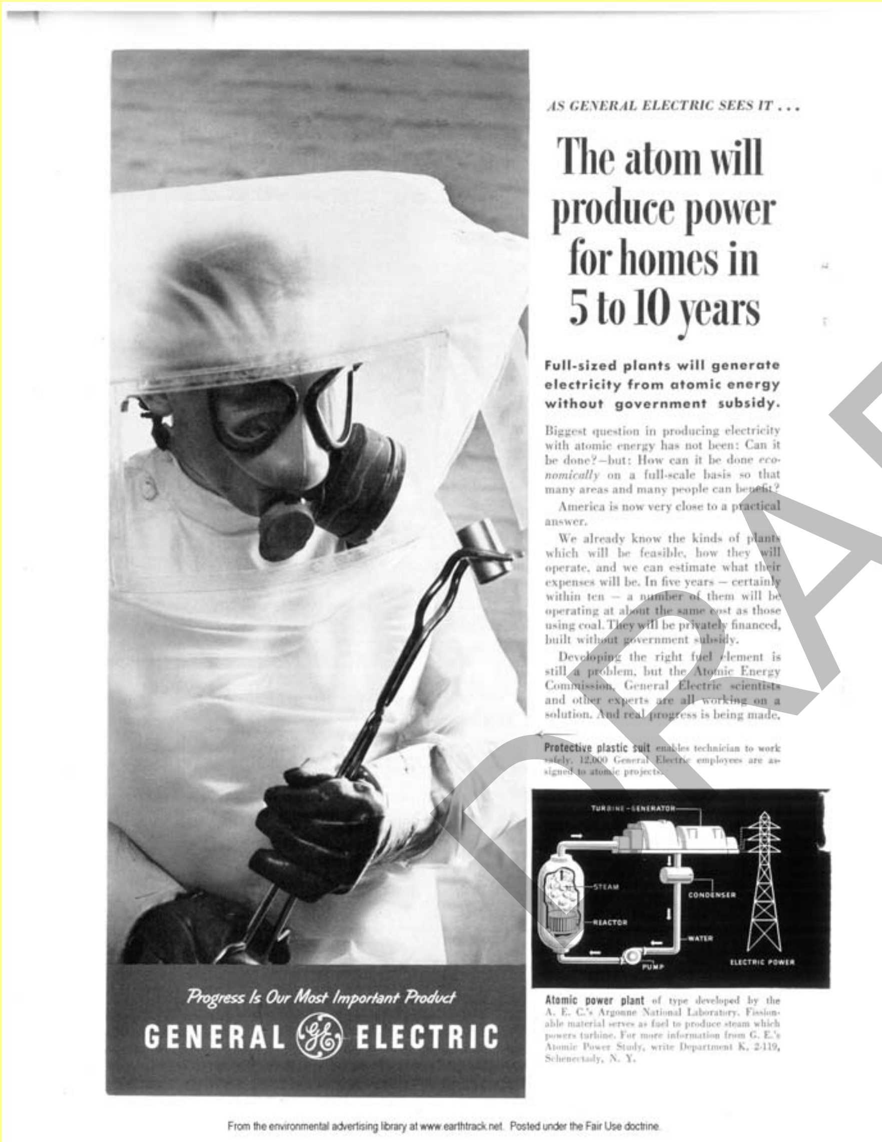

"We already know the kinds of plants which will be feasible, how they will operate, and we can estimate what their expenses will be. In five years – certainly within 10 – a number of them will be operating at about the same cost as those using coal. They will be privately financed, built without government subsidy."

-General Electric Advertisement, 1954

Historic Subsidies to Nuclear: Subsidy Dependency an Old Problem

Subsidizing Plant Construction and Operation (2007$)

Period of Analysis	Federal Subsidy, $Billions		Subsidy, cents/kWh		Avg Subsidy as % of Industrial Price	Analysis	Notes
	Low	*High*	*Low*	*High*			
2008	-	-	5.8	8.4	77%	Koplow/Earth Track calculations	Share of NEPOOL wholesale price
1947-99	178.0	-	1.5	-	NA	Goldberg/Renewable Energy Porfolio Project (2000)	P-A not estimated.
1968-90	122.3	-	2.3	-	33%	Komanoff/Greenpeace (1992)	P-A not estimated.
1950-90	142.4	-	2.6	-	NA	Komanoff/Greenpeace (1992)	
1989	7.6	16.2	1.4	3.1	32%	Koplow/Alliance to Save Energy (1993)	
1985	26.8	-	7.0	-	83%	Heede, Morgan, Ridley/Center for Renewable Resources (1985)	P-A not estimated.
1981	-	-	5.9	12.3	105%	Chapman et al./US EPA (1981)	Tax expenditures only.
1950-79	-	-	4.1	6.0	NA	Bowring/Energy Information Administration (1980)	Tax and credit subsidies not estimated.

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Subsidy Case Study: UniStar Nuclear, LLC and Its Partners

- **Cutting edge technology?** Calvert Cliffs will use an Areva 1600 MW "Evolutionary Power Reactor".
- **Main players.** Joint venture formed July 2007 between Constellation Energy and Electricite de France (EDF).
  - Absorbed earlier partnership between Constellation and Areva NP.
  - EDF committed $350m immediate investment; $275m additional if benchmarks met. Can buy up to 9.9% of Constellation.
- **Current roles.**
  - **Constellation and EDF**: own and operate Calvert Cliffs III (Lusby, MD) and at least three other reactors.
  - **Areva NP**: Reactor technology and marketing.
    - Plants will all use Areva's European Pressurized Reactor (EPR). Called "Evolutionary Power Reactor" in US; Areva spent $200m to adapt reactor to US market.
    - Areva comprised of old Framatome and 1/3 ownership by Siemens. Both French and German governments have significant ownership.
  - **Bechtel**: Architect, engineer, and constructor of new plants.
  - **Additional partners** for license preparation; and forgings and machining.

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Venture Strategy: Market Side

- **First mover advantage**, to secure access to key subsidies and scarce parts.
  - First firm to submit COL paperwork (albeit partial).
  - Early standardization of reactor design.
- **Economies of scale** through multiple installations, single partners, standardization.
- **Minimize public opposition** by using existing reactor sites; redefined "construction" to eliminate oversight of many site prep activities.

Venture Strategy: Subsidies are Integral

- **Michael Wallace**, Co-CEO, Constellation.
  - "Without loan guarantees we will not build nuclear power plants." (NYT, July 2007).
- **Joe Turnage**, Sr. VP, Constellation Generation Group
  - *Associate Member Geesman*: "And just to revisit the cap question again. Your business model is premised on receiving the federal loan guarantee for each of your four projects. Is that correct?
  - *Dr. Turnage*: "That is correct." (CEC Workshop Transcript, 29 June 2007: 302).
- **Foreign subsidies** also important.
  - "COFACE, the French Ex-Im Bank equivalent, and JBIC, the Japanese equivalent, absolutely [sic] prepared to loan into these projects at attractive rates. They are not going to do it unless we fix the pari passu problem." (Turnage, CEC, 295).

Nuclear Subsidies to Capital Investment and Market Price Support

	Revelance to Calvert Cliffs III	Anticipated Subsidy Magnitude
Subsidies to Capital Costs		
Cost of Funds		
Federal loan guarantees	Eligible	Very large
Advantaged credit, foreign banks	Eligible	Large
Ratebasing of WIP/AFUDC	Merchant plant; not relevant.	N/A
Regulatory risk delay insurance	Eligible	Medium
Cost of Capital Goods		
Accelerated depreciation	Automatic	Large
Research and development	Pro-rata beneficiary	Low to Medium
Output based subsidies		
Production tax credit	Eligible	Large
Market Price support		
Renewable portfolio standard	Nuclear eligible in some federal amendments; not currently in MD standard.	Potentially Large

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Nuclear Subsidies to Operating Costs (1)

	Revelance to Calvert Cliffs III	Anticipated Subsidy Magnitude
Subsidies to Operating Costs		
Fuel and Enrichment		
P-A cap on liability: fuel cycle, transport, contractors.	Pro-rata beneficiary	Moderate
Uranium % depletion	Pro-rata beneficiary	Low
HEU dilution programs	Pro-rata beneficiary	Unknown
Enrichment D&D: LT funding shortfall	Pro-rata beneficiary	Low
Virtually free patenting of federal hardrock mining claims (including uranium)	Pro-rata beneficiary	Low
No royalty payments on uranium extracted from federal lands	Pro-rata beneficiary	Low
Inadequate bonding for uranium mine sites	Pro-rata beneficiary	Low
Insurance		
P-A cap on liability	Automatic	Large
Regulatory oversight		
Incomplete recovery of NRC oversight costs.	Pro-rata beneficiary	Low; most costs now covered.

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Nuclear Subsidies to Operating Costs (2) and Closure/Post Closure

	Revelance to Calvert Cliffs III	Anticipated Subsidy Magnitude
Subsidies to Operating Costs, continued		
Taxes		
MD property tax abatement	Specific to plant	Relatively small
Depreciated value rather than assessed value as MD tax base	Automatic	Relatively small
Plant security		
Low design basis threat	Plant designed for higher than standard	N/A
Emissions and waste management		
Windfall CO2 credits from grandfathering based on energy output.	Depends on CO2 control regime.	Potentially Large
Inadequacy of waste disposal fee - spent fuel	Pro-rata beneficiary	Low-Moderate
Payments for late delivery of disposal services	Not relevant since new reactor not covered by old agreement.	N/A
Subsidies to Closure/Post-Closure		
Decommissioning trusts: preferential tax rates, special transfers; underaccrual.	Only preferential tax rates would be relevant for a new reactor.	Relatively small

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Building a New Reactor: Constellation's Ever-Changing Cost Estimates

- Overnight costs (excludes financing) – internal estimates:
  - 2005: $1,600-$2,000/kWe (UniStar EPR, 2005).
  - March 2007: $1,935/kWe (Turnage, 12 March 2007).
  - June 2007: $2,400/kWe (Turnage, CEC: 288).
  - December 2007: $2,650/kWe (Turnage, 10 December 2007)
- "All-in" costs:
  - Industry, June 2007: $5,000-$6,000/kWe (Quillian, NEI, CEC: 260).
  - Constellation, June 2007: $3,125/kWe (Turnage, CEC: 281).
  - Industry, October 2007: $5,000-$6,000/kWe (Moody's, 10/07).
  - Moody's estimate translates to **$8-9.6 billion for one Areva EPR**.
- Which metric?
  - "From a credit perspective, Moody's is indifferent to what the 'overnight' cost of the actual nuclear generating plant might be – as overnight costs exclude owner's costs and price escalation." (Moody's, 10/07).

Valuing the Subsidies: UniStar's Estimate

- No PTCs or loan guarantees: $80/MWh.
- Loan guarantees, no PTCs: $48/MWh.
- Loan guarantees and PTCs: $37/MWh
  - Constellation's Turnage tags the difference as "potential rate payer value," though they are a merchant supplier.
  - Turnage: "More fundamentally, at $80/MWh, these plants would not likely be built."
- They value the subsidies at **$575 million per US Evolutionary Power Reactor per year**. (Turnage, 12 March 2007:48).
  - 1600 MW at 95.3% capacity factor (their assumption) results in a **subsidy of 4.3 c/kWh**.
  - EPACT allows guarantees to run 30 years; nominal value over this time would be nearly $13 billion *for a single reactor.*

Optimistic Underlying Assumptions Understate Subsidies

- **Cost of funds too low.** Underestimates merchant cost of capital.
  - Assumes 50% debt (@12%); 50% equity (@18%).
  - Too optimistic? Constellation current ROE is 18.93%; clearly new build nuclear deserves more.
  - Constellation's 5-year Debt/Cap ratio is 51.8% *for existing facilities.* (Moody's 10/07).
  - Absent subsidies, equity ratios would need to be substantially higher – 65-70% even for non-nuclear merchant plants. (Keystone, 6/07).
- **Capacity factor too high.**
  - Constellation assumes 95.3% capacity factor; this is aggressive.
  - Highest US industry-wide capacity factor was 90.3% (2002). Keystone high value is only 90% as well; Harding views 75-85% as reasonable for new build.
  - While 34 plants exceeded UniStar target in 2006, lifetime performance at this level, with a new reactor design, will be much more difficult.
- **Plant costs too low.** Base case assumes overnight costs of $1,935 kWe.
  - Company estimates already higher; and may be higher still at point construction starts.

Full Cost of Nuclear: Subsidies Exceed Private Investment

	Low	High	
	Cents per kWh		
I. Private investment in Calvert Cliffs III			
Base case of Calvert Cliffs	3.7	3.7	Constellation estimate, Mar. 07
II. Public investment in Calvert Cliffs III			
A. Selected EPACT subsidies			
Production tax credits	1.1	1.1	Constellation estimate assuming full access.
Loan Guarantees, 100% of debt	3.2	3.2	Actual value probably higher due to higher merchant cost of capital.
Industry total estimated cost	8.0	8.0	
B. Additional subsidies ignored in Constellation models			
Accelerated depreciation	0.3	0.6	15 yr 150% DB vs. service life.
Price-Anderson cap on reactors	0.5	2.5	Based on Heyes (2002); values uncertain.
Waste fund short-fall	-	0.2	Based on Rothwell (2005); needs updating.
Calvert Co. property tax abatement	0.0	0.0	$20m/year.
Cost of capital value of delay insurance, first two reactors	0.7	0.8	Based on Bradford (2007).
Add-in missing subsidies	1.5	4.1	
III. Total cost of nuclear power			
Public subsidy	**5.8**	**8.4**	
Public/private share	**155%**	**226%**	
Full cost of power	**9.5**	**12.1**	

GHG Reductions Via the Nuclear Fuel Cycle: How Efficient?

	Nuclear	Versus Coal	Versus Gas	Versus Hydro	Versus Wind	Notes/ Sources
Lifecycle Emissions (mt CO2-equivalent/GWh)						
Baseline	17	1,041	622	18	14	(1) Meier (2002), cited by Turnage (2007)
Reductions from nuclear	na	1,024	605	1	(3)	(1) Meier (2002), cited by Turnage (2007)
Cost of GHG Reductions (Increases) via Nuclear Pathway ($/mt CO2-equivalent reduced)						
Gross subsidy cost only	na	82	138	83,617	(27,872)	(2) Earth Track calculations
Total cost (subsidy + private investment)	na	118	199	120,617	(40,206)	(3) Earth Track calculations
Value of Reductions ($/mt CO2-equivalent futures contracts)						
Chicago Climate Exchange (CCX)	3.6	3.6	3.6	3.6	3.6	(4) CCX data
European Climate Exchange (ECX)	27.3	27.3	27.3	27.3	27.3	(4) ECX data
Opportunity Cost of Mitigation through New Nuclear (mt market offsets for cost of 1 mt offset via nuclear)						
Subsidy cost only	na	3 - 20	5 - 35	3,050 - 23,225	1,020 - 7,740	(5) Earth Track calculations
Total cost (subsidy + private investment)	na	4 - 30	7 - 55	4,415 - 33,500	1,470 - 11,165	(5) Earth Track calculations

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Subsidy Mechanics: Loan Guarantees

- Industry focus tends to be on default rates; guarantees provide large subsidies even if no default.
- Benefits come through dramatic reductions in the cost of capital.
  - **More debt.** Allows much higher use of debt (up to 80% rather than 20-25% with no guarantees); debt is much less expensive.
  - **Risk-free rate.** Allows lenders to base interest rates on the credit worthiness of the guarantor (in this case the default "risk-free" rate of the federal government), rather than the high risk project.
  - **Lower risk of loss of equity.** By reducing cost of debt service and risk of non-payment on the debt, the bankruptcy risk to equity investors is reduced, driving down equity costs as well.
- **Long-term availability of cheap credit.**
  - Guarantees can be extended for up to 30 years.
  - This enables the company to pay back their more expensive financing costs first.

Energy Loan Guarantees: Large, Concentrated Bets

- Recommendation in FY08 Omnibus spending bill:
  - $38.6 billion.
  - **Nuclear: $20.5b** ($18.5 to reactors; 2 to enrichment, but still "too low" according to NRC Commissioner Jaczko to cover $500b rebuild costs).
  - Coal: $8.0b ($6 to coal with CCS; 2 to gasification)
  - Misc. renewables: $10.0b
- Other agencies active in energy (FY08 Budget, 2006 actual data):
  - Total US gov't loan guarantees outstanding: $1.1 trillion.
  - DOE energy R&D, all resources: $8.6b
  - Eximbank: 2,677 financings in 2006 totaling $12.1b in commitments. Portfolio: $36b in loan guarantees; $7b loans
  - OPIC: Portfolio: $5.5b in guarantees: $0.6b in loans.

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Energy LG Very Large When Compared to Other Government Bailouts

- Chrysler, 1979 (CBO, 2004)
  - $1.5b in guarantees ($2.6b in 2007$); cut borrowing costs by 8%.
  - 50% private sector matching required.
  - 1% annual servicing fee; plus 11 year grant of 14.4m stock warrants.
- America West Airlines, 2002 (CBO, 2004)
  - $380m in guarantees ($437m in 2007$).
  - 5.5% LG fee in year 1; 8.0% subsequently.
  - 18.8m stock warrants for 10 years.
- Bailout of Mexico, 1995
  - $20b ($26b in 2007$).

Price Anderson at Calvert Cliffs

- New reactors *would not* have been covered without the extension in 2005.
- Proximity to population centers, expensive RE, should result in higher than average premiums under a real insurance program.
- Calvert Cliffs located 50 miles from Washington, DC; 75 miles from Baltimore.
  - Nearly 8 million people live in the Baltimore-Washington,DC-consolidated metropolitan area.
  - Among the most expensive real estate markets in the country.

Price-Anderson: Adequacy of Coverage

Insurance Coverage if Accident At Calvert Cliffs III

		Nominal		Present Value
Total payments from Calvert III to offsite parties				
Primary insurance, $mils	$	300.0	$	300.0
Retrospective premiums, $mils	$	95.8	$	64.4
Total liability for Calvert III	$	395.8	$	364.4
Additional resources from other reactors				
Retrospective premiums, $mils	$	9,963.2	$	6,696.2
Total available to offsite parties	$	10,359.0	$	7,060.6
Adequacy of Coverage				
Balt/WDC MSA 2000 Population, millions				7.6
Total insurance available, $/person			$	929
Calvert III coverage, $/person			$	48
Reactor::latte ratio				17

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Price-Anderson: Protecting Yourself Versus Protecting Others

		Coverage $Millions
Calvert III Insurance for property and business operations		
Property Insurance		
Nuclear property	$	500
Blanket excess	$	2,250
Terror attacks under conventional property	$	1,000
Accidental outage coverage	$	490
Total available to business	$	4,240
Calvert III self-coverage/offsite coverage		11.6

Source: Constellation Energy Group Form 10-K, December 31, 2006.

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Summary

- **Subsidies hide important cost and performance variation in energy resources.**
  - Core subsidies to ethanol and nuclear differ, but the results are the same: more expensive energy and impediments to cheaper, quicker alternatives.
  - GHG mitigation via nuclear can be orders of magnitude more expensive than alternatives.
- **Capital markets price risk into projects for a reason.**
  - Longer gestation, larger investments, and greater volatility all provide bigger opportunities to waste societal wealth.
  - Sub-prime mortgage meltdown should be a reminder that guaranteeing high risk ventures is not costless.
- **Policy should focus on highlighting the cost differences associated with different energy attributes, not trying to subsidize them away.**
  - Fuel type, time and location of delivery, load factor, use of constrained T&D infrastructure, investment risk/capital cost, and environmental profile.
  - Structure should be neutral between demand and supply side actions.