

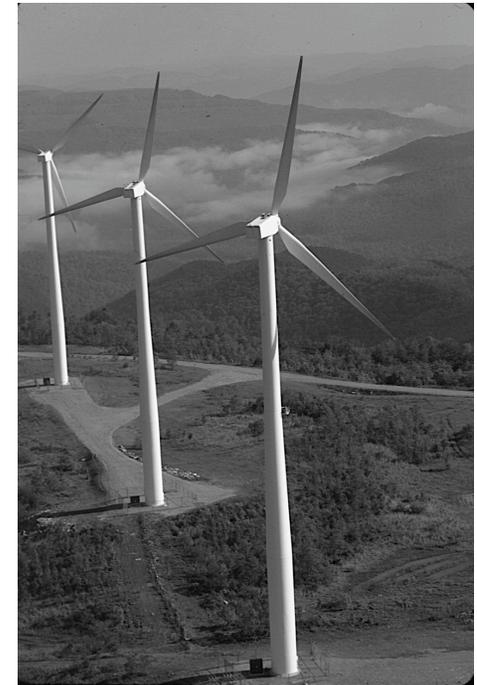


Nuclear Power and Subsidies: Economics of New Nuclear

Webinar Presentation
April 2011

About Us

- **The Southern Alliance for Clean Energy (SACE) has been a leading voice for energy reform to protect the quality of life and treasured places in the Southeast for over 25 years. Founded in 1985, SACE is the only regional organization primarily focused on developing clean energy solutions throughout the Southeast.**
- **As we look towards the future, SACE's commitment to preserve, restore and protect our environment through the use of innovative technology, grassroots and grassroots education, and pioneer policy work remains steadfast.**



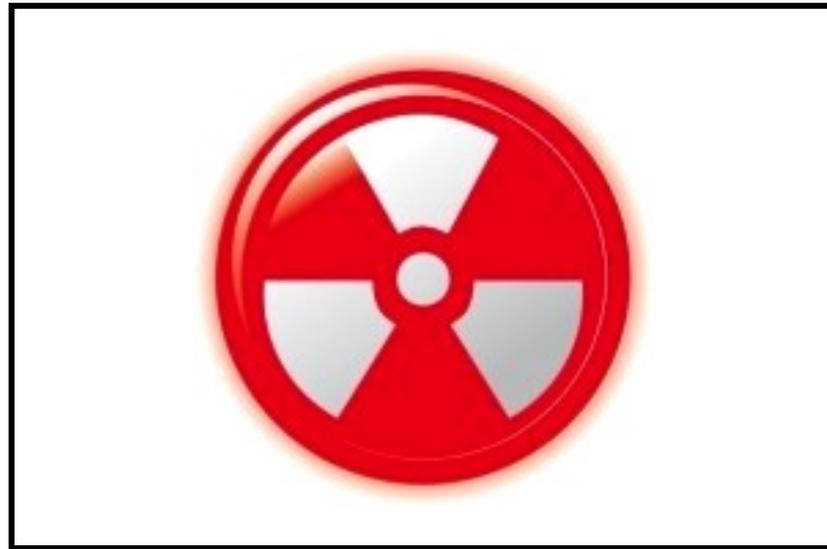
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Assessing the Impact of Fukushima on the US Nuclear Renaissance



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Nuclear Power: Still Not Viable Without Subsidies

Southern Alliance for Clean Energy
Webinar, April 5, 2011

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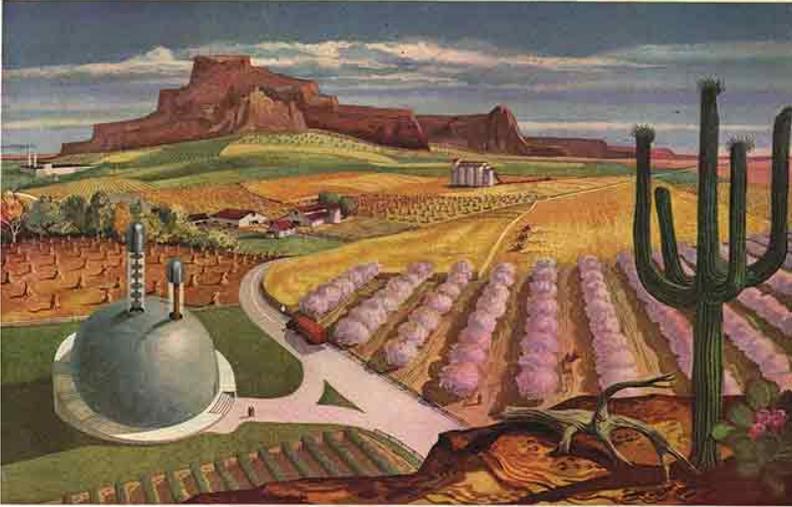
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Study Overview

- Catalog as many fuel-cycle subsidies in one place as possible to bring the transparency needed for real debate (study reviews ~40).
- Process:
 - Review scores of historical studies, cost assessments, industry statements and reports.
 - Develop high and low estimates based on this historical work and own calculations.
 - Reflects complexity of the programs being evaluated and differing, but plausible assumptions.
 - Aim to bound the subsidy value rather than estimate it exactly.
 - Even the lower-bound estimate leads to important policy conclusions.
- Objectives:
 - Identify patterns of support for nuclear power over the past five decades.
 - Estimate magnitude of:
 - Legacy subsidies
 - Ongoing support for existing plants
 - Support for new reactors
 - **Presented as levelized c/kWh**
 - Describe programs qualitatively even where quantification wasn't possible.
- Identify policy reforms that will help achieve more neutral energy playing field.

Don't Stop Dreaming; Just Use Your Own Money

BY MEN WHO PLAN BEYOND TOMORROW



Deserts Will Bloom Through Atomic Power



NEW "BREAD BASKETS" of the world can grow where only sand and scrub had been. Harnessed atomic energy will transform deserts into rich fruit and grain country... provide power to tap subterranean water for irrigation, power to run machines, to operate utilities. Already Atomic scientists are adapting the world's newest wonder to this peacetime use.

AMONG the good things of life, Americans by the millions rate high the wholly unique Canadian whisky they order by name—Seagram's V.O. This lightest of all Canadian whiskies, this clean-tasting imported blend is Canadian whisky at its glorious best.

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Life Magazine advertisement, 1947

- What timeframe?
- What options foregone?
- What measures of success?
- New problems created?
- **Whose money?**

Political Selection of Nuclear via Subsidies Hides Important National Trade-offs

- **Total costs** (private plus subsidies) needed to properly evaluate options and trade-offs.
- **Financial:** unprecedented subsidies to individual, privately-owned assets.
- **Environmental:** need to invest in most cost-effective, rapid-deployment solutions to de-carbonize first.
- **Competitive:** dynamic industries grow from vibrant, competitive marketplace, not from politically-selected winners.
- **Performance:** political favoritism and separation of investor risk from reward result in poor outcomes, large losses.

Discussion Overview

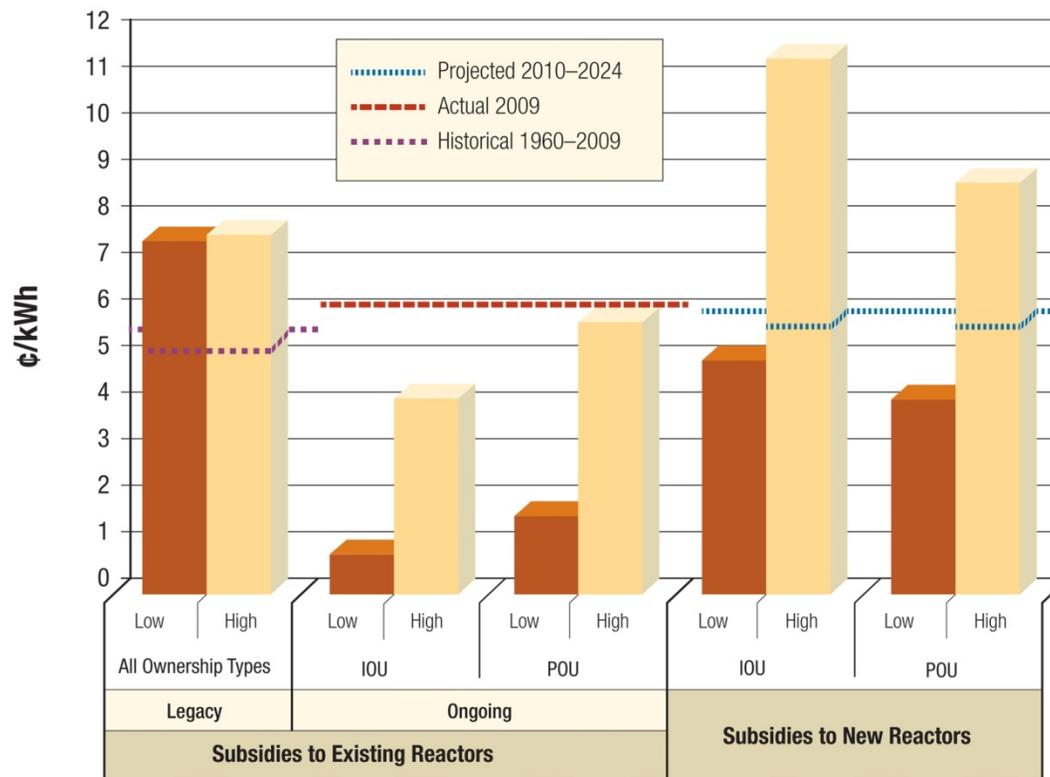
- General findings
 - Patterns in subsidy types over time.
 - Magnitude of subsidies
- Overview of main subsidies
- Policy recommendations
- Questions

Nuclear Subsidies: Risk Shifting More Important than Cash

- Nuclear a high risk investment
 - Expensive, technically-challenging, long-build times, poor history of economic performance and delivery cost.
 - Sensitive to changes in marketplace, problems at other reactors around the world.
 - Long duration management challenges due to radioactivity.
- Pricing risk is a core function of capital markets; but market pricing of risk in nuclear sector renders the plants uncompetitive.
- Shifting construction cost, market, and operating risks:
 - Reduce cost of capital by shifting risks of cost overruns, defaults, and market changes during construction period from investors to taxpayers and customers.
 - Loan guarantees, CWIP, delay insurance
 - Reduce after-tax cost of large capital purchases:
 - Accelerated depreciation, investment tax credits, production tax credits.
 - Cap accident risks (Price-Anderson)
 - Socialize longest duration risks associated with decommissioning (tax breaks) and radioactive waste management (nationalization).
- Additional subsidies to key inputs (uranium, enrichment services, water).

Nuclear Subsidies Often Exceed Market Value of Power

Figure ES-1. Nuclear Subsidies Compared to EIA Power Prices



Note: Legacy subsidies are compared to the Energy Information Administration (EIA) average 1960–2009 industrial power price (5.4 ¢/kWh). Ongoing subsidies are compared to EIA 2009 actual power prices for comparable busbar plant generation costs (5.9 ¢/kWh). Subsidies to new reactors are compared to EIA 2009 reference-case power prices for comparable busbar plant generation costs (5.7 ¢/kWh).

Legacy Subsidies: Central Factor in Creating Today's "Inexpensive" Reactors

- Often worth more than the power the reactors produced.
 - More than 7 c/kWh
 - Roughly 140% of the average wholesale price of power for the 1960-2008 period.
- Without the subsidies, many plants would not have been built; competitive environment even worse.
- With them, nuclear infrastructure was still uncompetitive on a total cost basis: hundreds of billions of dollars were written off, or forced through to customers as cost overruns or stranded costs.
- Main legacy subsidies were to capital: ITCs, accelerated depreciation, charging current customers for interest on new project construction.

Ongoing Subsidies: Major Factor in Low Reported Operating Costs

- Subsidies are a significant factor in the operating cost advantage of nuclear today.
- In comparison to legacy subsidies, ongoing support for existing reactors seems low: 0.7 to 5.8 c/kWh (13 – 98% of the value produced during in 2009).
 - Even low-end subsidies are more than 35% of nuclear production costs (O&M plus fuel) that is often presented as an indicator of the industry's competitiveness.
 - This subsidy comprises nearly 80% of the production-cost advantage relative to coal.
- Using high-end estimates, subsidies are an even larger contributor to the observed operating cost advantage of nuclear plants.
- Drivers of variance between high and low estimates:
 - Differing assumptions of litigation payouts over delays for nuclear waste fund and liability caps.
 - Continued access to subsidized credit and operations for POUs.
 - Decline of large capital subsidies to IOUs as capital base depreciated.

New-Build Nuclear: Subsidies on Track to Exceed Value of Power Produced

- As with legacy subsidies, subsidies to new build are likely to exceed the value of the power these facilities will produce:
 - 4.2 to more than 11 c/kWh
 - Equivalent to 70 to 200 percent of EIA's projected value of power over the next 15 years.
- Subsidy levels are clearly high enough to skew investment patterns and inter-fuel substitution.
- Caps on some of the subsidies will *hopefully* prevent all reactors from tapping into them; however:
 - Many legislative efforts to relax or remove these caps.
 - Congressional backers also seeking to add still more lucrative subsidy programs.
- Most important subsidies to new build: loan guarantees, liability cap, CWIP, tax-exempt borrowing for POUs, nationalized waste management.

Factors of Production (1)

- Capital subsidies most important source of support.
- Loan guarantees:
 - Current: \$18.5b for reactors; \$4b for front-end.
 - Proposed: \$36b by Obama; \$93b by NEI; \$100b or more under CEDA per CBO estimates.
- Huge benefit even if no default:
 - Ability to use way more debt, and obtain that debt at “risk-free” rate.
 - Industry’s own estimates: 2.5-3.7 c/kWh.
 - For a 1600 MW Areva reactor, this is equal to \$495m/ reactor-yr or nearly \$15b over life of the loan.

Factors of Production (2)

- Accelerated depreciation: 15 yr. write-off versus 40-60 year life of facility.
 - Worth \$40-80m/year per reactor.
 - Proposals (e.g., Kerry-Lieberman) to allow 5 year write-off.
- Subsidized borrowing costs for POUs.
 - Municipal bonds, Build America Bonds.
 - Estimated value of more than 3 c/kWh.
- Construction Work in Progress (CWIP)
 - Immediate recovery of new project costs from ratepayers.
 - 0.41 to 0.97 c/kWh on top of LGs; higher without LGs.

Masking the True Costs of Producing Nuclear Energy: Intermediate Inputs

- Fuel
 - Percentage depletion, inadequate bonding, poor site management: subsidized extraction, high contamination.
 - Limited data available indicates that remediation costs per unit processed ore extracted often higher than the value of yellowcake (U₃O₈).
- Water often ignored
 - Nuclear is the most water-intensive large scale thermal energy technology in use.
 - Even if returned to source, quality, temperature and flow patterns are harmed.
 - Few if any reactors pay for their water; estimated subsidy at \$600-700m per year.

Shifting Security and Accident Risks to the Public: Price-Anderson

- “Temporary” measure renewed since late 1950s.
- Largest “pool” in the world for third party nuclear liability, but still problematic.
 - Paid over more than six years: present value is roughly \$8.5b, well below the more than \$12b gross figure put forth by industry.
 - Large storm events and many nuclear accident scenarios have exceeded this damage level.
 - BP Horizon oil spill: \$40.9 billion cost estimate by BP, nearly 5x the Price-Anderson cap on a PV basis.
 - Substantial counter-party risks due to industry concentration and systemic risks to sector following an accident.
- Subsidy estimates cover very wide span (0.1 – 2.5 c/kWh).
 - Clearly more empirical work is needed.
 - Fukushima accident suggests liability subsidy less likely to be at low-end of estimate range.
- Very likely industry could purchase much higher levels of coverage.
 - They are already doing so for their own plants.
 - New instruments (e.g., catastrophe bonds) increase the amount of underwriting cover available.

Shifting Long-Term Operating Risks to the Public

- Much larger end-of-life liabilities than other power sources.
- Nuclear waste management:
 - Nationalized for small fee per kWh at huge risk to taxpayer.
 - Large trust fund balances do not mean there is no subsidy
 - Operating surplus \neq actuarial balance; lifecycle costs could exceed collections.
 - Entire service operated at break-even, with no required ROI or taxed profits.
 - Utilities allowed access to repository with no capacity reserve fee; very low interest charges on delayed payments.
 - All risk of delay shifted to taxpayers.
 - Subsidies of 0.2-0.95 per kWh for existing reactors (roughly \$1.6-\$7.5 billion/year).
 - Lower for new build assuming better risk sharing on delays.
- Decommissioning
 - Ultimate cost still unknown; substantial risk of under-accrual (though not counted here). Investment return deficit relative to current cost escalation assumptions ~\$60m/year.
 - Tax subsidies to nuclear decommissioning trusts estimated at \$450m to \$1.1b/year – equivalent to at least 75% of what the industry pays into their NDTs each year.

Recommendations

- End, don't expand, nuclear subsidies.
 - Proper regulation and fee structures for uranium mining.
 - Market-oriented approach for financing Nuclear Waste Repository.
 - Push to charge for cooling water.
 - Repeal tax breaks for decommissioning trusts.
- Any subsidies that are awarded should be allocated by competitive bidding.
- Modernize liability systems for nuclear power: higher limits, counterparty risks.
- Roll back CWIP, ensure POUs and ECAs properly integrate the higher risks of nuclear projects in their planning and investment decisions.
- Much more detail on all of these programs in the full report.

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