Reducing the Impact of Used Nuclear Fuel from Advanced Reactors: Public Views on Facility Design and the Role of Trust

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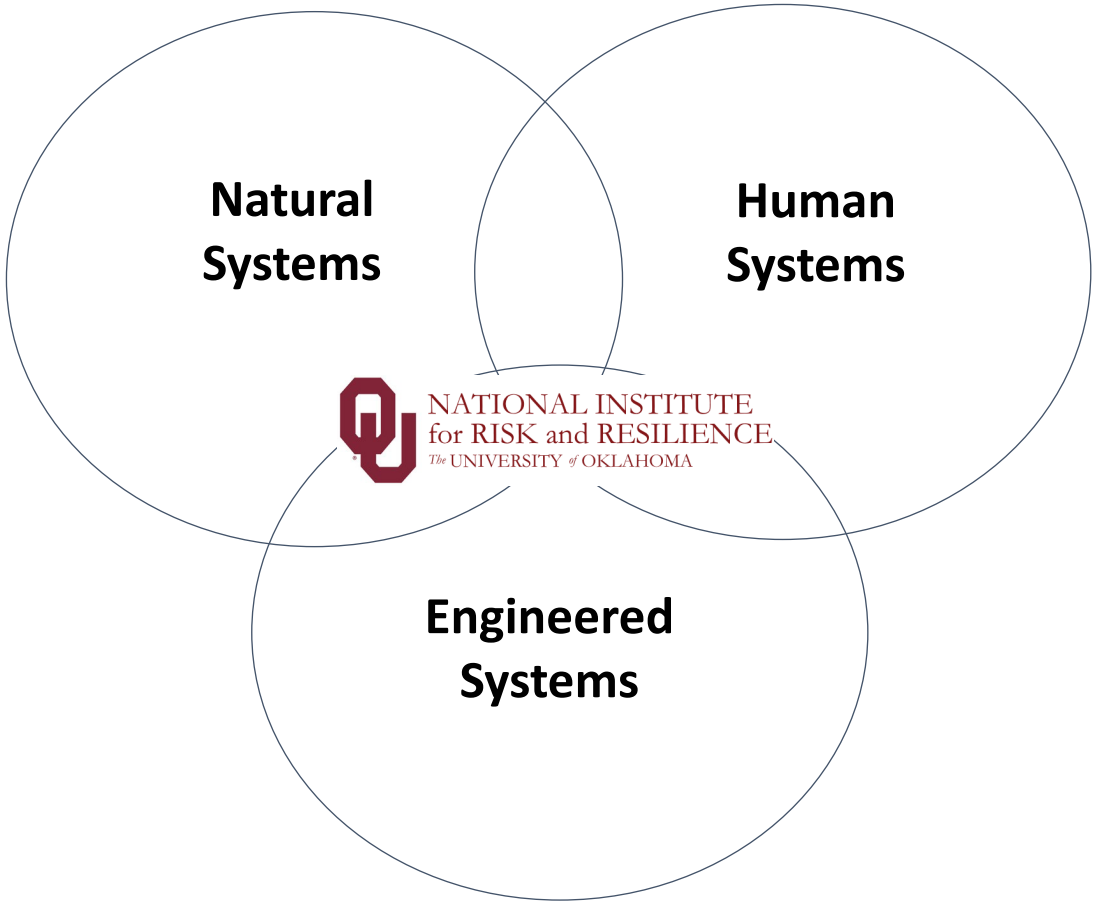
NIRR Mission

Mission: integrate social, physical, and engineering sciences to reduce risk and enhance resilience by addressing complex societal problems that span natural, human, and technical systems



Background: Public Perceptions About Nuclear Technology

Survey Research Analysis Program

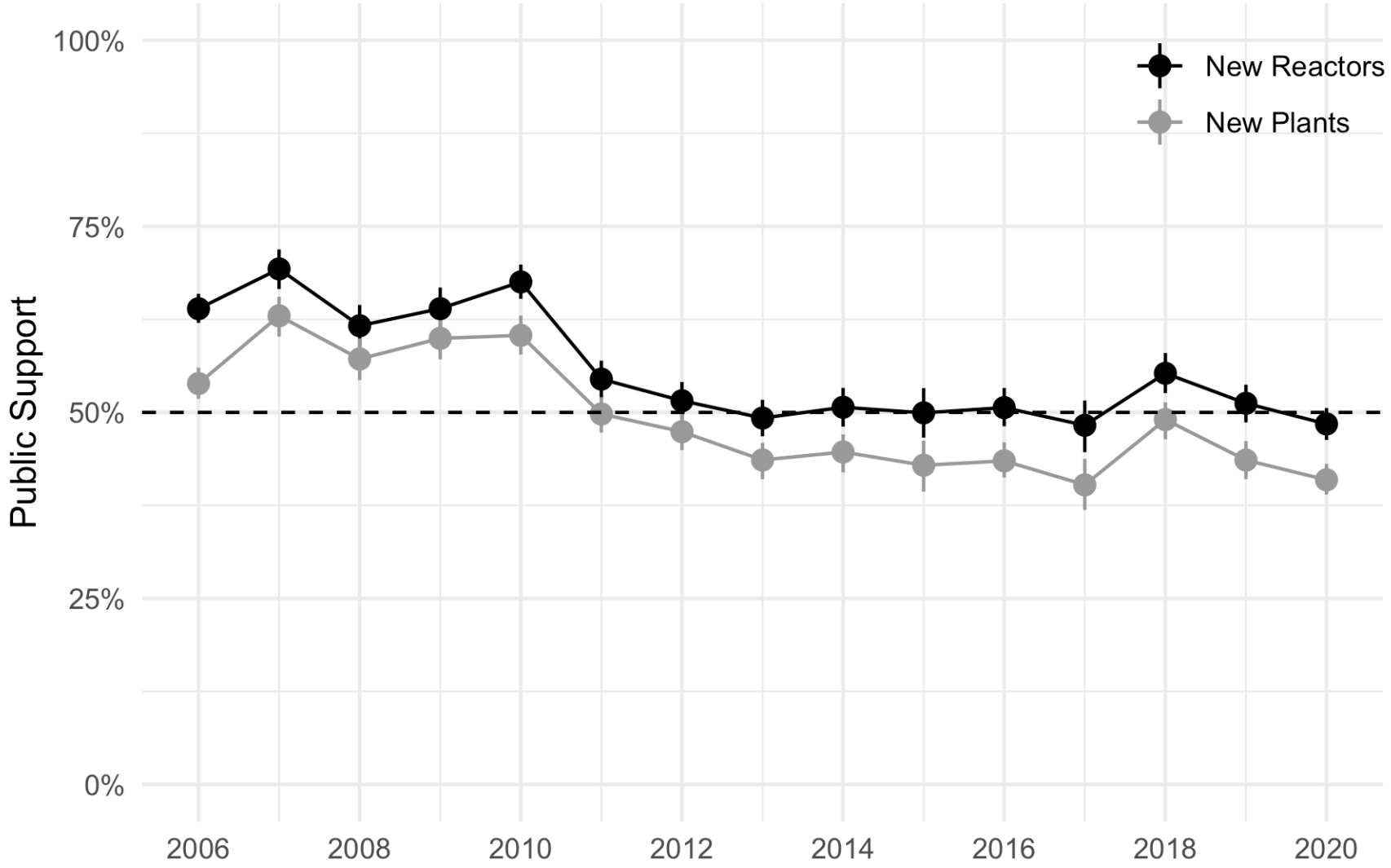
- Encompassing nuclear security, nuclear energy, and nuclear waste management
- Data on public attitudes using annual national internet/phone surveys since 1993
- Over 90,000 total research participants

- Basis for analysis of evolving context, key trends, programmatic priorities, and public perceptions of new technologies

- Core focus areas:
  - Risk and benefit perceptions surrounding nuclear issues
  - Implications of events on nuclear energy views (e.g. Fukushima, WIPP)
  - Implications of facility designs
  - Evolving patterns of institutional trust
  - Preferences for advanced reactor designs (e.g. SMR's and micro-reactors)

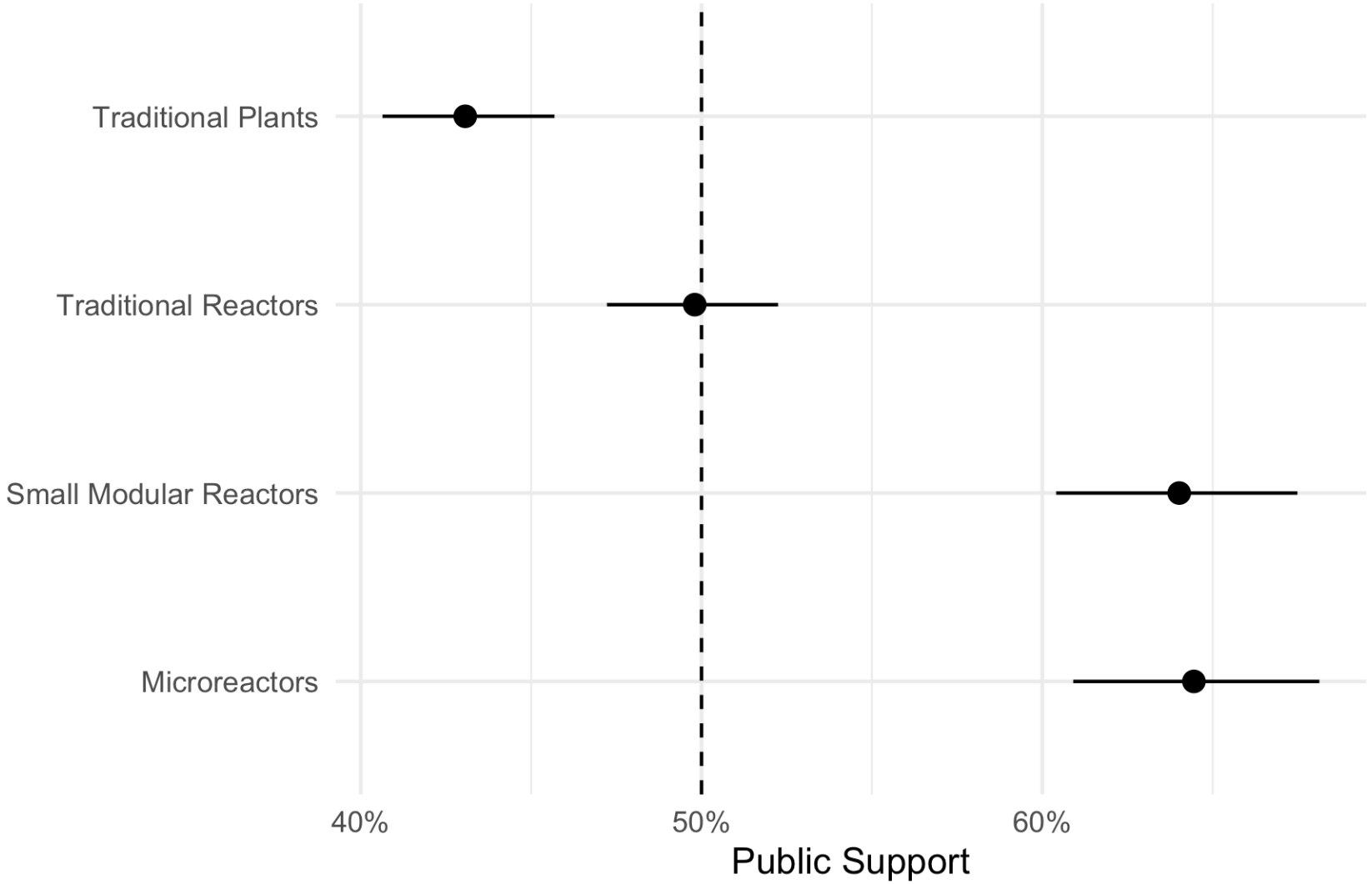
Stagnation in Public Support for Nuclear Energy

- How do you feel about constructing:
  - Additional nuclear reactors at the sites of **existing** nuclear power plants in the US?
  - Additional nuclear power plants at **new** locations in the US?
- Public support decreased significantly after Fukushima and never recovered
- Support is higher for new reactors at existing locations than new plants



Potential of Advanced Nuclear Reactors

- How do you feel about constructing:
  - Additional nuclear reactors at the sites of **existing** nuclear power plants in the US?
  - Additional nuclear power plants at **new** locations in the US?
  - Small modular reactors
  - Microreactors
- Public support is significantly higher for SMRs and Microreactors



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UNF Management, Engineering, and Trust

Advanced reactors have the potential to reinvigorate public support for nuclear energy in the US. However…

- We expect that used nuclear fuel management will strongly affect public views about new nuclear technologies
- New technology programs will have to consider the variety of factors that shape public perceptions about used nuclear fuel management

Most research looks at three types of factors: risk perceptions, location of proposed facilities, and demographics

Today's discussion:

- The role of engineering and facility design
- The role of trust in key actors

Engineering and Facility Design

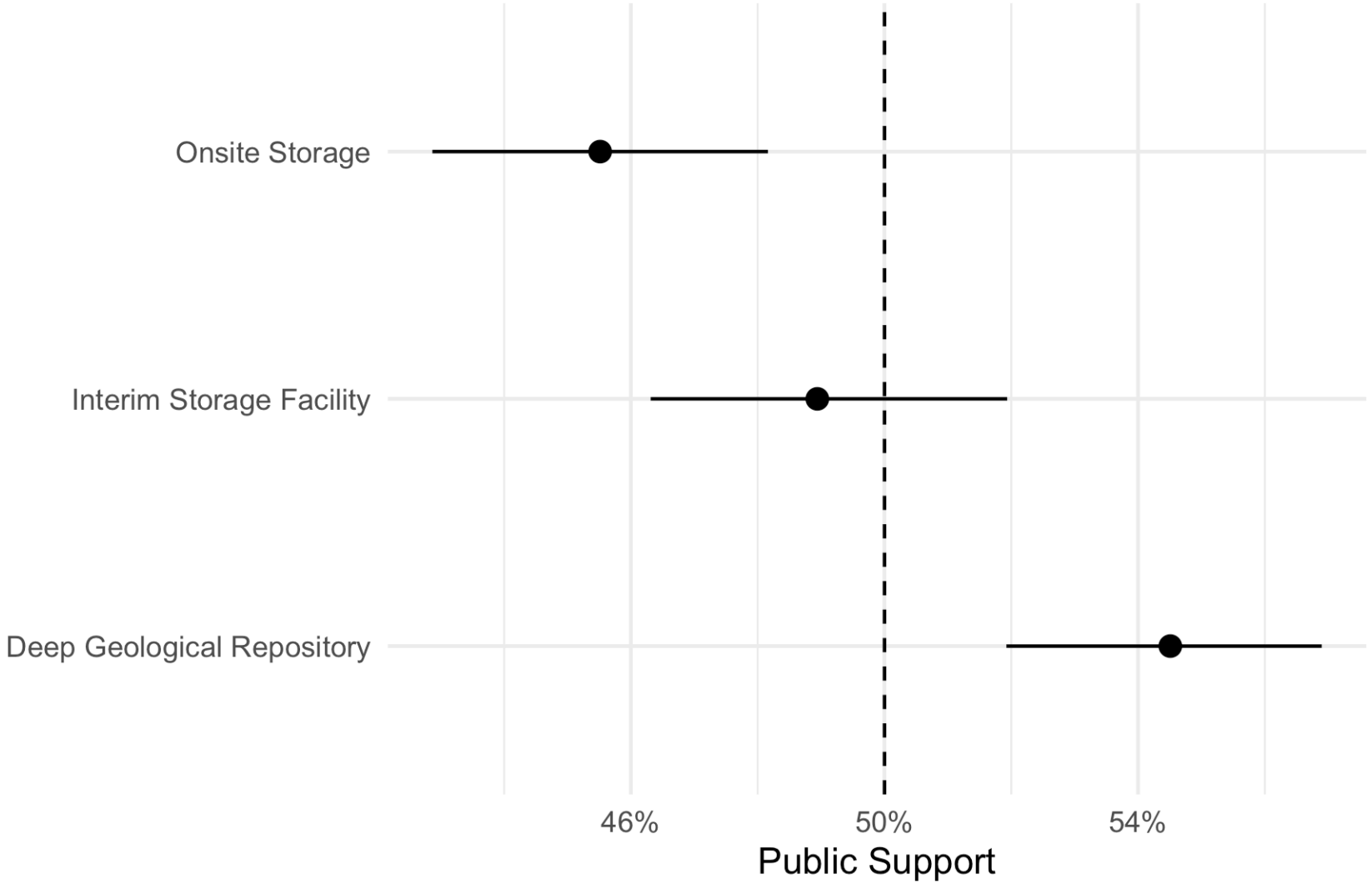
What roles do engineering and facility design play?

- Any attempt to site a nuclear facility will have to contend with an existing set of narratives (stories) about risk, harm, and benefit

- Design elements, and how they are described, provide the structure for public narratives
  - Sole focus on managing the risks of used nuclear fuel vs. articulating the potential benefits of UNF facilities such as retrievability, reuse, research laboratories, education, and jobs
  - How/whether attributes of the facility portray: nature of the materials (harm reduction vs. potential for reuse); activities at the facility (no activity vs. research lab); and technological optimism (final disposal vs. retrievability)

Facility Options and Public Support

- How do you feel about:
  - Storing spent nuclear fuel at or near nuclear power plants?
  - Siting and constructing one or more interim storage facilities for consolidating spent nuclear fuel in the U.S.?
  - Constructing a storage facility deep underground where spent nuclear fuel from all over the U.S. would be stored?
- Support is lowest for continued on-site storage and highest for a deep geologic repository



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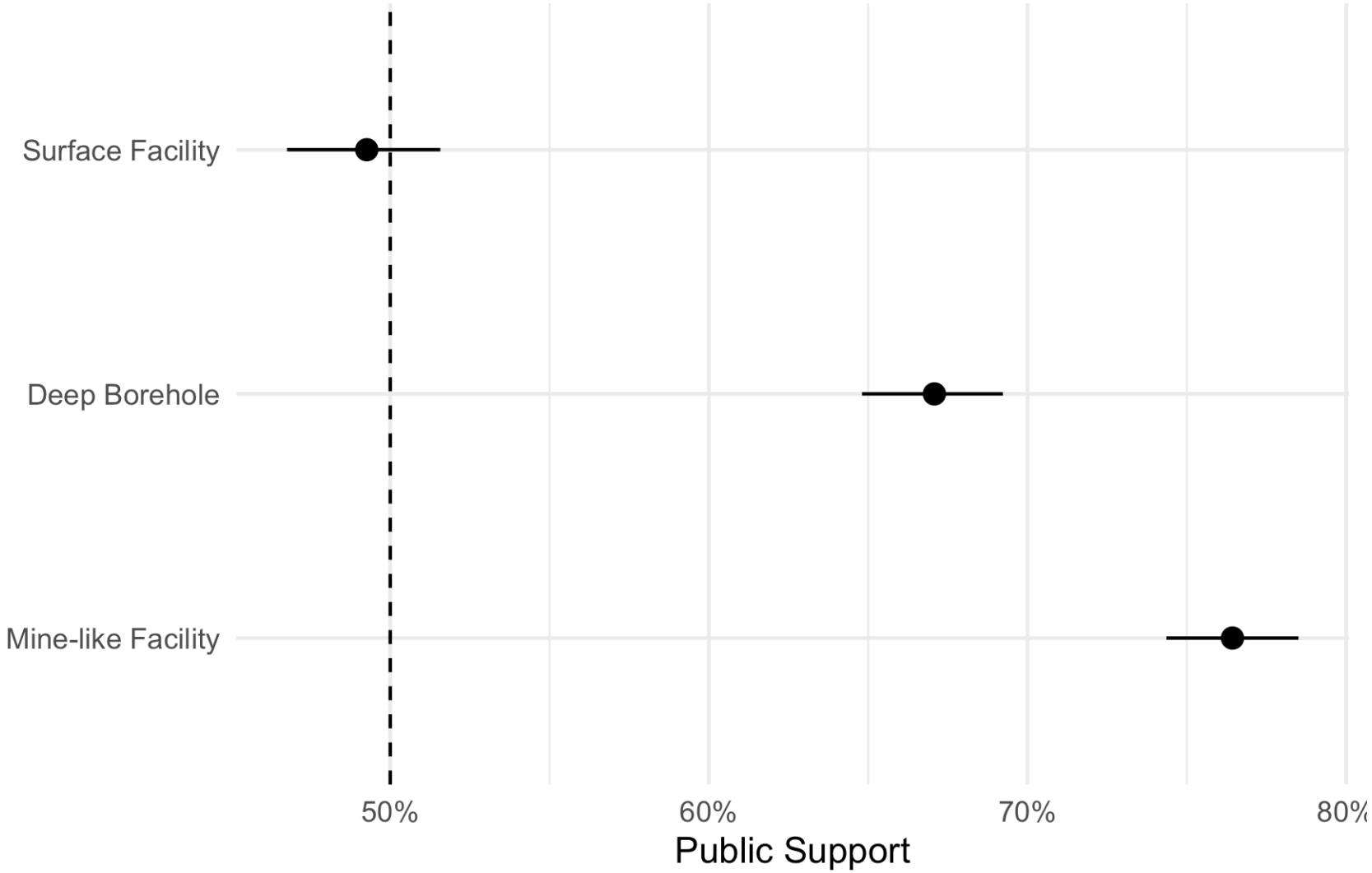
Engineering Options and Public Support

- How do you feel about constructing:
  - Storage facilities at or near the surface of the earth that are less permanent but allow retrieval for reprocessing, research, or other treatments?
  - Deep boreholes that would provide permanent and safe disposal, but would make materials extremely difficult to retrieve after the boreholes are sealed?
  - Storage facilities underground that are like mines that could be either permanently sealed or could allow materials to be retrieved?
- Support for a mine-like facility design is significantly higher than a deep borehole or surface facility design



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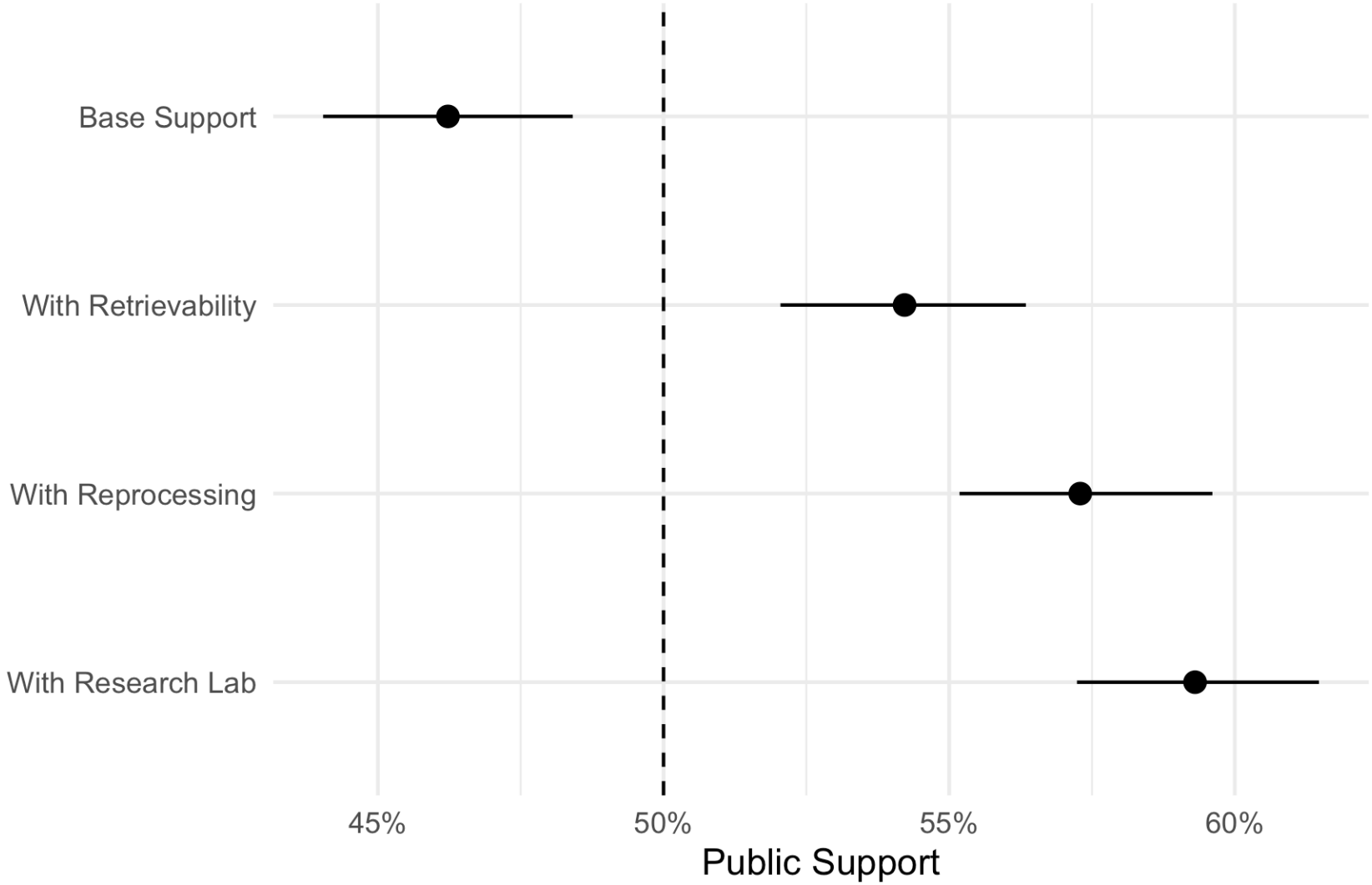
Facility Design Attributes and Public Support

- What would happen to your level of support for the Yucca Mountain project if you learned that the facility would:
  - Remain open for an extra 100 years to allow time for development of new technologies?
  - Include capacities for reprocessing spent nuclear fuel?
  - Include a national research laboratory?
- Articulating possible benefits increases support significantly
- Attributes are not mutually exclusive, so support could be even higher with two or more features



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Public Trust and UNF Management

UNF facility siting involves an array of actors such as government agencies, non-governmental organizations, private sector entities, and scientists and experts

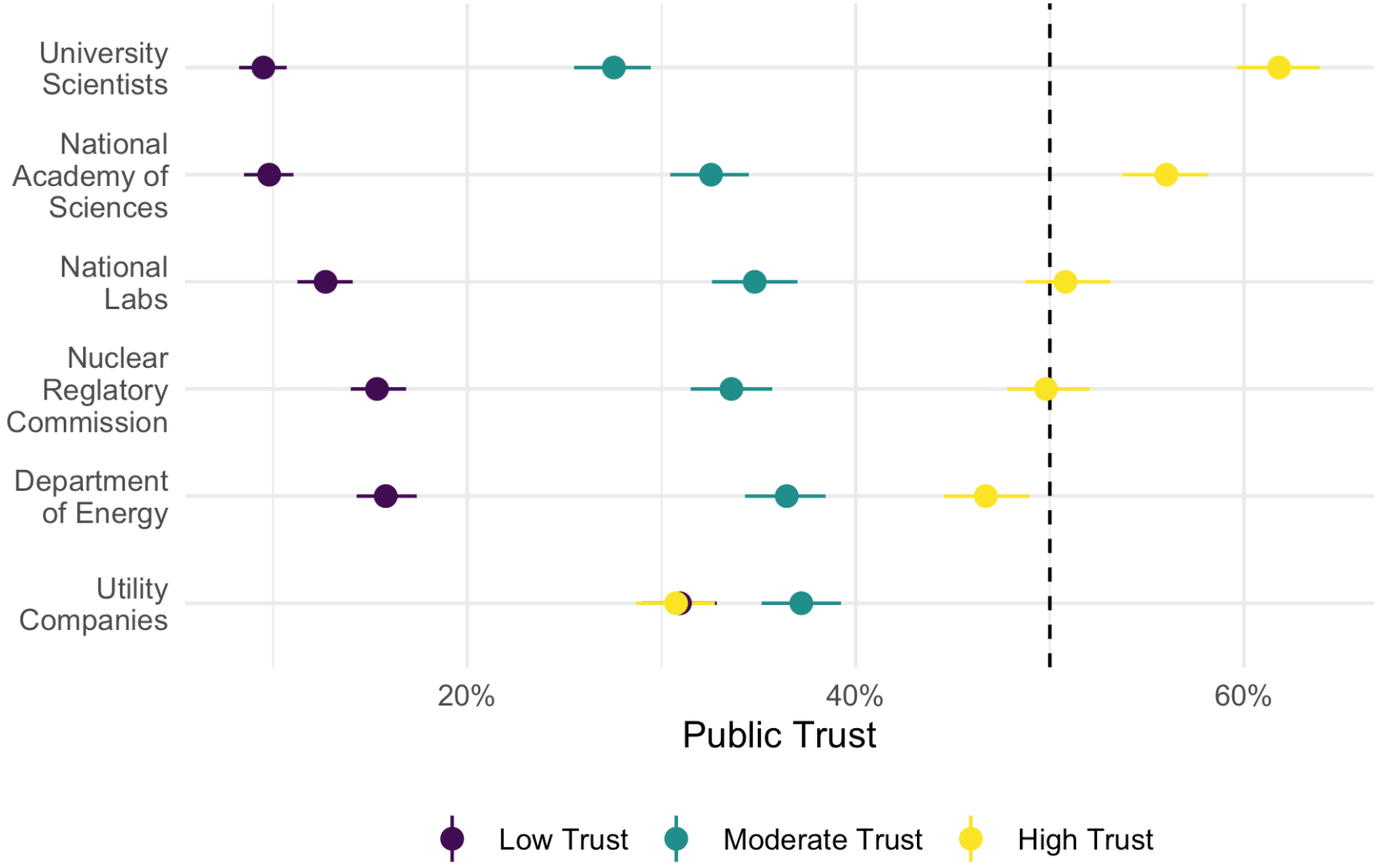
- Any participant in nuclear facility siting is affected by (and has a stake in) trust for this array of actors
- Trust varies across actors

What role does trust play in the UNF management process?

- **Direct role:** trust in key experts is directly linked with support for UNF management
- **Indirect role:** risk perceptions are difficult to change, but their negative effect on public support can be attenuated by building trust in key actors
  - Some people may believe that UNF management is risky, but they trust that the core actors will do everything they can to minimize the risk

Trust in Experts Varies

- Trust varies across experts from key government agencies that manage UNF, university scientists, the NAS, and experts from utility companies
- Trust is highest for university scientists and the NAS; lowest for utility companies



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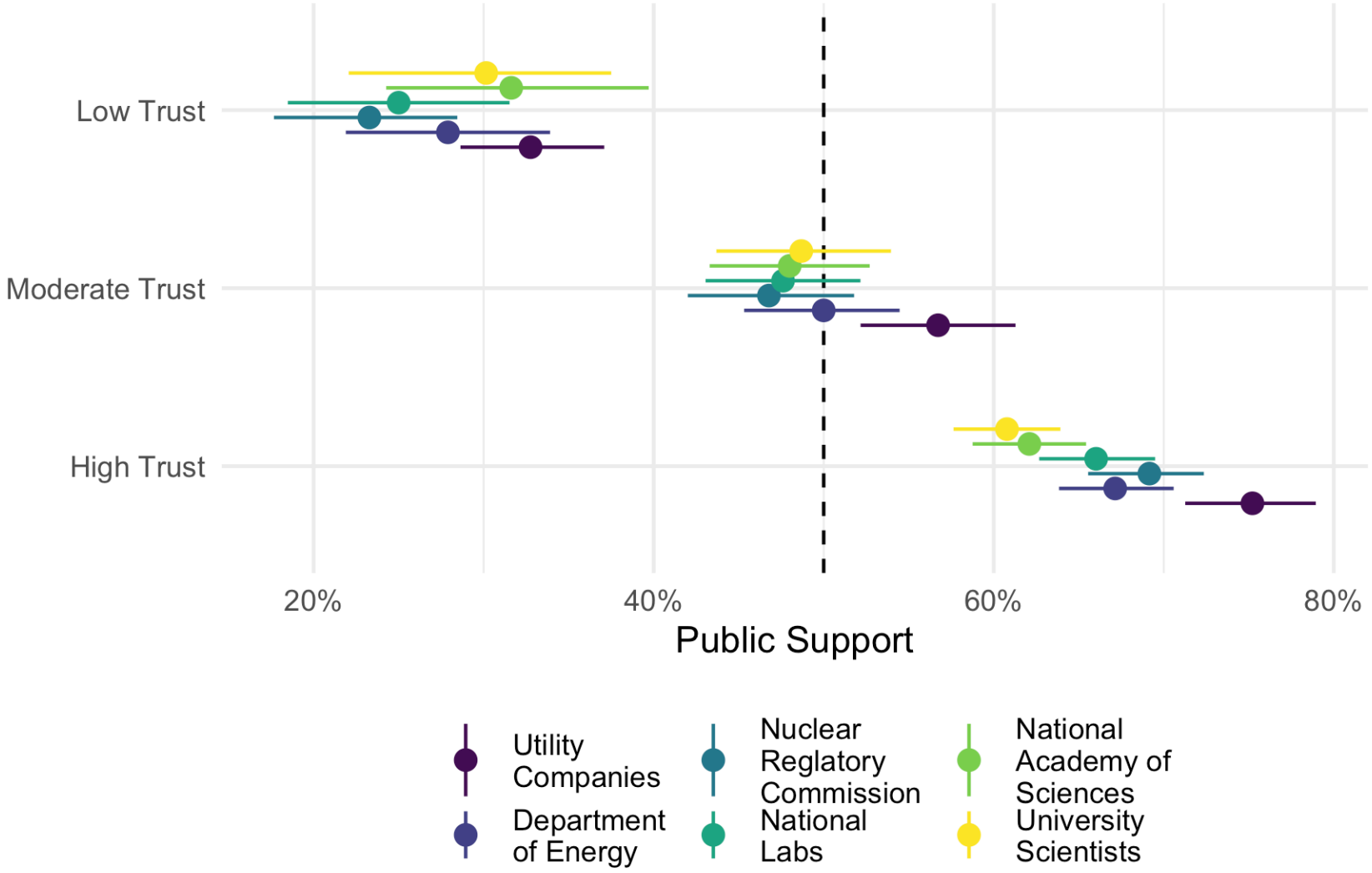
Trust in Experts Increases Public Support for UNF Management

- How does trust directly affect support for constructing a deep geologic repository in the US?
- Those with high levels of trust in experts are significantly more likely to support facility construction
- Trust in utility companies matters the most, followed by the DOE and NRC



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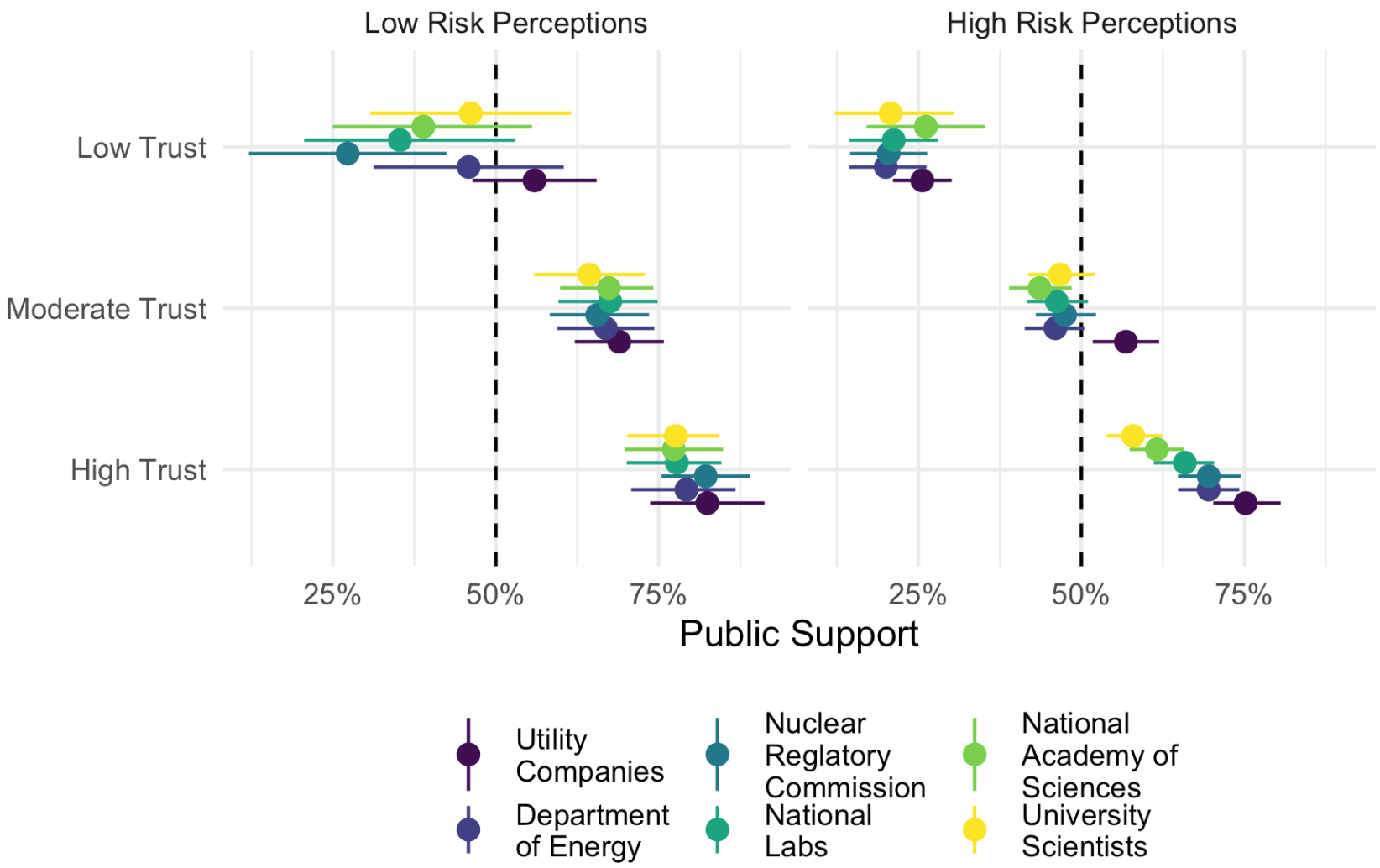
Trust in Experts Moderates the Negative Impact of Risk Perceptions

- How does trust moderate the effect of negative risk perceptions on support for UNF facility siting?
- High levels of trust attenuate risk perceptions
- Those with high levels of trust (even when they perceive risks to be high) are significantly more likely to support facility construction
- Trust in utility companies matters the most, followed by the DOE and NRC



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Key Takeaways

Public support for traditional nuclear technology in the US has stagnated

- Advanced reactor technologies have the potential to reinvigorate public support
- However, UNF management is likely to play key role in shaping the future of AR technologies in the US

The role of engineering and facility design:

- Engineering design plays an important role in how host communities and broader publics view the facility
- Design elements, and how they are described, provide the structure for public narratives
- How the facility portrays the nature of nuclear materials, proposed activities at the facility, and technological optimism

The role of trust:

- UNF facility siting involves an array of actors with varying levels of public trust
- Any participant in nuclear facility siting is affected by (and has a stake in) trust for this array of actors
- Trust directly affects public support for facility siting
- Trust also moderates the negative effect of risk perceptions on public support for facility siting

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