Advanced Reactor Financing

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Financing Nuclear Power

**Observations:**
- Capital Supply = T’s
- Capital Behavior
- Uncertainty issues
- Negative IR’s
- Investors Options
- Equity – risk view
- Debt – where are the pension funds to go?

- Mostly good news for NE ....and Infrastructure
<table>
<thead>
<tr>
<th>Ref#</th>
<th>Category</th>
<th>CRITICAL RISK AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FIN</td>
<td>Equity funding risk</td>
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<tr>
<td>2</td>
<td>FIN</td>
<td>Project development</td>
</tr>
<tr>
<td>3</td>
<td>POLICY</td>
<td>Community risk, local opposition</td>
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<td>4</td>
<td>ECON</td>
<td>Market off-take risk for sales</td>
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<td>5</td>
<td>ECON</td>
<td>Construction completion risk</td>
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<td>6</td>
<td>TECH</td>
<td>Design, technology performance</td>
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<td>7</td>
<td>TECH</td>
<td>Infrastructure, grid interface</td>
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<tr>
<td>8</td>
<td>TECH</td>
<td>Nuclear fuel proliferation security</td>
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<tr>
<td>9</td>
<td>POLICY</td>
<td>NRC Regulatory delay risk</td>
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<tr>
<td>10</td>
<td>POLICY</td>
<td>Legal: Site control, permitting</td>
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<td>11</td>
<td>ECON</td>
<td>Operating cost and maintenance</td>
</tr>
<tr>
<td>12</td>
<td>FIN</td>
<td>Debt coverage; Capital Structure</td>
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<tr>
<td>13</td>
<td>ECON</td>
<td>Fuel supply disruption</td>
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<tr>
<td>14</td>
<td>ECON</td>
<td>Force Majeure (Insurable)</td>
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<tr>
<td>15</td>
<td>TECH</td>
<td>Nuclear accident (Off-site damage)</td>
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SUMMARY: Global Competitive Landscape

- Several Nuclear Financing Models vie for primacy
- USA Private Utility model is the exception
- Most of the next wave of NEW build is overseas
- SOVEREIGN Models have taken lead outside USA
- Cost is a major factor, but not the ONLY factor
- Strategic National interests & financing play a role
- Emissions savings are a factor in Europe & Asia
- Sovereign Vendor financing poses a large threat
- SMR’s and Advanced Reactors are impacting now
New construction of reactors is a Sovereign decision, more than mere economics.

New Reactors: Where’s the Growth?... Asia, MidEast

Sovereigns dominate new orders. USA and Japan built their fleets of reactors in smaller regional utilities, rather than in national enterprises.
### Nuclear Financing Models: Private vs Sovereign

<table>
<thead>
<tr>
<th>A) Private Utility (Traditional IOU)</th>
<th>E) Electro – Exeltium (industry users)</th>
</tr>
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<tbody>
<tr>
<td>(USA, Japan)</td>
<td>(France, EU?)</td>
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<tr>
<th>B) Customer Consortium Financing</th>
<th>F1) Sovereign w/ Revenue Subsidies</th>
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<tbody>
<tr>
<td>(Nordic, Canada)</td>
<td>(EU, UK, Canada); for emissions savings</td>
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<tr>
<th>C) Industrial Vendor Team, w ECA</th>
<th>F2) Sovereign Monopoly Owner</th>
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<tbody>
<tr>
<td>(USA, S.Korea, Japan)</td>
<td>(China, India, Middle East, Russia)</td>
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<tr>
<th>D) Project Finance (SMRs/GenIV)</th>
<th>G) Sovereign Vendor Team</th>
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<tr>
<td>(USA, UK? -- Emerging…)</td>
<td>(Russia, China)</td>
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Based on Fiona Reilly, PWC
Investor Ready Cities

How cities can create and deliver infrastructure value
DOE Programs Support the Full Arc of Commercialization

**Commercial Maturity**

**Technology Maturity**

**Technology Risk**

**Commercial Maturity**

**Technology Maturity**

**Technology Risk**

**Demonstration**: DOE Applied Science Programs; EERE; Fossil; Electric; Nuclear

**R&D**: DOE Labs

**Initial Commercial Deployment**: DOE Loan Program

**Commercial Financing**: Banks & Bond Market

**Equity**: Private

**Debt**: US Gov’t

**Grants**

**Grants**
India, Russia to accelerate civil nuclear energy cooperation

The nuclear cooperation includes building on negotiations to sign advance contract for the design of the third and fourth reactor units to come up at the Kudankulam site in Tamil Nadu. A contract for the design (of the third and fourth power units) has been under negotiation.


Kundapur Vaman Kamath (India), former CEO of Industrial Credit and Investment Corporation of India, will head the Bank, capitalized at $100 billion ($10B from each, plus “$50B equity on call” as needed).

Each founding country 1 vote; no vetoes.

PLUS, the BRICS countries' currency reserves pool is $100 billion. China will contribute $41 billion, while Brazil, India and Russia will provide $18 billion each and South Africa will put forward $5 billion – “an insurance instrument against financial risks and the risks related to the situation on the world financial markets”.

www.russia-direct.org/russian-media/brics-development-bank-begins-operation
SUMMARY: T.Grants for Energy, a $25B Experiment

- From 2009-2015, we conducted a $25B experiment and got 10 GWe of mostly wind and solar, concentrated West of the Mississippi.
  -- $90B in total project costs for 33.3 GWs gross, 10.2 GWe.

- Obs #1: How much nuclear can be built for $25B in Subsidies?
- Obs #2: Most of the Wind capacity is WEST of Mississippi.
  -- Wind only competes with Nuclear in the Upper Midwest.
- Obs #3: Solar power will triple from 1% to 3% of US Total, and in SW.
- Obs #4: Plenty of reactor capacity needs to be replaced at current sites – Siting is not really the problem. (Cheap gas is).
- Obs #5: When targeting Exports, Emissions savings still matter.

- For $90B, >15GW of nuclear can be built ($6B per GW).
  ➔ $25B in Subsidies like T.Grants would be $1.67B per GW.
  ➔ Why not target HALF of that as Advanced Reactors? [National Policy]
Treasury Grants (S1603): $25B, mostly Wind, Solar

Cumulative grants awarded, 2009 to July 2016: $24.9B for 33.3 GWs gross (10.2 GWe Net)

- $25B in Tax subsidies
- $90B in Total Project Value

33 GW gross
10 GWe

Total investment: $90.2B
($24.9B from 1603 grants)
For 10.2 GWe (net),
Or $8,900 per KWe.

Source: U.S. Treasury
http://www.treasury.gov/initiatives/recovery/Documents/STATUS%20OVERVIEW.pdf
Treasury 1603: MWs Installed by Fuel Type

Projects from 2009 to July 2016

Figure 3: Generation Capacity by Project Type

- **Wind**: 21.6 GW
- **Solar**: 8.3 GW (mostly Utility-scale)

https://www.treasury.gov/initiatives/recovery/Pages/1603.aspx
“As of September 2014, LPO-financed projects have already repaid nearly $3.5 billion of principal, as well as more than $810 million of interest, and the estimated loss ratio on LPO’s portfolio is approximately 2% of LPO’s total commitments.”

LPO INVESTMENTS

$30 BILLION IN LOANS, LOAN GUARANTEES, AND COMMITMENTS

LEVERAGED OVER $50 BILLION IN TOTAL PROJECT INVESTMENT

APPROXIMATELY JUST 2% IN PORTFOLIO LOSSES

LESS THAN 10% OF THE LOAN LOSSES PROVIDED BY CONGRESS

14,000,000 METRIC TONS CO₂ EMISSIONS PREVENTED

900,000,000 GALLONS GASOLINE SAVED

AMERICAN JOBS CREATED OR SAVED 56,000

PRODUCING ENOUGH CLEAN ENERGY TO POWER MORE THAN 1,000,000 AVERAGE AMERICAN HOMES

POLLUTION REDUCTION EQUIVALENT TO TAKING 3,000,000 CARS OFF THE ROAD

DOE Loan Program Portfolio: $30 Billion

DEPLOYING INNOVATION
$30 BILLION INVESTED IN MORE THAN 30 DIVERSE PROJECTS NATIONWIDE

Tesl
Shepherds Flat
Desert Sunlight
Ford
Ivanpah
Vogtle

INNOVATION CONTINUES

MORE THAN $40 BILLION IN DEPLOYING AUTHORITY

ADVANCED TECHNOLOGY VEHICLES MANUFACTURING
ADVANCED FOSSIL ENERGY
RENEWABLE ENERGY & EFFICIENT ENERGY
ADVANCED NUCLEAR ENERGY

AS OF OCTOBER 2015
LPO’s Public-Private Partnerships Expanded Total Project Investment

$26 Billion in Total Project Investment

LPO Loan Guarantees
$16.1 Billion

Private Equity
$9.3 Billion

Co-Lending with Commercial Banks
$0.5 Billion

Tax Equity: Google, Mid-American, Liberty Media

Developers: NRG, Abengoa, Exelon, etc.
DOE Loans in Advanced Nuclear

Advanced Nuclear Reactors
- Projects with state-of-the-art design improvements in fuel technology, thermal efficiency, modularized construction, and safety systems

Small Modular Reactors (SMRs)
- Utilize standardized design and are nominally 300 MW or smaller in size
- Projects have state-of-the-art design improvements

Upgrades and Upgrades at Existing Facilities
- Improvements to an existing reactor to increase efficiency
- Critical improvements that are requisite to current or future facility operation

Front-End Nuclear
- Uranium conversion or enrichment
- Nuclear fuel fabrication

QUALIFYING PROJECTS ARE NOT LIMITED TO THESE TECHNOLOGIES.
LPO Application and Underwriting Process

**Part I Application**
- Basic Project Details
- Initial Greenhouse Gas Analysis
- Project Readiness to Proceed
- $50,000 Fee (non-refundable)

**Part II Application**
- All Documents Required to Continue Due Diligence
- Initiate Loan Guarantee Underwriting
- Hire Independent Engineer and Legal Counsel; Credit Rating
- $350,000 or $100,000 fee (Loan Guarantee < $150 million)

**Conditional Commitment**
- Negotiation of Conditional Commitment
- Issue Conditional Commitment
- 25% of Facility Fee (1% of loan value)

**Loan Guarantee**
- Negotiate Final Loan Agreements
- Initial Funding
- Remaining Facility Fee, Credit Subsidy Cost, Annual Maintenance Fee
- Ongoing Project Management
DOE Loan Program Performance

“In the five years since LPO began financing projects, actual and estimated loan losses to the portfolio are less than $780 million or approximately 2% of the program’s loans, loan guarantees, and conditional commitments and less than 3.6% of the total funds disbursed to date.”

<table>
<thead>
<tr>
<th>LPO PORTFOLIO PERFORMANCE SUMMARY</th>
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<tr>
<td>Loans and Loan Guarantees Issued</td>
<td>$30.29 billion</td>
</tr>
<tr>
<td>Conditional Commitments</td>
<td>$3.96 billion</td>
</tr>
<tr>
<td>Amount Disbursed</td>
<td>$21.71 billion</td>
</tr>
<tr>
<td>Principal Repaid</td>
<td>$3.49 billion</td>
</tr>
<tr>
<td>Interest Earned</td>
<td>$0.81 billion</td>
</tr>
<tr>
<td>Actual and Estimated Loan Losses</td>
<td>$0.78 billion</td>
</tr>
<tr>
<td>Losses as % of Total Commitments</td>
<td>2.28%</td>
</tr>
<tr>
<td>Losses as % of Amount Disbursed</td>
<td>3.59%</td>
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<tr>
<td>Average Loan Tenor</td>
<td>22.3 Years</td>
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(As of September 2014)

Subsidies / Tools:

Currently in Law:
- Price-Anderson Nuclear Indemnification Act
- Government R&D
- NRC – Regulatory Delay insurance (EPAct 2005)
- Production Tax Credit (EPAct 2005)
- Accelerated Depreciation
- ITC
- Loans / Loan Guarantee (@ Treasury interest rate)
- State / City level specific incentives

Other possible mechanisms:
- Line tariff / Feed-in tariff / Revenue support
- Dispatch Preference (e.g., via FERC or states)
- Carbon / GHG incentive (tax provision)
- Other… (already risk isolated via Utility)
Direct subsidies (grants, tax credits) provide good lift for energy sources, but they cost the most for the budget. Cooperative grants (co-funding) cost less, but offer less lift. Loans provide very good leverage, and lift. Codes or standards force deployment and do not impact the budget as much – challenging to implement.

(A) Direct Subsidies
- Investment Tax Credits
- Production Tax Credits
- Feed-in tariffs (revenue)
- Rebates
- Grants

(B) R&D Funding
- DOE Cooperative grants
- R&E Tax Credits (Sec. 41)
- Tax Equity (inefficient)

(C) Standards / Mandates
- Industry Standards (ASTM, etc)
- State mandates

(D) Licensing / Direct Credit
- Direct Loans
- Loan Guarantees
- State Dispatch Preference
- Long Term Off-take Agreement
- NRC Licensing Reform

High Impact
“LIFT” or Deployment, Market adoption

Low Impact

High cost to budget
“LEVERAGE” on government funding

Lower cost, More leverage
Xi Hosts 56 Nations at Founding of Asian Infrastructure Bank – June 29, 2015
Questions?

AR / Nuclear Power: Global View
The Competitive *(or... not so much)*
Market Landscape

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