Allocation of Risk in Building Capital-Intensive Electricity Generation: What Role for Government?

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Public good of low-carbon electricity supply: what role for government?

- Main low-carbon sources of electricity supply are carbon intensive:
  - Nuclear
  - Renewables
  - CO2 capture
- Government considering range of policies to promote adoption
  - CO2 prices or caps
  - Production tax credits
  - Loan guarantees (risk → taxpayers)

Which mixes of policy tools would achieve the objective at lowest net social cost?

Allocation of risk affects the cost of electricity for capital-intensive plants

Example: nuclear plant with a $3,000/kWe EPC cost (total overnight $3500-$4000/kWe), 4-year construction time:

Regulated Utility (risk → ratepayers)	**Merchant Plant** (risk → investors)	**Merch., guarantee** (risk → taxpayers)	**Reg., guarantee** (risk → taxpayers)
$60.2/MW-hr	$98.5/MW-hr	$64.8/MW-hr	$50.4/MW-hr
50/50 debt/equity; 6% debt, 12% equity	50/50 debt/equity 8% debt, 15% equity	80/20 debt/equity 6% debt. 15% equity	80/20 debt/equity 6% debt, 12% equity

Estimates from Nuclear Energy Institute economic model; regulated utility assumes 100% CWIP; all figures levelized 2007$

- *Competitive electricity markets inadvertently suppress capital-intensive low-carbon generation – loan guarantees counteract this effect*

Mixing carbon prices and risk allocation to make low-carbon sources competitive

Reg. Utility (risk → ratepayers)	**Merchant Plant** (risk → investors)	**Merch., guarantee** (risk → taxpayers)	**Reg., guarantee** (risk → taxpayers)
SC Coal, CO_2=\$0 \$54.7/MW-hr	SC Coal, CO_2=\$0 \$78.9/MW-hr	Assume no SC coal guarantee	Assume no SC coal guarantee
Nuclear \$60.2/MW-hr	Nuclear \$98.5/MW-hr	Nuclear \$64.8/MW-hr	Nuclear \$50.4/MW-hr
Nuclear competitive if CO_2≥\$6/t	Nuclear competitive if CO_2≥\$20/t	Nuclear competitive with no-guarantee coal at CO_2=\$0/t	Nuclear competitive with no-guarantee coal at CO_2=\$0/t

- Not intended as prediction of actual costs
  - purely illustrative of effects of risk allocation on carbon price for competitiveness;
  - MIT study found nuclear competitive in merchant base case at ~CO_2=\$27/t – but estimated prices have increased since then

Unique risks for new nuclear plants

- *Wide range of unique nuclear risks at present – financing not available on terms in previous slides for first plants*
- Technology risk
  - Plant designs that have either never been built anywhere, or have never been built in the United States
  - No new plants built in United States since 1970s, companies and personnel have no recent experience
  - New Finnish plant – first of the EPR design – experiencing large delays, cost overruns
  - Large increase in estimated costs in past 5 years (~100%)
  - 1970s cost overruns bankrupted some builders, led to large defaults, "stranded costs" in move to competitive markets
  - Limited capacity may create competition for supplies, labor, driving up costs (e.g., Japan Steel Works only OECD supplier for large steel forgings – 3-year backlog)

Unique risks for new nuclear plants (II)

- Regulatory risk
  - Untested new NRC combined construction and operating license (COL) approach – how long will it take, will projects be blocked?
- Political risk
  - Positive polls, but political strength of anti-nuclear forces largely untested in recent years
  - Potential long-term spent fuel liability from Yucca Mountain delay (though some in market say availability of low-cost dry cask storage makes this a modest financial factor, though large politically)
- Accidents/terrorism risk
  - Liability limited by Price-Anderson, but still a factor
  - Major accident or nuclear terrorist incident anywhere in the world could make nuclear power projects politically impossible to complete

Congressional responses to date

- Production tax credits for low-carbon generation
  - No benefit unless project succeeds, begins generating
  - Very helpful for high-cost, low or moderate risk projects (e.g., solar or wind) – not as helpful for high-risk projects (e.g., nuclear)
  - Costly – 1 ¢/kW-hr →~$2B/GWe present value cost to taxpayers over 40-year life (at 90% capacity factor)
- Insurance for regulatory risks
  - Specific to nuclear – doesn't handle other risks
- Loan guarantees
  - $38.5 billion in omnibus appropriation, $20.5 billion nuclear
  - Firms receiving guarantee pay "subsidy cost" – in theory, no net costs to taxpayers (though greater portion of risks for taxpayers)
- *Carbon cap and trade, other carbon price mechanisms still being debated*

Loan guarantees -- why shouldn't this be left to markets?

- With loan guarantees, government effectively providing default insurance – couldn't market provide that?
  - For nuclear projects in particular, some major firms say unable to assess and price risks – too many unknown factors
  - With uncertainties, market costs of money and insurance would make projects uncompetitive
  - In essence, government taking on unknown risks at below-market rates
  - Market might be adequate for lower-risk technologies – but should nuclear get special treatment?
- Nuclear projects in particular simply too big for even biggest generators to carry on balance sheets
  - Total project costs in range of $6 billion
  - Problem could in principle be solved with investment partners

Some questions for discussion

- What set of policy tools would lead to deployment of low-carbon electricity generation at lowest total social cost?
  - One option: high carbon price (through tax, or cap and trade)
  - Another: loan guarantees plus moderate carbon price
  - Another: carbon prices plus production tax credits
  - Which is better for the overall economy?
- Do loan guarantees inherently distort markets, making non-guaranteed technologies – including efficiency – less attractive by comparison? How damaging is this?
- How much risk of major defaults are the taxpayers being asked to take on with loan guarantees – For nuclear? For solar? For wind? For carbon capture? Is DOE well-suited to calculating this, to set subsidy cost?

Some questions for discussion (II)

- Are loan guarantees appropriate:
  - Only to get the first few plants of a new technology built, buying down the first-of-a-kind risks?
  - Indefinitely, for technologies that offer non-monetized public goods? (How do we take into account "public bads," such as nuclear sabotage or proliferation risks?)
  - Or not at all?
- How could loan guarantees be structured so low-carbon technologies could complete to receive them, rather than Congress picking winners (as in recent bill)?
- What other policies could governments use to make capital-intensive low-carbon technologies more competitive?

Some questions for discussion (III)

- For nuclear in particular, will we end up, after EPAct subsidies for first few units, with still-uncompetitive plants?
- What policy tools – and in particular approaches to risk allocation – should be applied to get adequate deployment of electricity infrastructure beyond generation?
- Are loan guarantees an appropriate role for the U.S. government in promoting deployment of nuclear and other low-carbon sources in other countries?
  - Guarantees currently available for U.S. exports from Ex-Im
  - Other countries – e.g., France, Russia, Japan – also support their vendors with low-cost financing
  - In this case, "public good" being supported is export-led jobs – guarantees are available whether the project is low-carbon or not