

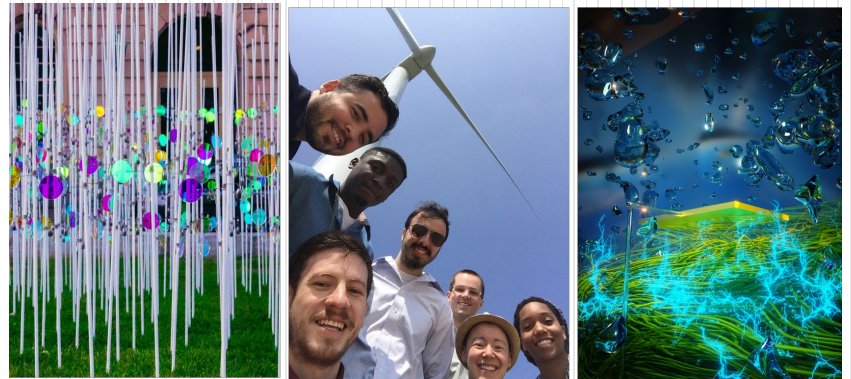
Decision making for demonstration funding: Risk and portfolios

Erin Baker

Distinguished Professor, University of Massachusetts,
Amherst

March 30, 2023

Energy
Transition @ UMass
Institute Amherst

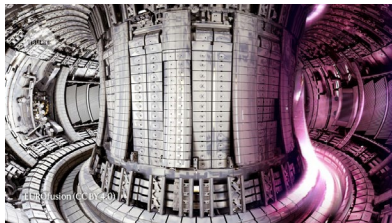


Uncertainty

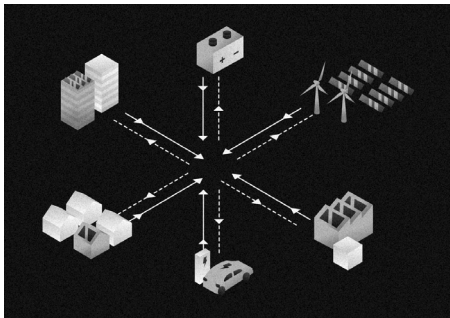
Rationale

Risk
implications

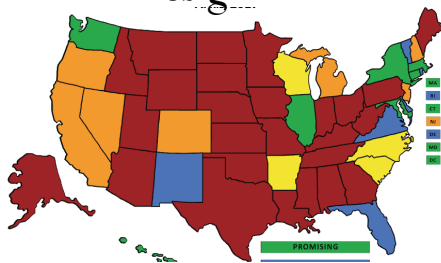
Portfolio
implications



Technological



Design



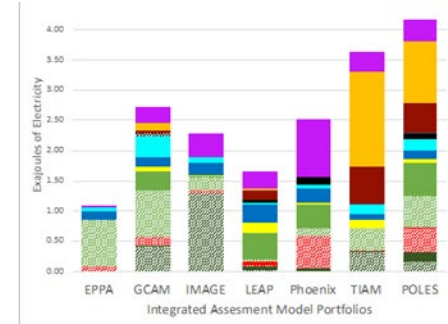
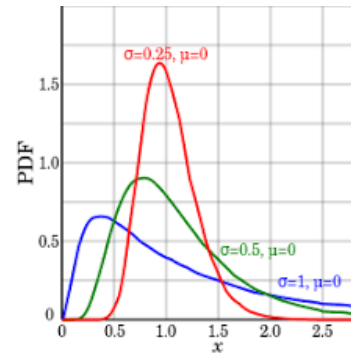
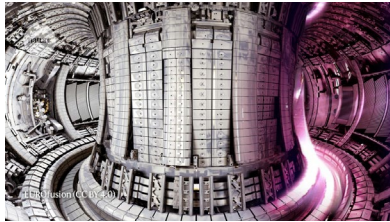
Policy

Uncertainty

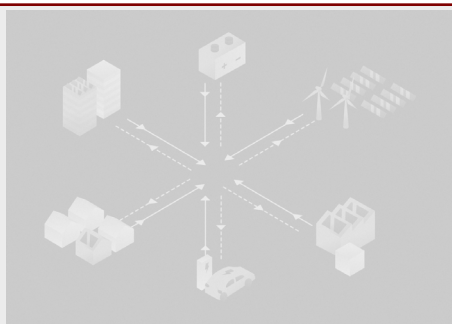
Rationale

Risk
implications

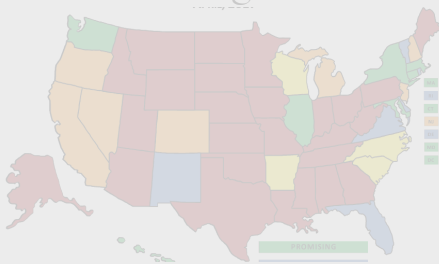
Portfolio
implications



Technological



Design



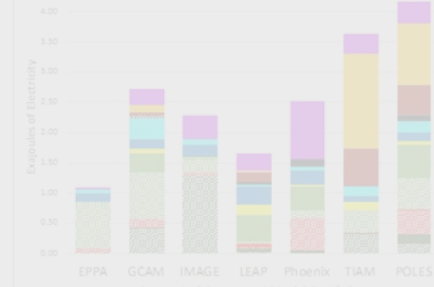
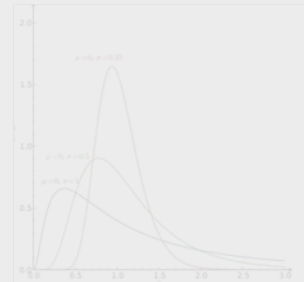
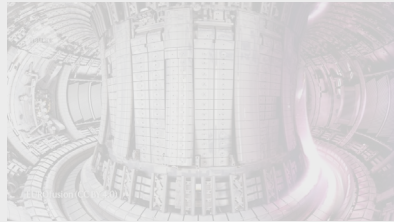
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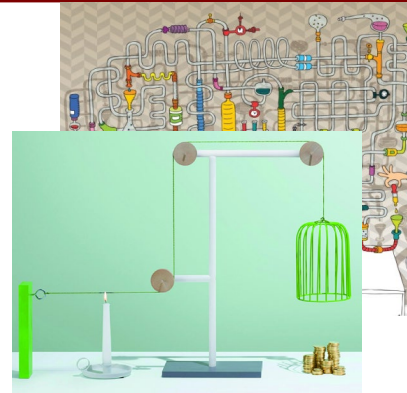
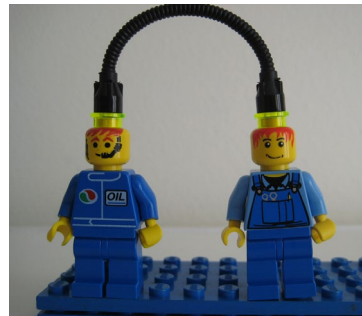
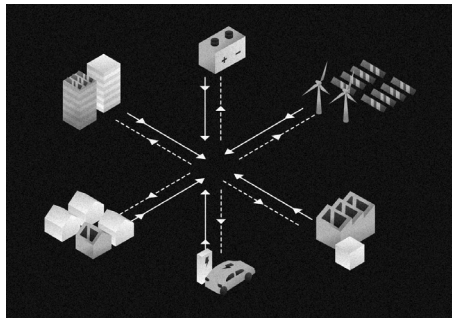
Rationale

Risk implications

Portfolio implications



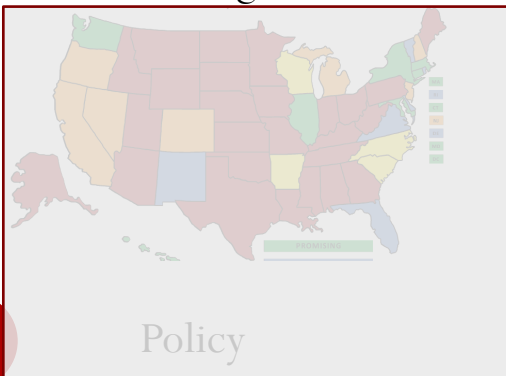
Technological



FOSSIL RESOURCES	BIOMASS/WASTE	H ₂ O SPLITTING
<ul style="list-style-type: none"> Low-cost, large-scale hydrogen production with CCUS New options include byproduct production, such as solid carbon 	<ul style="list-style-type: none"> Options include biogas reforming and fermentation of waste streams Byproduct benefits include clean water, electricity, and chemicals 	<ul style="list-style-type: none"> Electrolyzers can be grid-tied, or directly coupled with renewables New direct water-splitting technologies offer longer-term options
<ul style="list-style-type: none"> Coal Gasification with CCUS Natural Gas Conversion with CCUS SMR 	<ul style="list-style-type: none"> Biomass Conversion Waste to Energy ADG 	<ul style="list-style-type: none"> Direct-Solar High Temp. Electrolysis Low Temp. Electrolysis Electrolysis STCH PEC

CCUS: carbon capture, utilization, and storage; SMR: steam methane reforming; ADG: anaerobic digester gas; STCH: solar thermochemical hydrogen; PEC: photoelectrochemical

Design



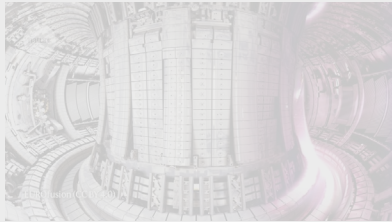
Policy

Uncertainty

Rationale

Risk implications

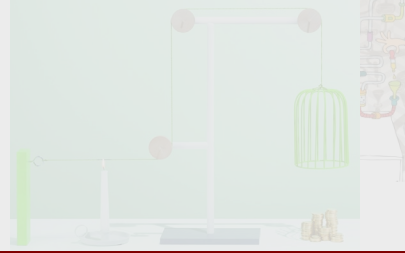
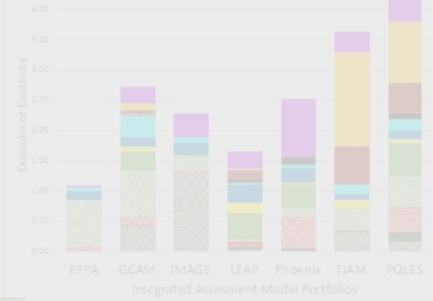
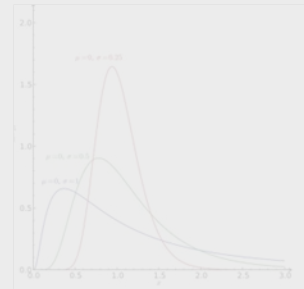
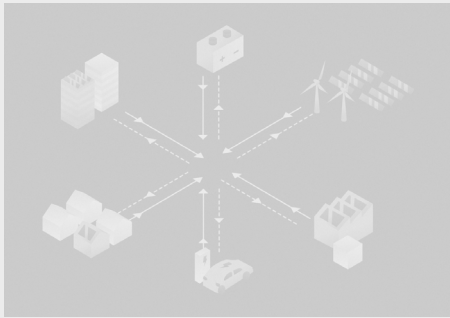
Portfolio implications



Technological

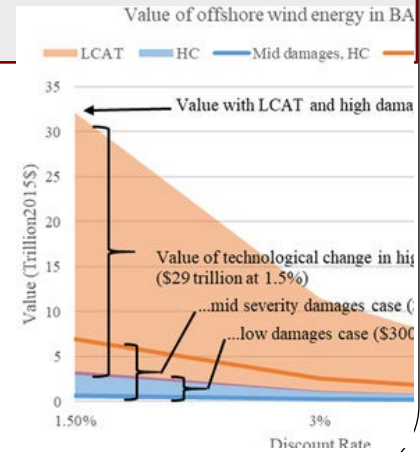
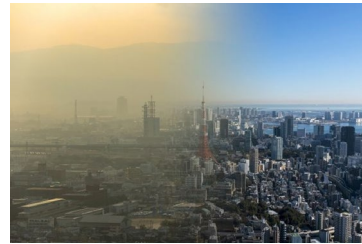
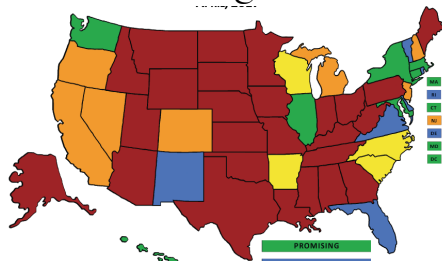


Design



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 SMR Coal Gasification with CCUS Natural Gas Conversion with CCUS	 ADG Biomass Conversion Waste to Energy	 STCH High Temp. Electrolysis Low Temp. Electrolysis Photoelectrochemical

CCUS: carbon capture, utilization, and storage; SMR: steam methane reforming; ADG: anaerobic digester gas; STCH: solid thermochemical hydrogen; PECI: photoelectrochemical



Diversify leadership



- “*Start ups* funded by the top VCs were nearly 90% male. 72% of founders were white ...14% were Ivy League-educated.” RateMyInvestor Report
- companies in the top quartile for gender diversitywere **15 percent** more likely to experience **above-average profitability**; ...(f)or ethnic and cultural diversity...a **35 percent** likelihood of outperformance. McKinsey and Company
- A.P. Ravikumar, E. Baker, A. Bates, D. Nock, D. Venkataraman, T. Johnson, et al., *Enabling an Equitable Energy Transition Through Inclusive Research*, Nature Energy, (2022). <https://doi.org/10.1038/s41560-022-01145-z>
- **Workshop on Priorities and Research Needs for an Equitable Energy Transition** from 9:30-1:30 on Friday, April 28, 2023, in Washington DC. To register: <https://forms.gle/1LaW9iP2ns2Q8ze67>. More info: <https://nsf2026.umasscreate.net>

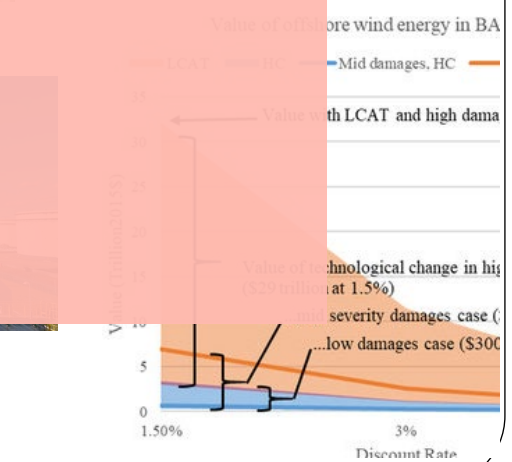
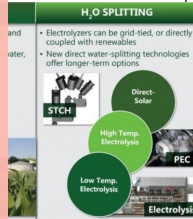
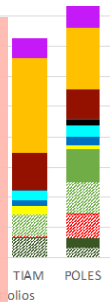
Uncertainty

Rationale

Risk
implications

Portfolio
implications

- Diversify Risk Profiles
 - High risk, long tails
 - Opportunity to learn
 - Policy risk
- Diversify topics
 - Across technology categories
 - Across approaches
- Diversify leadership

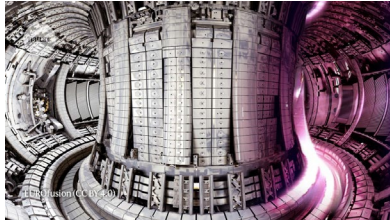


Uncertainty

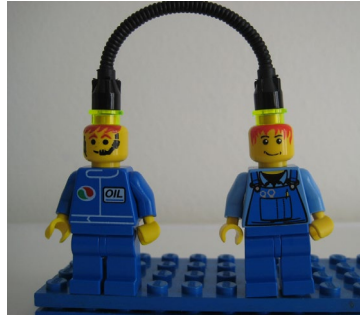
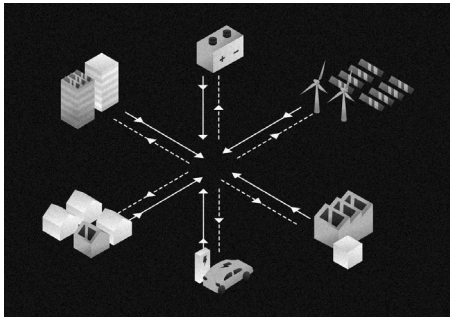
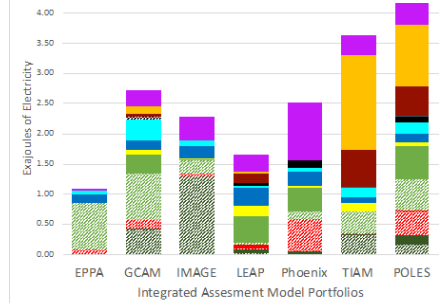
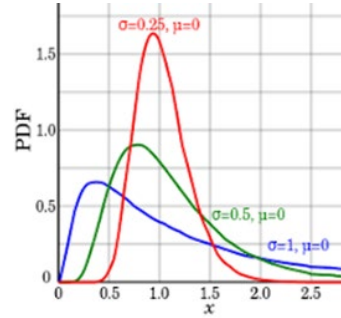
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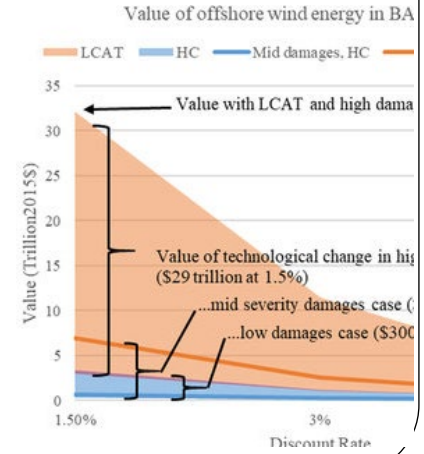
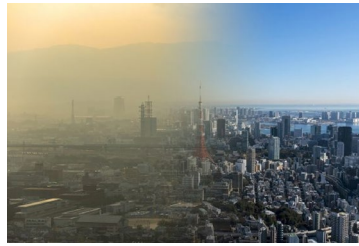
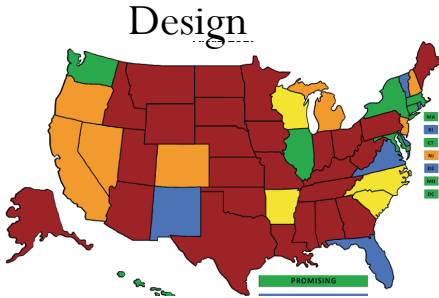


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Uncertainty	Rationale	Risk implications	Portfolio implications
Technological	Risk aversion/long tails	Risky projects with large upside	Diversify technologies
Design	Cost of learning/spread out knowledge	Maximize option value	Diversify approaches
Policy	Costs and feasibility	Projects not profitable under current policy	Add options to portfolio