Market Design for the Clean Energy Transition: The Role of New Generator Finance

Resources for the Future and World Resources Institute

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Steyer-Taylor Center for Energy Policy & Finance
Stanford University
The Elements of Success

Technology

Sustainable Energy Future

Policy

Finance
Problem Statement

“The problem is the absence of a sufficient pipeline of bankable projects. . .[I]nvestment and finance remain constrained by serious barriers linked to market and policy failures, along with country-specific impediments, market conditions (including fossil fuel prices) and technical challenges.” OECD, 2016
Setting the Stage

![Graph showing the relationship between capital required, level of risk, and venture capital capacity.](Graph Source: Tana Energy Capital LLC)
Project finance: Single-asset project company, built around a web of contracts
Why is project finance important?

Note: This excludes corporate M&A transactions and private equity buyouts. Project finance includes debt and equity invested in projects above 1MW.
The Energy 202: Clean energy investment needs to triple to halt catastrophic warming, finds new report
DERISKING DECARBONIZATION:
Making Green Energy Investments Blue Chip

October 27, 2017
Three Major Clean Energy Finance Problems

- **QUANTITY PROBLEM**: Current annual global clean energy investment must triple—from $0.75T to $2.25T—to keep global warming under 2°C. This would absorb ~2/3 of the world’s total annual new investible capital;

- **QUALITY PROBLEM**: There is a serious mismatch between the conservative risk profile of most major institutional investors and high-risk nature of most clean energy projects today;

- **LOCATION PROBLEM**: A tripling of spending must occur within a pool of capital mostly held in OECD nations, while much of it will have to be spent in the developing world—with all the attendant risk.
### IEA’s Annual Spending on Clean Energy 2016-2040 by Category ($ billions/yr)

<table>
<thead>
<tr>
<th>Category of Spending</th>
<th>2010-2015 Average</th>
<th>“450 Scenario” 2016-2040</th>
<th>Multiple 450 vs. Today (x)</th>
<th>Dollar Change vs. Today</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewables</td>
<td>$282</td>
<td>$503</td>
<td>1.8x</td>
<td>$220</td>
</tr>
<tr>
<td>Electricity Networks</td>
<td>229</td>
<td>288</td>
<td>1.3x</td>
<td>59</td>
</tr>
<tr>
<td>Other Low CO₂ (CCS, Nuclear, Etc.)</td>
<td>13</td>
<td>114</td>
<td>8.8x</td>
<td>101</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>221</td>
<td>1,402</td>
<td>6.3x</td>
<td>1,181</td>
</tr>
<tr>
<td>Totals:</td>
<td>$746</td>
<td>$2.3T</td>
<td>≈3x Current Spending</td>
<td>$1,561</td>
</tr>
</tbody>
</table>
Asset Holdings and New Investible Inflows for World’s Major Institutional Investors ("Stocks" vs "Flows")

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pension Funds</td>
<td>$25</td>
<td>$1.1</td>
<td>$1.0</td>
<td>OECD Contributions as % GDP</td>
</tr>
<tr>
<td>Insurance Companies</td>
<td>$23</td>
<td>$(0.9)</td>
<td>$0.2</td>
<td>OECD Assets 2015 vs. 2014 &amp; 2010</td>
</tr>
<tr>
<td>Mutual Funds</td>
<td>$37</td>
<td>$1.9</td>
<td>$1.3</td>
<td>ICI Tables 65 &amp; 67 for Net Purchases</td>
</tr>
<tr>
<td>Sovereign Wealth Funds</td>
<td>$8-9</td>
<td>$0.2</td>
<td>$0.5</td>
<td>SWFI Assets 2015-16; Preqin 2011-16</td>
</tr>
<tr>
<td>Billionaires</td>
<td>$7</td>
<td>$(0.6)</td>
<td>$0.4</td>
<td>Forbes 2015 vs. 2014 &amp; 2010</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$100</strong></td>
<td><strong>$1.7T/yr Δ</strong></td>
<td><strong>$3.4T/yr Δ</strong></td>
<td><strong>Versus $2.3T /yr Need</strong></td>
</tr>
</tbody>
</table>

* Insurance, SWF, and billionaires net inflows not available—change in net assets used as proxy.
Quality Problem – Bonds
Big Need, Little Risk Appetite ($B)

“New Money” High Yield Bonds = ~1% of $7.3 trillion 2016 U.S. Bond Market (Billions).

- $2,322
- $1,308
- $241
- $152
- $89

- US Gov’t & Muni.
- Mtge & Asset-Backed
- Inv. Grade Corp
- High Yield Refinancing
- High Yield New Funding
Quality Problem – Pension Funds
Most Clean Energy Investment in a 9% Allocation ($T)

9% x $24T = ~$2T

- Mutual Funds, $6.6, 30%
- Equities, $5.9, 27%
- Corporate Bonds, $1.9, 9%
- Insurance Contracts, $0.9, 4%
- Real Estate, $0.4, 2%
- Private Equity, Loans & Other, $2.0, 9%
- Government Bond and Cash, $4.3, 19%
Location Problem – Capital in Wealthy Countries, Spending in Poor Countries ($Bn)

- China ($6,980)
- India ($2,448)
- Brazil ($2,389)
- Russia ($2,470)

Legend:
- Green: Today’s Assets
- Red: Investment 450 Scenario (2014-35)
“Making Green Energy Investments Blue Chip”

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Specific Investment Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markets</td>
<td>Electricity Market Design</td>
</tr>
<tr>
<td></td>
<td>Fossil Fuel Prices</td>
</tr>
<tr>
<td>Policy</td>
<td>Mandates &amp; Carbon Pricing</td>
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<td></td>
<td>Government Subsidies</td>
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<tr>
<td>Project Development</td>
<td>Innovative Technologies</td>
</tr>
<tr>
<td></td>
<td>Government Approvals &amp; Permitting</td>
</tr>
<tr>
<td>Investment Framework</td>
<td>Rule of Law</td>
</tr>
<tr>
<td></td>
<td>Tax Issues</td>
</tr>
<tr>
<td></td>
<td>Debt Regulation, Equity Disclosure &amp; Currencies</td>
</tr>
</tbody>
</table>
The “Big Four” Investment Risks: Some Examples

#1 Policy
- Unstable/un-bankable emissions rules, carbon pricing, EE stds
- Trade policy (e.g. solar tariffs)
- Feed-in-Tariff contract risks
- Net Energy Metering problems
- Fuel economy stds in flux → EVs?

#2 Market
- Low/volatile nat. gas and oil prices
- Low/unstable electricity prices
- Over-generation/curtailment risks
- Dispatch rules in “competitive markets” vs ZECs, etc.
- Lack of “capacity” markets → PPA issues
- Storage—resource or load?

#3 Project Development
- Permitting reqs and timelines
- Technology issues → EPC Issues
- Transmission /Interconnect
- Land availability
- PPAs/Regulatory approvals
- Problematic gov’t support
- Access to dev capital and debt mkts

#4 Investment Regime
- U.S. tax incentives; alternative minimum tax; passive loss rules
- Unstable currencies in dev. world
- Weak contract, bankruptcy laws
- Basel III bank capital rules
- Export Credit Agency maturity limits
- Sovereign Wealth Fund tax treatment
Example of an Investment Risk

Local Currency Needed to Buy $1 USD in BRIC Countries 2007-2017

<table>
<thead>
<tr>
<th>Currency</th>
<th>2007</th>
<th>2017</th>
<th>Low Value vs. USD</th>
<th>Decade Change$^{169}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil Reals</td>
<td>1.8</td>
<td>3.1</td>
<td>4.17</td>
<td>(72%)</td>
</tr>
<tr>
<td>Russian Rubles</td>
<td>25</td>
<td>57</td>
<td>82</td>
<td>(128%)</td>
</tr>
<tr>
<td>Indian Rupees</td>
<td>40</td>
<td>64</td>
<td>68</td>
<td>(60%)</td>
</tr>
<tr>
<td>Chinese Yuan</td>
<td>7.5</td>
<td>6.5</td>
<td>7.5</td>
<td>+13%</td>
</tr>
</tbody>
</table>
A Hypothetical Project

Four Risks Compound, Cash Flow Dives & Capitalization Falls

- **Falling Cash Flow**
- **Project Not Financable**
- **Value Dropping Below Cost**

<table>
<thead>
<tr>
<th>Risk Type</th>
<th>Capitalization Cost (MW $500s)</th>
<th>Project Cost (MW $500s)</th>
<th>Annual EBITDA (MW $500s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired</td>
<td>$300,000</td>
<td>$105,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>1. CO2 $ Unstable</td>
<td>$240,000</td>
<td>$120,000</td>
<td>$240,000</td>
</tr>
<tr>
<td>2. Elec $ Unstable</td>
<td>$120,000</td>
<td>$105,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>3. EPC Uncertain</td>
<td>$105,000</td>
<td>$105,000</td>
<td>$105,000</td>
</tr>
<tr>
<td>4. Debt Term Constrained</td>
<td>$105,000</td>
<td>$105,000</td>
<td>$105,000</td>
</tr>
</tbody>
</table>

- **Capitalization**
- **Cost**
- **EBITDA**

Falling cash flow and value dropping below cost lead to project not being financable.
“‘Investment grade’ energy policy is a critical factor for unlocking significantly scaled-up capital flows into renewable energy and energy efficiency. To be ‘investment grade’, policy needs to tackle all the relevant factors that financiers assess when looking at a deal. It must be embedded in wider energy policy, and be stable across the lifetime of projects. Investors need to be confident, in a policy-driven market, that governments are serious.” Kirsty Hamilton, Chatham House, 2009
Thank You
Disparate Treatment of Low-Carbon Resources in CA Electricity Market

- Higher reliability *RPS resources*, e.g. CSP, geothermal, and biomass lose out in spot power market auctions to less reliable but lower cost solar and wind.
- Low carbon *non-RPS* resources, e.g. large hydro, CCS, nuclear lose out to less reliable/lower capacity/lower-cost solar and wind.
- Low-carbon/higher reliability sources, e.g. CSP, geothermal, biomass and hydro lose out to higher-carbon/lower-cost natural gas generation in fixed-price *capacity-focused procurement*.
- Energy efficiency project investments lose out to solar and wind wrt state (and federal) incentives.
- Lower-cost/higher-capacity/longer duration non-battery storage, e.g. pumped storage, loses out to mandated procurement of higher-priced battery storage.
A Tax Policy Issue in Energy Project Investment

• Tax credits have driven much U.S. clean energy project investment but they are a problematic tool

• Limited universe of taxpayers with “tax appetite” who can ”monetize” tax credits
  • Many non-taxpayer investors = corps with large losses; REITs, partnerships/LLCs/MLPs; pension funds/charitable trusts/endowments; IRAs/401(k)s; state “permanent funds”

• Taxpayer universe further reduced by passive activity rules, corporate AMT, SWFs

• The limited group of “tax equity” investors can charge higher rates meaning more in their pockets, less in projects

• And, perversely, weak points in the economy, when investment most needed, are also when the least tax equity available

• Several solutions: “cash grant” alternative, open up MLPs and REITs, FITs, PABs etc.
## Temporal Phases of Project Financing

<table>
<thead>
<tr>
<th>Phase</th>
<th>Assessment</th>
<th>Development</th>
<th>Financial Closing</th>
<th>Construction</th>
<th>Term Financing</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Scale</td>
<td>1 year →</td>
<td>1-3 years →</td>
<td>1 year →</td>
<td>1-4 years →</td>
<td>½ year →</td>
<td>20 years</td>
</tr>
<tr>
<td>What Happens</td>
<td>Figure out if project makes sense.</td>
<td>Get all permits.</td>
<td>Lock down all debt &amp; equity – usually close simultaneously.</td>
<td>Draw down committed funding to build the project.</td>
<td>Get project working well enough so that long-term, permanent financing can be put in place.</td>
<td>Run the project: enforcing all input &amp; output contracts; avoiding defaults on loans, and; paying dividends to equity.</td>
</tr>
</tbody>
</table>