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Sandia National Laboratories

US Public Perspectives on Nuclear Issues in 2013: Focus on Interim Storage

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U.S. DEPARTMENT OF ENERGY | NNSA

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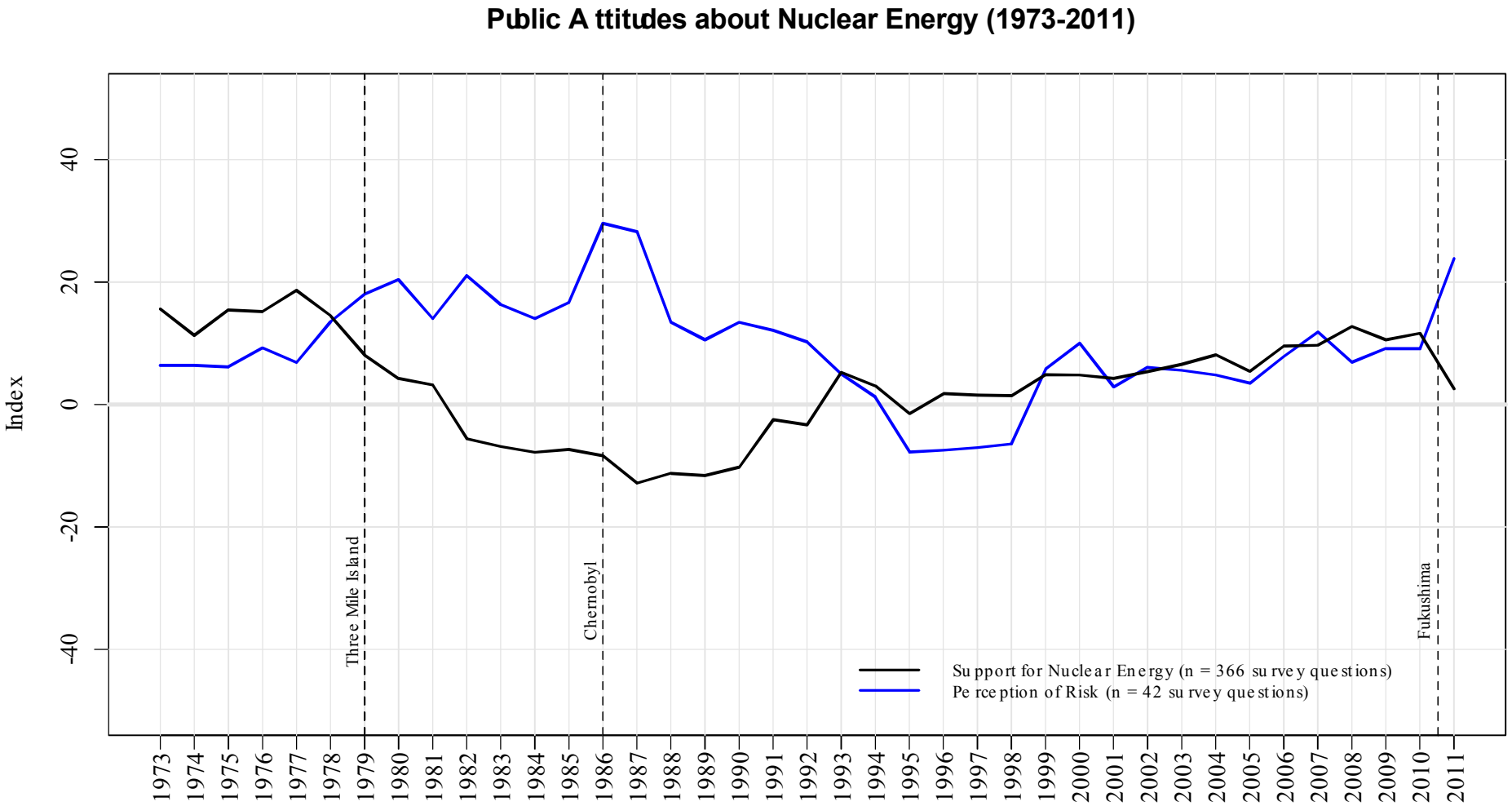
Overview

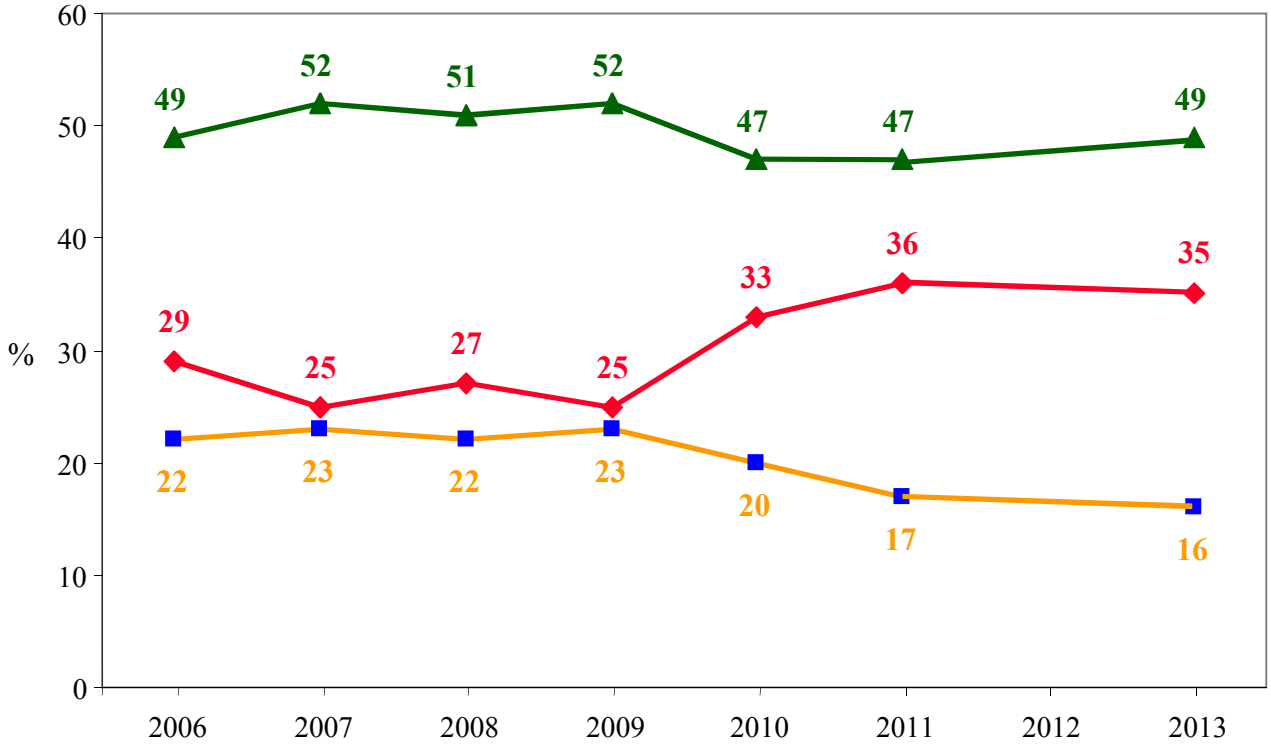
- Nuclear energy in context
  - Confidence and satisfaction with overall energy picture
  - Trends in support for nuclear energy
  - Implications of beliefs on climate change
- Public awareness of UNF cycle
- Introducing the public to interim storage
  - How options are presented matters
  - Implications of proximity
- The special issue of "stranded" UNF
- Institutional considerations and public engagement

Trends in US Nuclear Attitudes



Trends in Preferred Energy Sources in US

Notional Proportions of Total US Energy: Mean Preferences In Next 20 Years



2006–2013

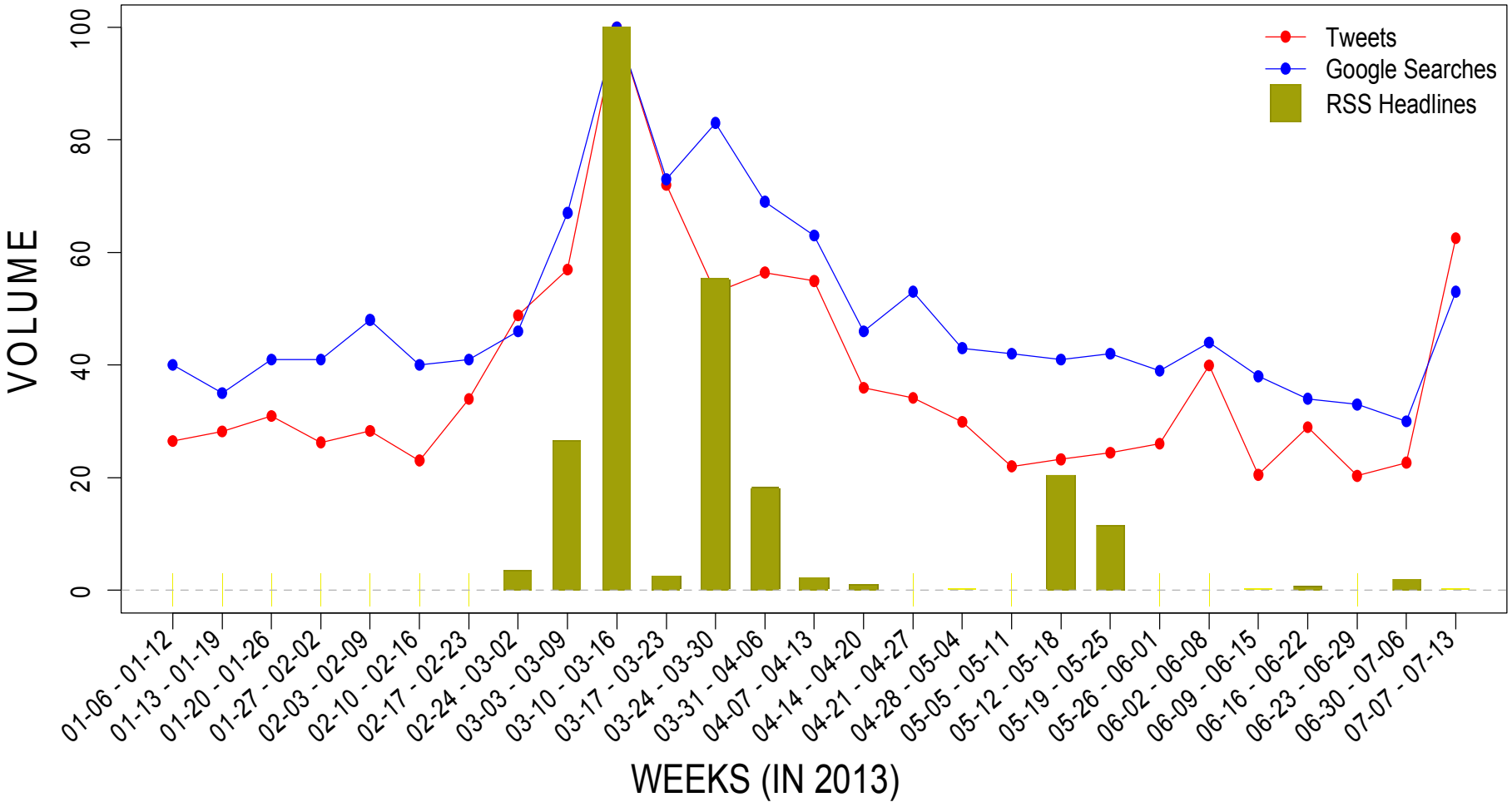
Renewables: 0 .0%

Fossil: + 20.7%

Nuclear: – 27.3%

2

Lingering Attention to Fukushima



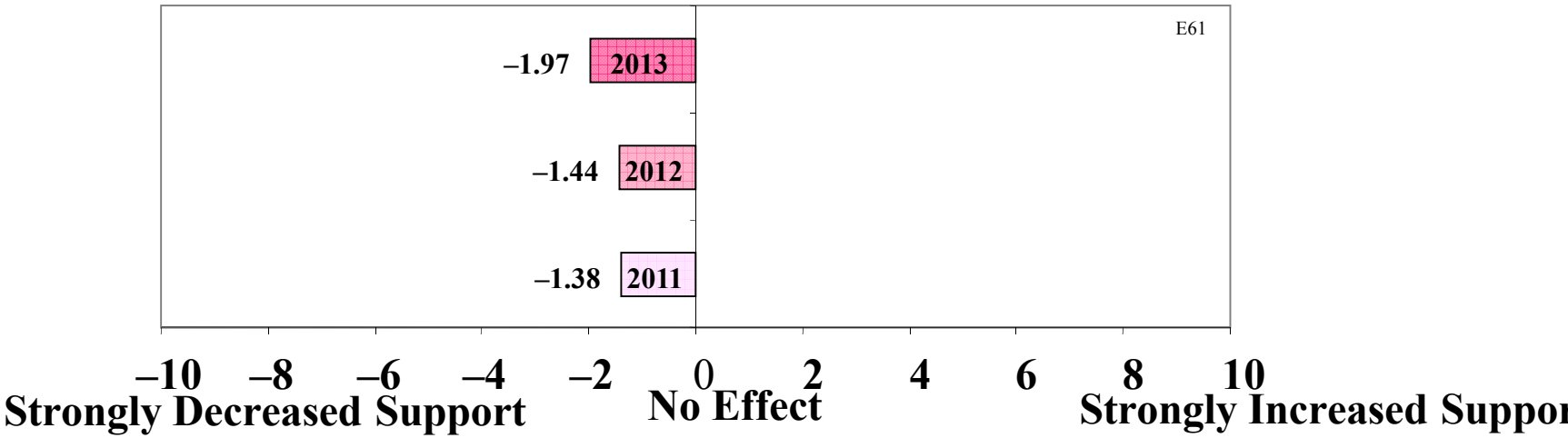
Slide 5

2 Hank Jenkins-Smith, 7/19/2013

Stated Effects of Fukushima

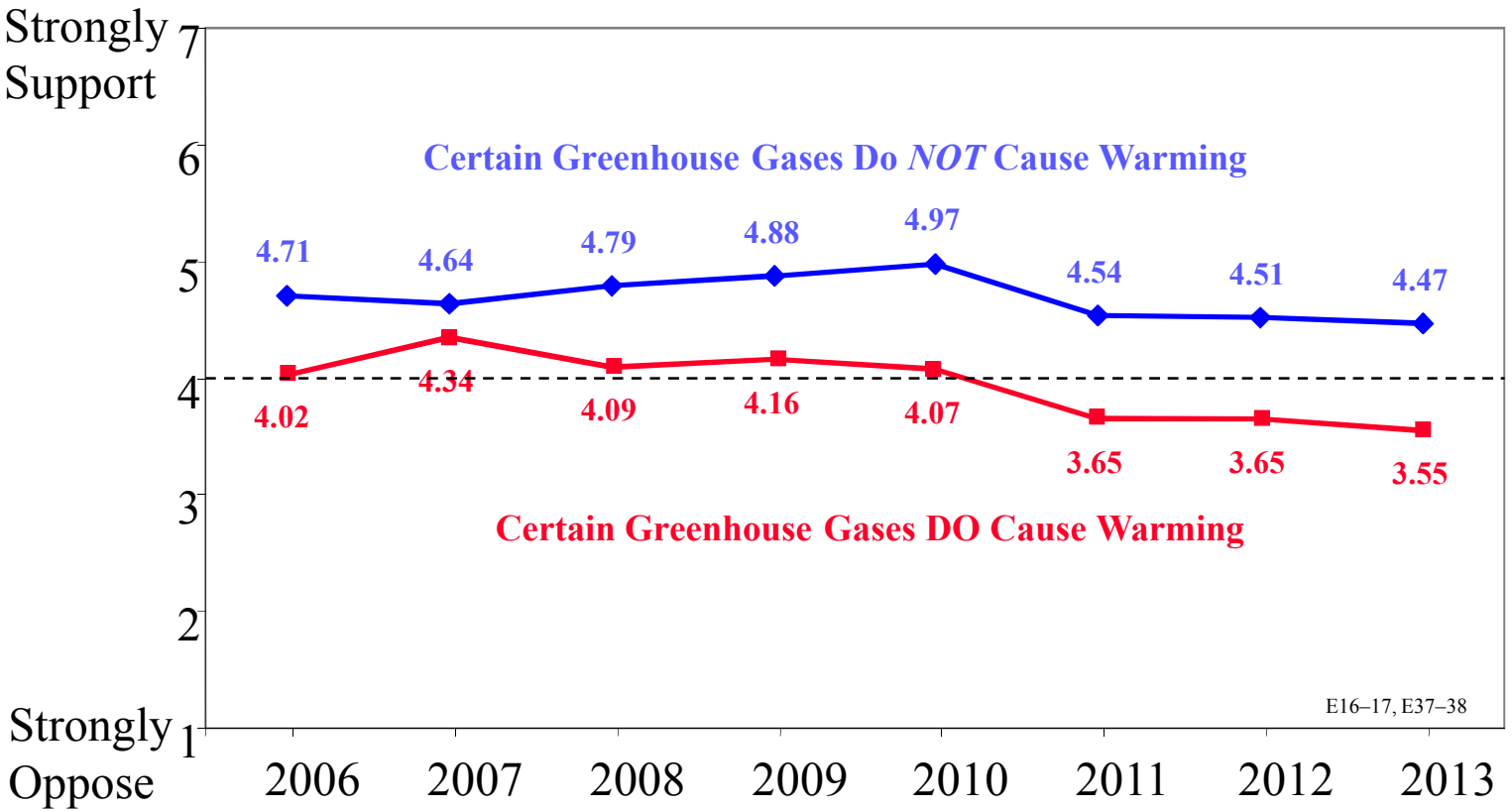
A severe earthquake occurred on March 11, 2011 in the Pacific Ocean near Japan, creating large tidal waves that destroyed some Japanese coastal cities. Also damaged was the Fukushima nuclear power plant, which released radioactivity into the atmosphere and nearby portions of the sea.

How have recent events in Japan influenced your support for nuclear power production in the United States?



Beliefs on GCC vs Nuclear Energy

Mean Support for New Nuclear Generation (Index)



Take-Away Points

- **Support for nuclear energy has eroded since 2010**
  - **Less concern and unrest about overall energy supplies and policies**
  - **Enhanced gas/oil futures may be contributing**
- **Perceptions of nuclear energy risks are up significantly**
  - **Effects and implications of Fukushima still unfolding**
  - **Support for new reactors has declined broadly**
  - **But support remains for nuclear energy as part of overall energy mix**
- **Greenhouse gases perceived to cause global climate change, but nuclear energy not yet seen as means to reduce them**
  - **Pervasive misunderstanding about nuclear generation producing greenhouse gases**

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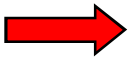


- Public awareness of UNF cycle

- Introducing the public to interim storage
  - How options are presented matters
  - Implications of proximity

- The special issue of "stranded" UNF

- Institutional considerations and public engagement

Nuclear Energy Awareness Index

- Is your primary residence located within approximately 100 miles of an operating nuclear power plant? (E39) — 47%
- What is currently being done with most of the used nuclear fuel produced in the U.S.? (E40) — 39%
- Nuclear power plants produce significant amounts of green house gases. 1 (strongly disagree) — 7 (strongly agree) (E22) — 33%
- Is used nuclear fuel being stored above ground at any nuclear power plant within your state? (E41) — 16%
- Have you heard about the Blue Ribbon Commission on America's Nuclear Future? (E41a) — 13%

Score: 0–5 Mean Correct: 1.48

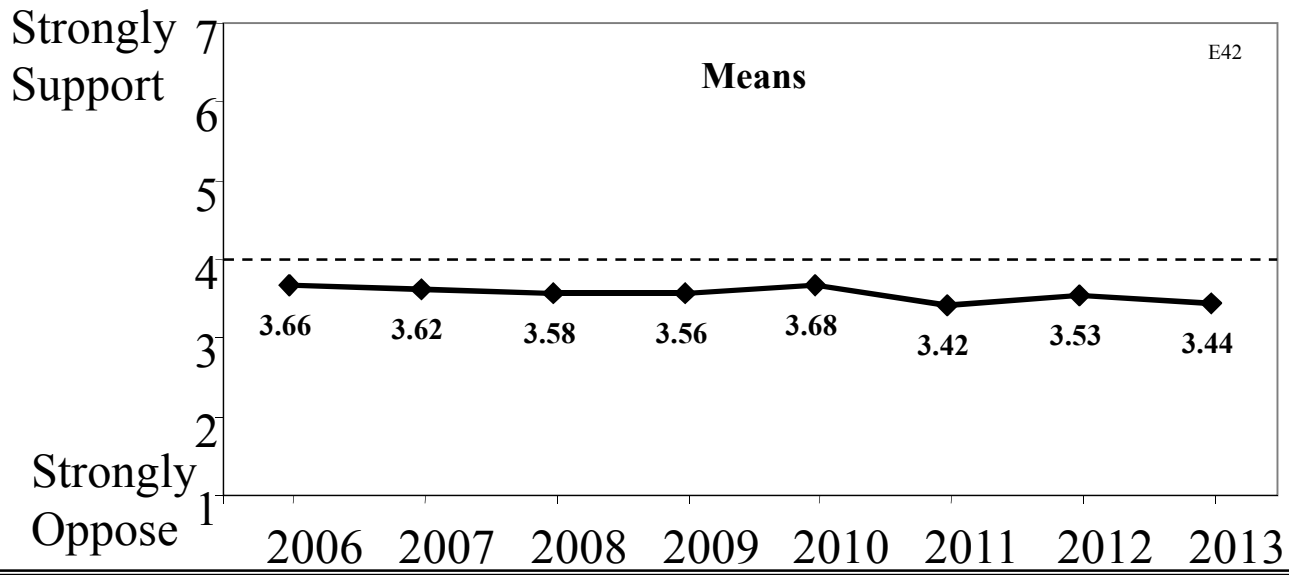
Minimum Factual Base

Used nuclear fuel is highly radioactive and must be safeguarded for thousands of years or chemically reprocessed, which is not economically feasible in the U.S. today. In 2010 the government halted construction of a deep underground facility inside Yucca Mountain in Nevada that had been intended for permanent storage and disposal of used nuclear fuel.

Currently, U.S. used nuclear fuel is temporarily stored at over 100 sites in 39 states. Most of it is at nuclear power plants where it is first placed in specialized concrete cooling pools, then transferred to specialized concrete casks stored above ground near the power plants. These cooling pools and storage casks are protected at all times by security forces. This is especially costly at ten sites where nuclear reactors have been shutdown, but extensive security measures must be continued to protect the used nuclear fuel.

In 2012, the President's Blue Ribbon Commission on America's Nuclear Future recommended that for the long-term we should build underground nuclear repositories for permanent storage and disposal of used nuclear fuel. In the near-term, the Commission recommended building interim sites for consolidating, securing, and temporarily storing used nuclear fuel currently being held at nuclear power plants.

Current Storage Practices



2006–2013

Support: –6.0 %

Support for Current Storage: 2013 Means

AGE	EDUCATION	GENDER	RACE/ ETHNICITY	INCOME	POLITICAL IDEOLOGY
18–29: 3.57	< Col Grad: 3.37	W: 3.34	Minorities: 3.40	< 50K: 3.37	Liberal: 3.21
30–49: 3.43	Col Grad: 3.53	M: 3.54	Majority: 3.46	50–100K: 3.46	Mod: 3.46
50+: 3.38				> 100K: 3.62	Consv: 3.65

Take-Away Points

- **Public knowledge of UNF management issues lacking**
  - **Salience low; unaware of need for new policies; susceptible to misinformation**
  - **Public engagement must be understood in terms of risk communications**
  - **Opinion measurement requires special techniques**
    - **Establishing shared minimum levels of crucial factual information**
    - **Presenting balanced policy arguments to establish context**
    - **Can provide consistent and reliable assessments over time**
- **When informed, respondents indicate general unease with current on-site temporary storage**
  - **Mean support consistently below mid-scale**
  - **Broad unease reflected across social and ideological subgroups**
  - **Respondents open to longer-term solutions**

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Interim Storage Concept

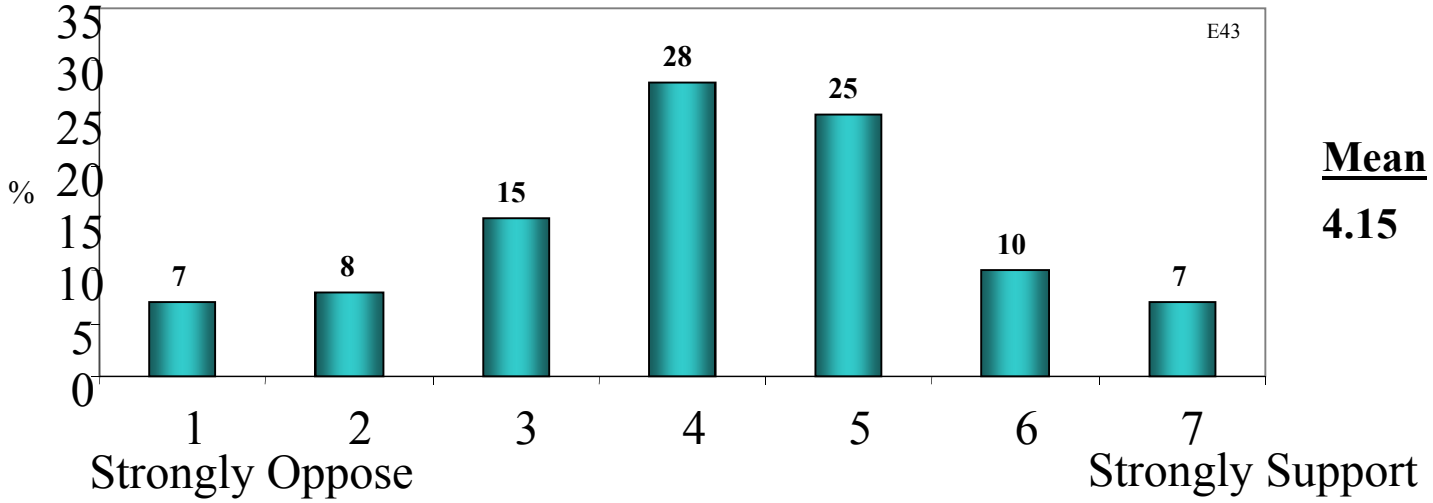
Arguments FOR:

- Available much sooner
- Consolidates security
- Reduces on-site inventories
- Removes "stranded" fuel

Arguments AGAINST:

- Postpones long-term solution
- Adds transportation risks
- More costly
- No-harm from current practices

Support for Generic ISF Concept: 2013



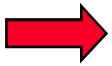
Mean

4.15

Presenting Design Concepts

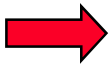
Additive vs. Discrete

- **Additive introduction describes a base-case interim storage facility, then presents added design options having implications for jobs and economy**



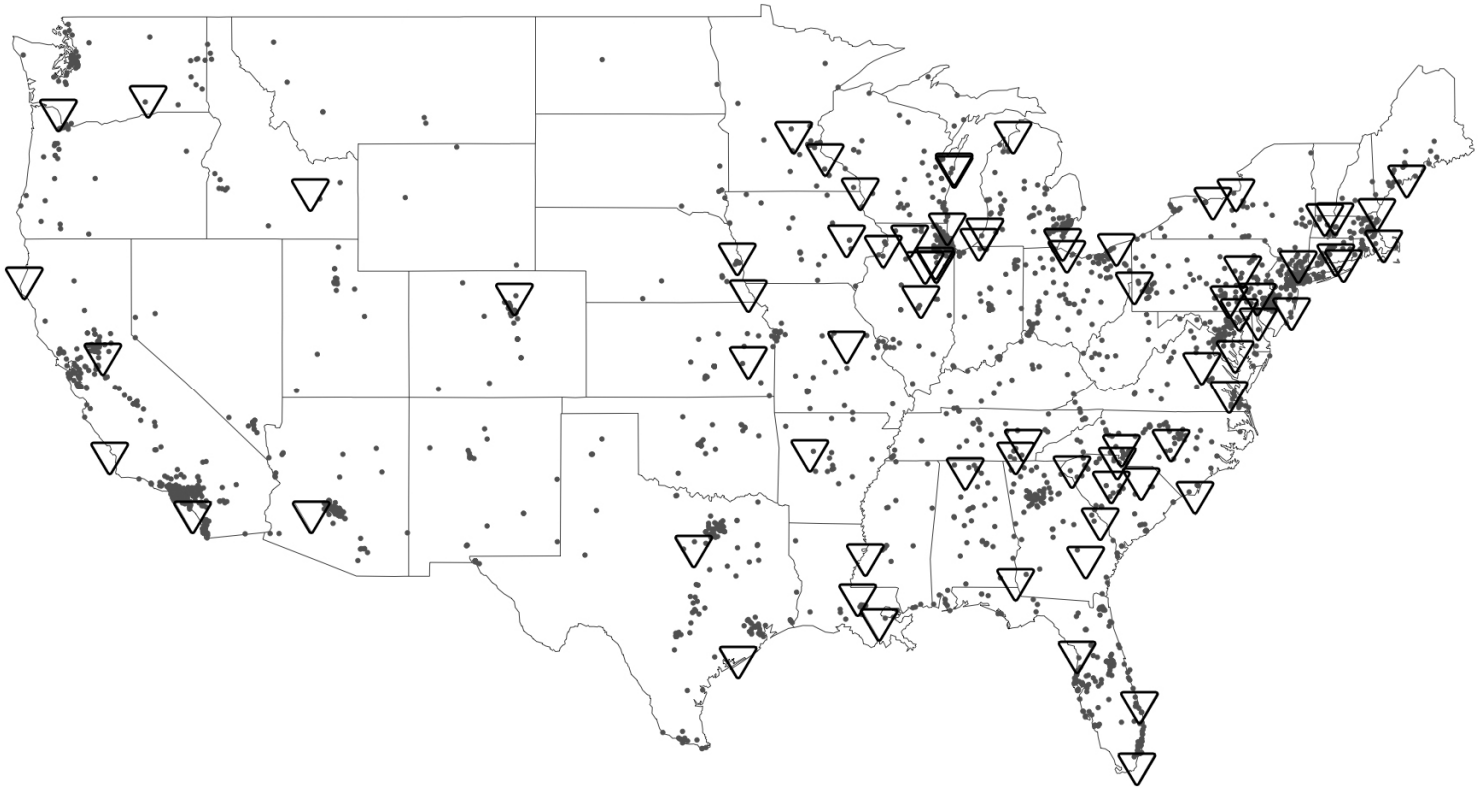
- Results in growing support as economically sensitive options are presented

- **Discrete introduction describes only one interim storage design concept to each subgroup. Though design concepts have differing implications for jobs and economy, options are not presented.**



- Produces little change in support among different designs, even when economically sensitive features are identified

UNF Sites vs. Respondents

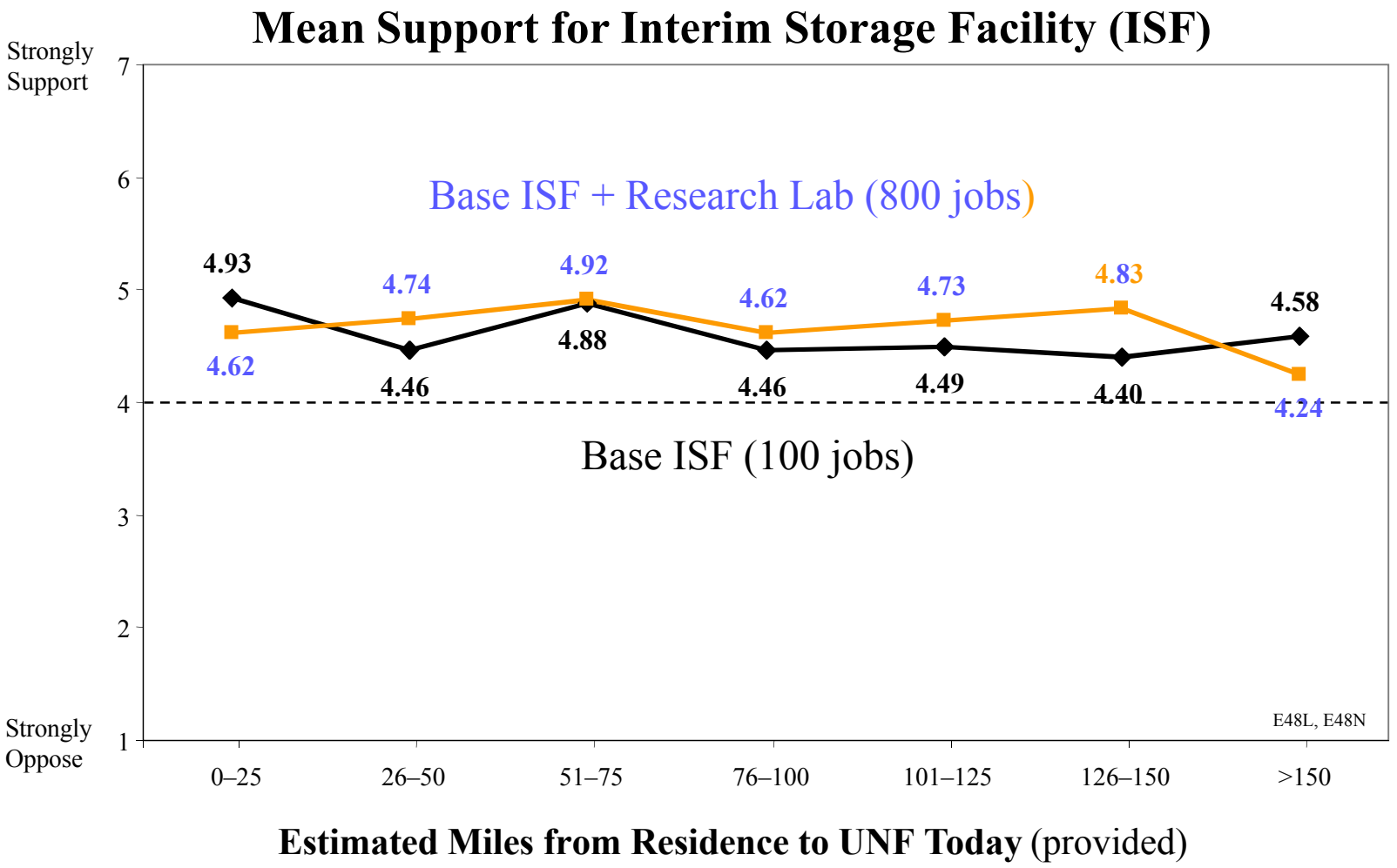


Estimates for Lower 48 Contiguous States:

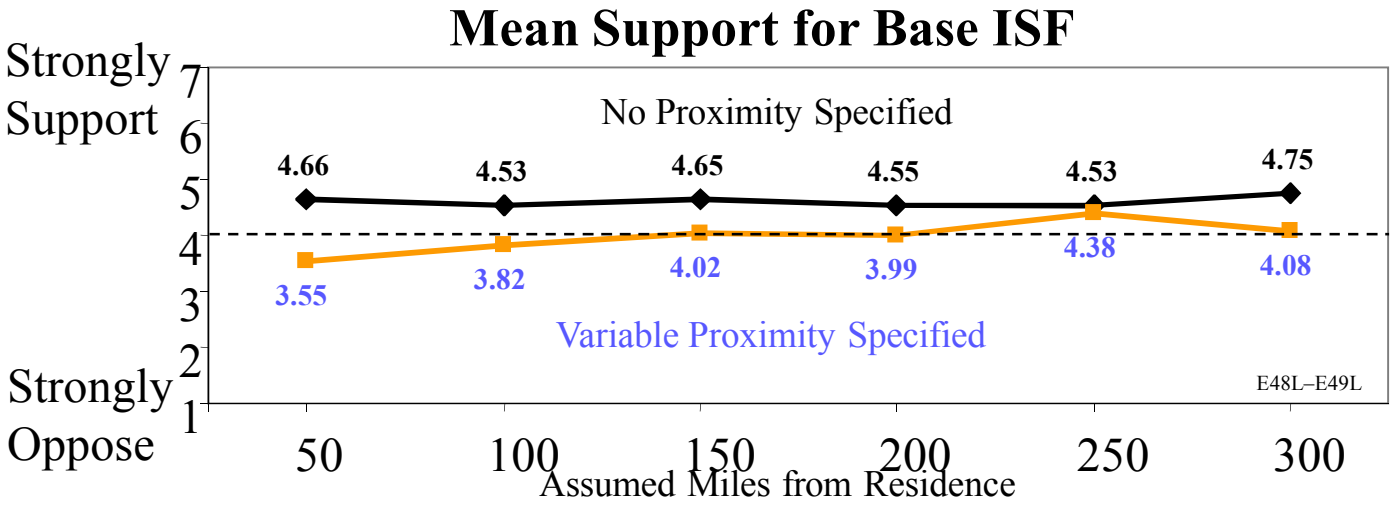
76% of population (79% of 2013 respondents) reside within 100 miles of UNF

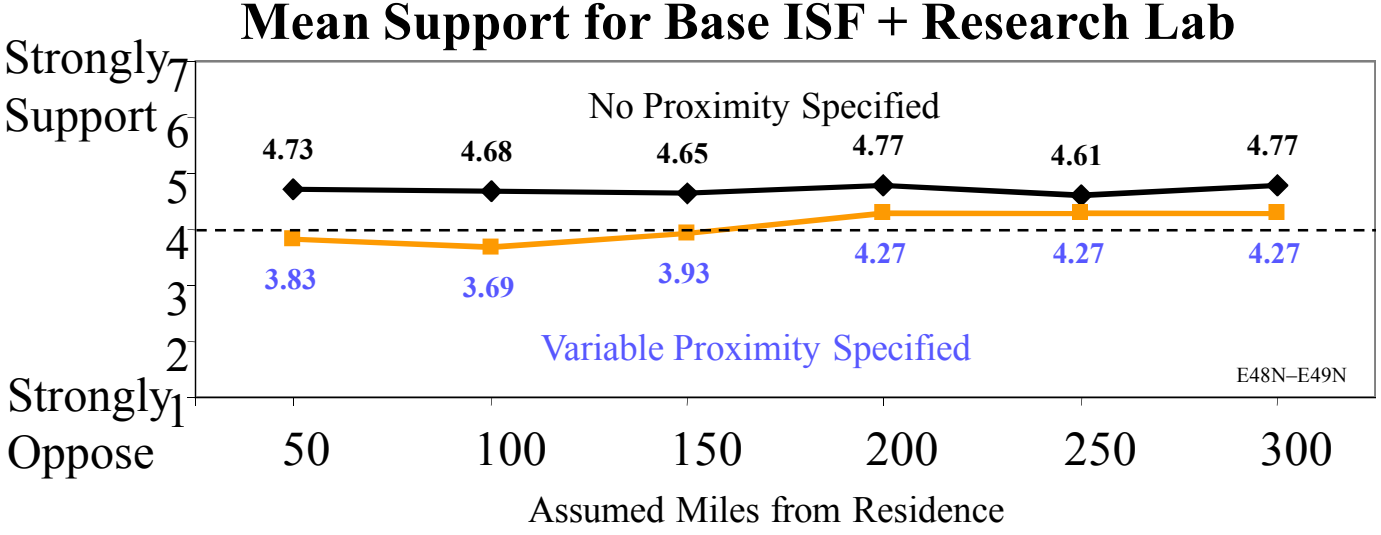
44% of population (46% of 2013 respondents) reside within 50 miles of UNF

Current Proximity to UNF vs. ISF



Assumed Proximity to ISF





Take-Away Points

- **Support for interim storage facilities modestly above midscale**
  - **43% support base option with generic facilities; 30% oppose**
  - **Support decreases with assumed proximity to residence**
- **How proposed design features are presented matters**
  - **Comparison across a menu of options appears to increase support**
  - **Start with base facility, then provide added design features and functions affecting jobs and economy (benefits) as options**
- **Proximity to existing and proposed facilities has complex effects**
  - **Some evidence that living near current UNF increases support for interim storage facilities**
  - **As proximity to new ISFs becomes salient for jobs and economy, opposition may shift to support (as with WIPP)**

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Consolidating Stranded Fuel

Assume that constructing a single interim storage facility is being considered that would receive only the "stranded" used nuclear fuel currently being stored at ten sites where nuclear reactors have been dismantled or no longer are in operation.

How do you feel about constructing a single interim storage facility to receive "stranded" used nuclear fuel from the ten sites with shutdown nuclear reactors?

(0 = Strongly Oppose—7 = Strongly Support)

Rationale (Four Subgroups)	% Oppose	% Undecided	% Support	Mean Support	% Change from Base
Base Case: no additional rationale provided	22	29	49	4.45	NA
Allow valuable properties to be used for other purposes	20	28	52	4.45	0
Inspect and repack materials for shipping to permanent repository	21	33	46	4.48	+ 0.6
Reduce costs	19	24	57	4.68	+ 5.2

Transporting Stranded UNF

If a decision is made to build an interim storage facility for the stranded nuclear fuel, shipments would likely arrive on specially designed rail cars. However, …

(Grp A) four stranded fuel storage sites are not connected to rail lines.

(Grp B) four stranded sites would need to refurbish the connecting rail lines.

The fuel currently is stored above ground in specially constructed concrete casks.

Policy Option	% Oppose	% Undecided	% Support	Mean (1–7)
Build new rail line from site to railhead (E47J)	45	18	37	3.75
Move casks by truck from site to railhead (E45J)	36	22	42	3.93
Move casks by barge from site to railhead (E46J)	47	19	34	3.60
Refurbish old rail line from site to railhead (E47K)	25	25	50	4.41
Move casks by truck from site to railhead (E45K)	39	24	37	3.80
Move casks by barge from site to railhead (E46K)	50	19	31	3.41

Transporting Stranded UNF

Mean Preferences by Region

If a decision is made to build an interim storage facility for the stranded nuclear fuel, shipments would likely arrive on specially designed rail cars. However, …

(Grp A) four stranded fuel storage sites are not connected to rail lines.

(Grp B) four stranded sites would need to refurbish the connecting rail lines.

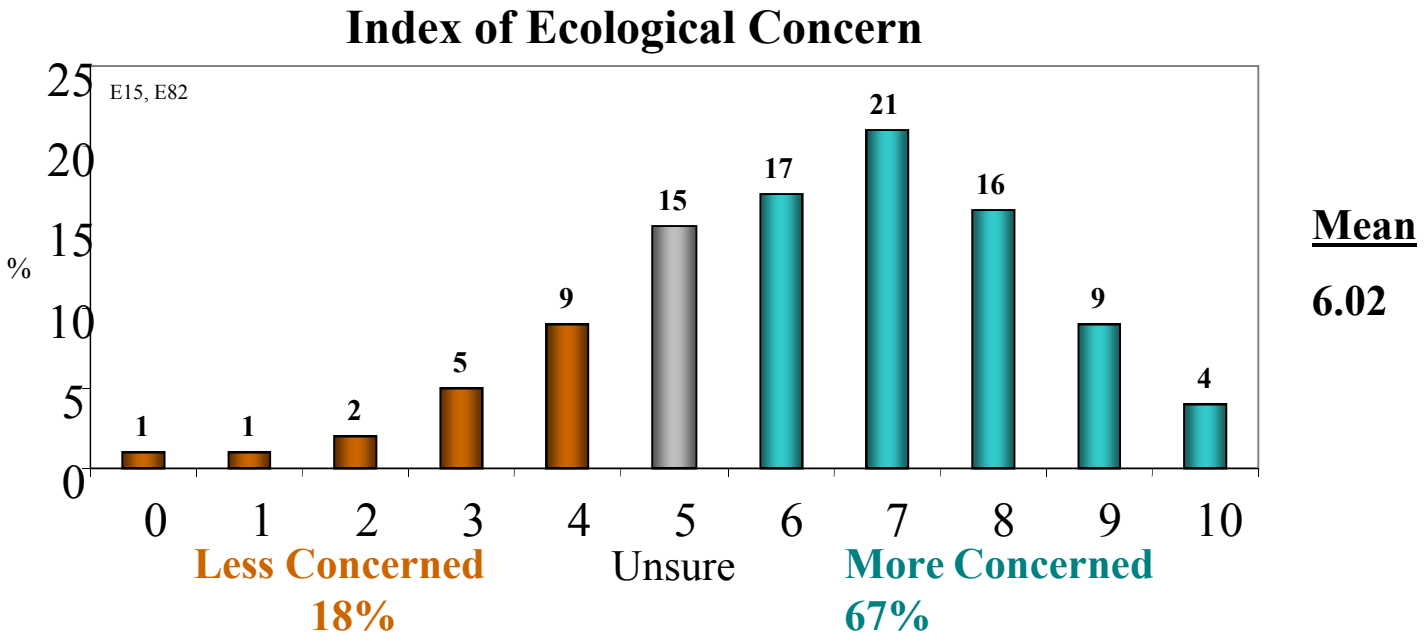
The fuel currently is stored above ground in specially constructed concrete casks.

Policy Option (Means: 1–7)	Northeast	Midwest	South	West
Build new rail line from site to railhead (E47J)	3.64	3.55	3.88	3.83
Move casks by truck from site to railhead (E45J)	3.94	3.91	3.86	4.06
Move casks by barge from site to railhead (E46J)	4.00	3.69	3.48	3.44
Refurbish old rail line from site to railhead (E47K)	4.26	4.43	4.54	4.31
Move casks by truck from site to railhead (E45K)	3.75	3.96	3.67	3.87
Move casks by barge from site to railhead (E46K)	3.64	3.19	3.48	3.33

Ecological Assessments

On a scale where zero means that nature is robust and not easily damaged and ten means that nature is fragile and easily damaged, how do you view nature?

On a scale where zero means the natural environment is not at all threatened and ten means the natural environment is on the brink of disaster, how do you assess the current state of the natural environment?



Transporting Stranded UNF

Mean Preferences by Ecological Beliefs

If a decision is made to build an interim storage facility for the stranded nuclear fuel, shipments would likely arrive on specially designed rail cars. However, …

(Grp A) four stranded fuel storage sites are not connected to rail lines.

(Grp B) four stranded sites would need to refurbish the connecting rail lines.

The fuel currently is stored above ground in specially constructed concrete casks.

Policy Option (Means: 1–7)	Ecologically Less Concerned (0–4)	Ecologically More Concerned (6–10)
Build new rail line from site to railhead (E47J)	3.94	3.64
Move casks by truck from site to railhead (E45J)	4.00	3.90
Move casks by barge from site to railhead (E46J)	3.63	3.59
Refurbish old rail line from site to railhead (E47K)	4.44	4.36
Move casks by truck from site to railhead (E45K)	4.11	3.66
Move casks by barge from site to railhead (E46K)	3.76	3.28

Take-Away Points

- **Interim storage facility for stranded UNF garners public support**
  - **Strongest rationale is cost savings from closing existing sites**
- **Rail transportation of stranded fuel favored *if* an existing rail line can be refurbished; if not, trucks preferred**
  - **Little support for building a new rail line to move stranded UNF**
  - **Respondents from NE rate barge and truck highest if no existing rail line; barge rated lowest in other regions**
  - **Results hold even for those most concerned about protecting the environment**

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Conceptualizing "Fedcorp"

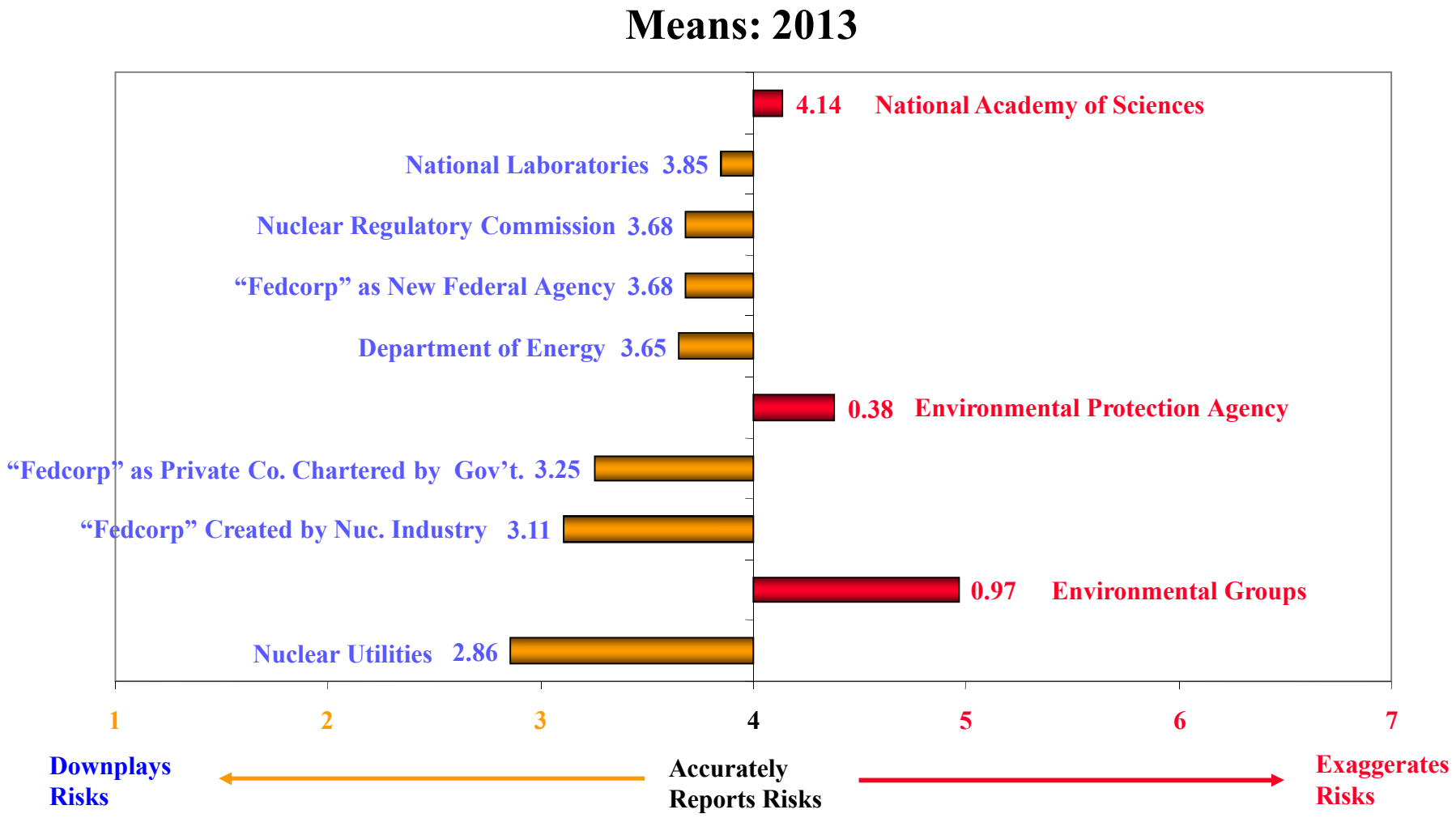
Split Design: Three Randomly Assigned Definitions

- **A private company chartered by the federal government that is funded by fees from nuclear energy, and that is given responsibility for managing used nuclear fuel from U.S. nuclear power plants. It would be subject to a Federal Oversight Board.** (E60P)

- **A private company created by the nuclear power industry that is funded by fees from nuclear energy, and that is given responsibility for managing used nuclear fuel from U.S. nuclear power plants. It would be subject to oversight from federal regulatory agencies.** (E60Q)

- **A new independent agency of the federal government, with leadership appointed by the president with the advice and consent of the Senate, that is funded by fees from nuclear power plants. It would be subject to a Federal Oversight Board.** (E60R)

Perceived Institutional Risk Bias



ISF Site Selection

Key Types of Decisions

- A *technical decision* that a particular site can be used to construct a safe and secure facility. This decision concerns such factors as the geologic, hydrologic, and population characteristics of the site (for example, avoiding earthquake-prone areas, flood zones, and densely populated areas). This decision is about technical requirements.

- A *decision by a potential host community to invite* the siting of an interim storage facility. This decision concerns agreement by local residents and elected officials that technical experts can consider siting an interim storage facility nearby. This decision is about public support.

%	ALL	Oppose ISF	Support ISF	Ecologically Unconcerned	Ecologically Concerned	Reside < 25 Miles from UNF
First determine technical suitability of candidate sites (E50)	**58**	55	61	62	56	63
First have state & local communities decide whether they would like to host ISF	**42**	45	39	38	44	37

Who Should Decide

Assume that a small rural community located about 50 miles from your primary residence has volunteered to host an interim storage facility for used nuclear fuel. Which of the following definitions of consent would you most support?

More Inclusive: "Consent" should involve local elected officials, state governor, both U.S. Senators, the U.S. congressperson representing the host community, the state's environmental protection agencies, and a majority of citizens in a state-wide vote.

Less Inclusive: "Consent" should involve agreement among only the elected representatives of those most directly affected and the state governor.

%	ALL	Oppose ISF	Support ISF	Liberals	Conservatives	Women	Men
More Inclusive Process (E63)	**79**	84	77	83	76	85	74
Less Inclusive Process (E63)	**21**	16	23	17	24	15	26

Understanding "Consent"

Who should be allowed to block/veto a siting decision for an ISF?

	%
A majority of citizens residing within 50 miles of the facilities (E64)	68
A majority of voters in the host state	68
Host state environmental protection agency or equivalent	53
U.S. Environmental Protection Agency	50
The governor of the host state	49
U.S. Nuclear Regulatory Commission	44
U.S. Department of Energy	44
Leaders of the host state's legislature	34
U.S. Congressperson representing the host district	32
Either of the two U.S. Senators representing the host state	31
Nongovernmental environmental groups in the host state	21

Likely Activity in Policy Process

If ISF / transportation route for UNF was proposed within 50 miles of your residence, how likely is it that you would …

Likelihood of Activities (1 = Not At All Likely—7 = Extremely Likely)	Means: Interim Storage	Means: Transportation Route
Attend informational meetings held by authorities (E75/T)	4.37	4.22
Write or phone your elected representatives (E78S/T)	4.20	4.24
Express your opinion using social media (E77S/T)	3.96	4.02
Serve on a citizens' advisory committee (E81S/T)	3.92	3.91
Help organize public ***support*** (E80S/T)	3.07	3.09
Help organize public ***opposition*** (E79S/T)	3.05	3.10
Speak at a public hearing in your area (E76S/T)	2.97	3.08

Take-Away Points

- **Institutional design of new authority related to expected risk bias**
  - **New independent federal agency perceived as more balanced, less biased than industry sponsored corporation**
- **Broad preference for assessing technical suitability before determining willingness to host interim storage facilities**
- **Clear majority support for broad, inclusive definition of consent**
  - **Local residents and other citizens of host state accorded highest priority for granting consent**
  - **Consent by federal and state environmental protection agencies also seen as important**
  - **Once given, most would allow consent to be withdrawn only until license approved and construction begun, then reversal not allowed**
  - **Most indicated likelihood of attending informational meetings during consideration of ISFs and associated transportation routes**
  - **About 22% indicated willingness to join support or opposition groups**

Comments and/or Questions?

Contact Information

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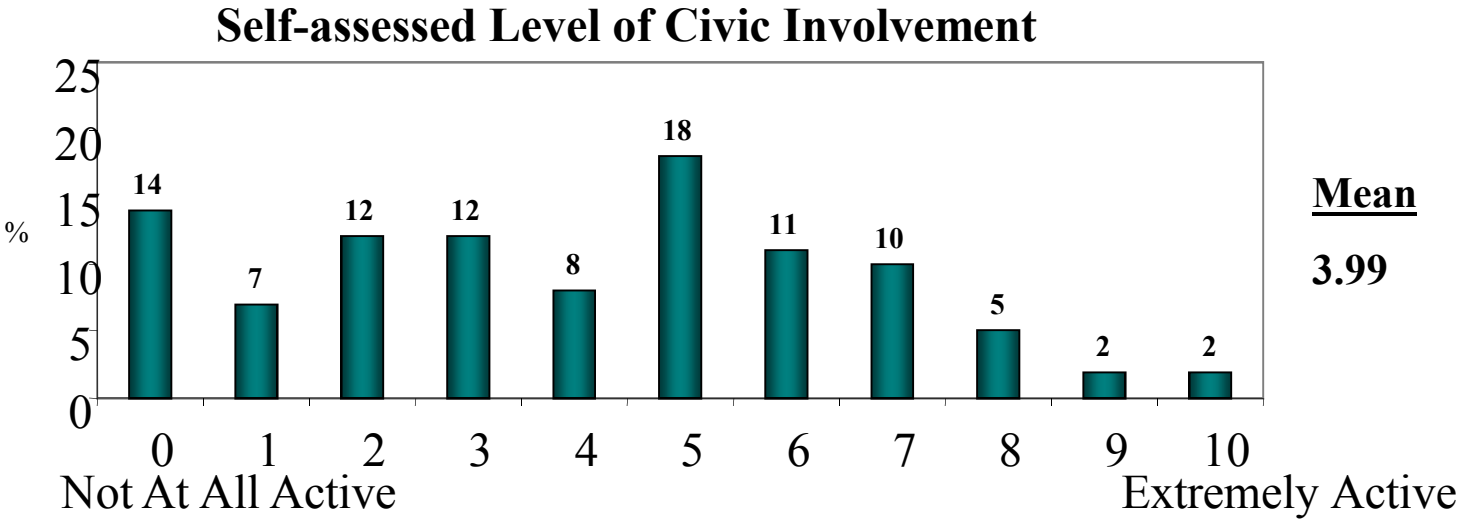
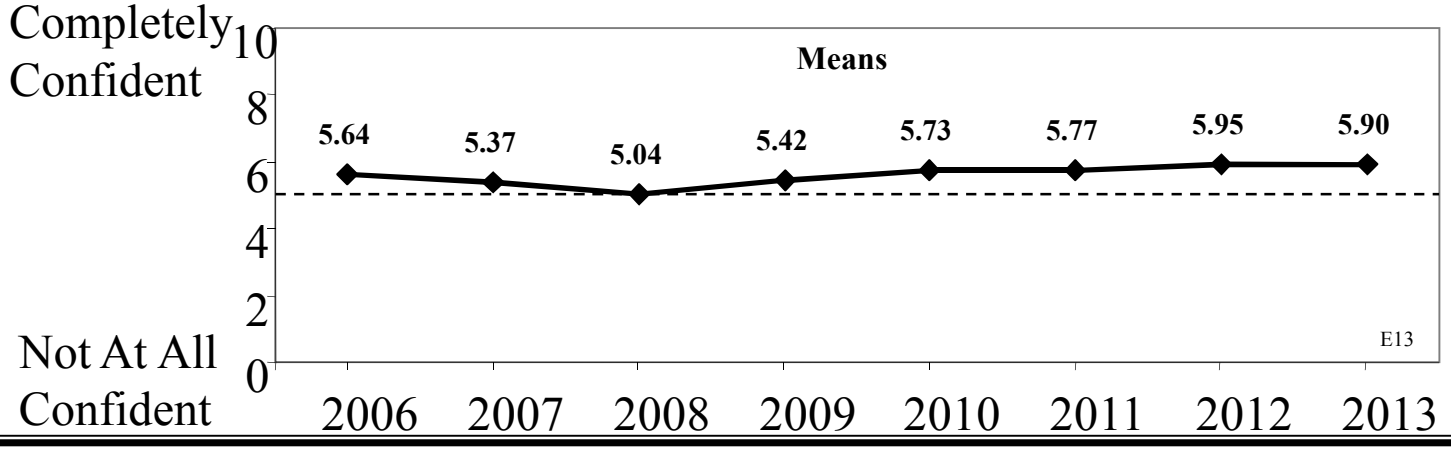
Characterizing Public Engagement

Activity	% Yes
Registered to vote	88
Voted in presidential election in 2012	81
Typically vote in local elections	70
Actively campaigned for any candidate last 10 yrs	18



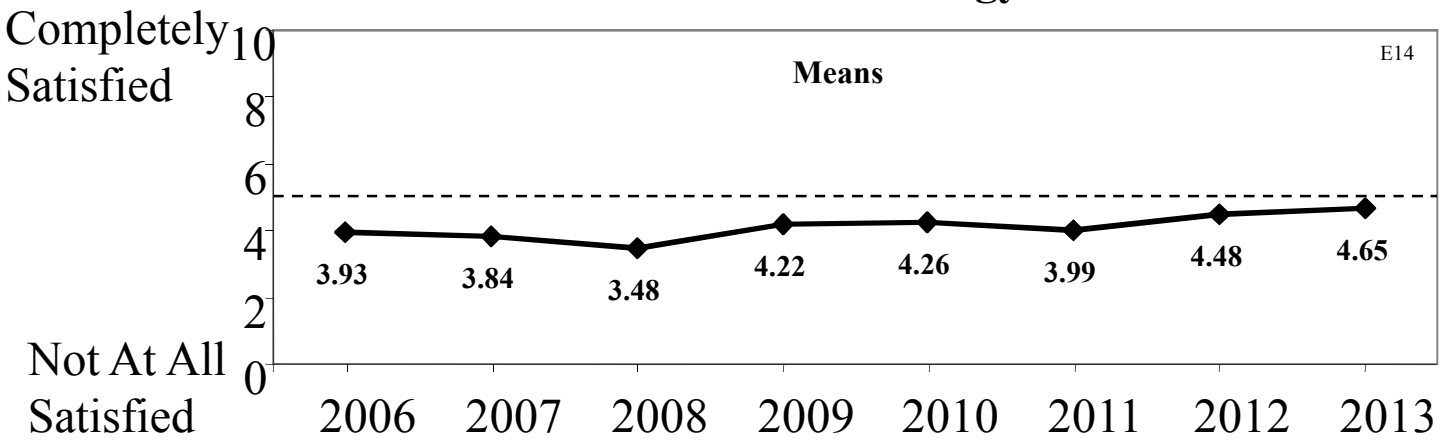
Trends in Energy Perspectives

Confidence in Adequate Sources of US Energy in Next 20 Years



2006–2013
+ 4.6 %

Satisfaction With Current US Energy Policies Overall

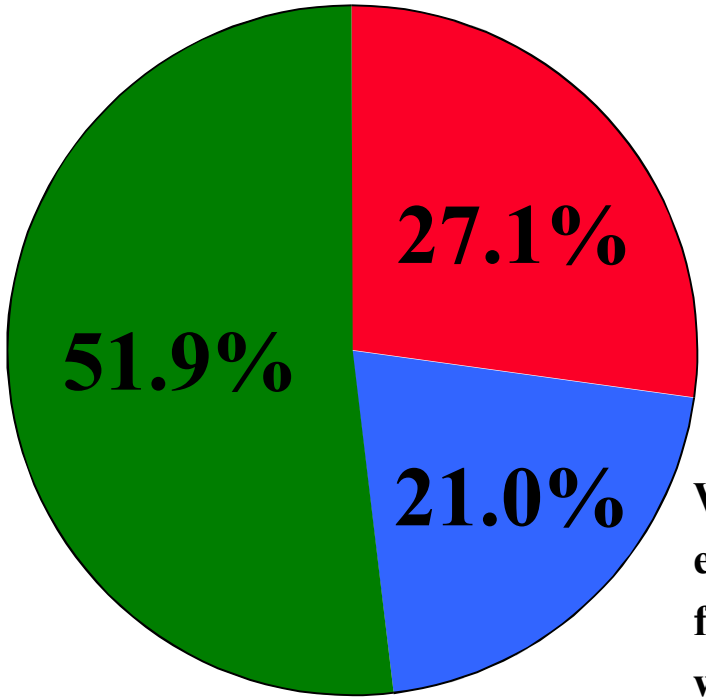


2006–2013
+ 18.3 %

Future Electricity Sources

Mean Preferences In Next 20 Years: 2013

What percent of our electricity should come from renewable sources, which currently provide about 13% of our total US electricity? (E26B)



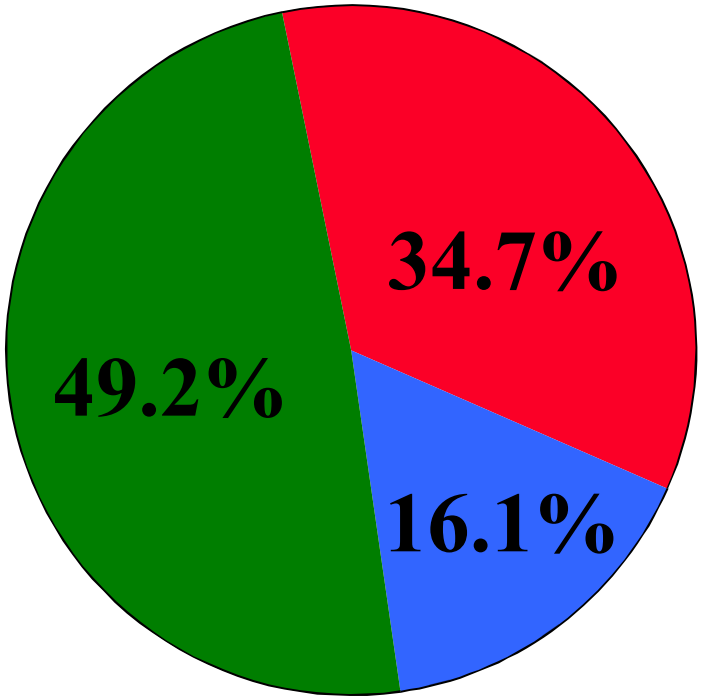
What percent of our electricity should come from fossil fuels, which currently provide about 66% of total US electricity? (E24B)

What percent of our electricity should come from nuclear generation, which currently provides about 21% of total US electricity? (E25B)

Future Energy Sources

Mean Preferences In Next 20 Years: 2013

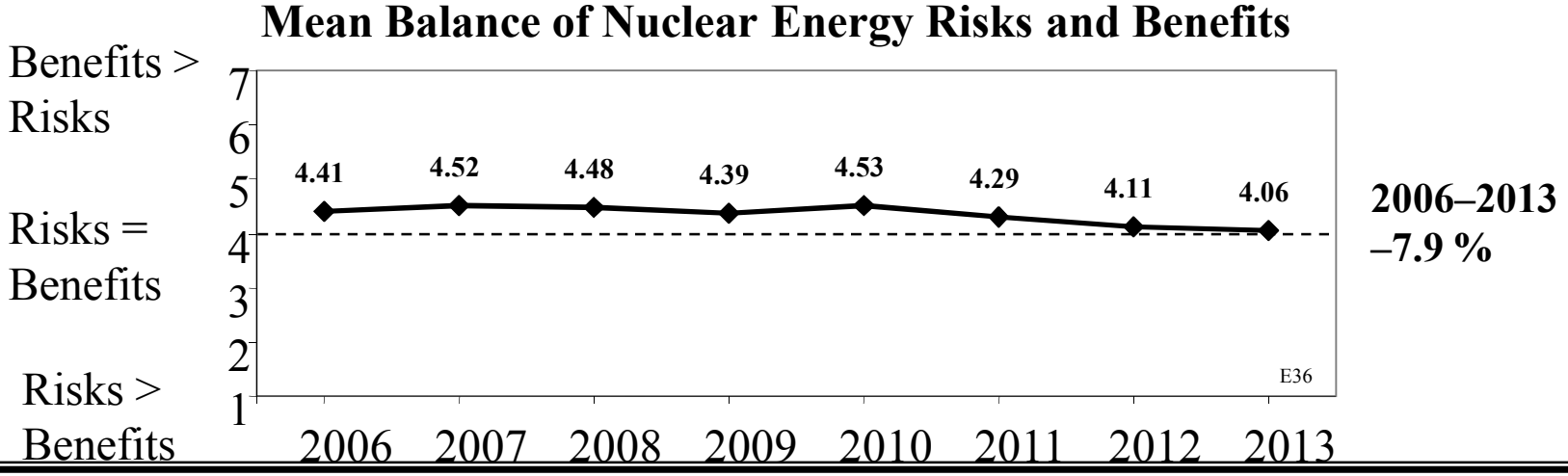
What percent of our energy should come from renewable sources, which currently provide about 8% of total U.S. energy? (E26A)



What percent of our energy should come from fossil fuels, which currently provide about 83% of total U.S. energy? (E24A)

What percent of our energy should come from nuclear generation, which currently provides about 9% of total U.S. energy? (E25A)

Nuclear Energy Risks & Benefits

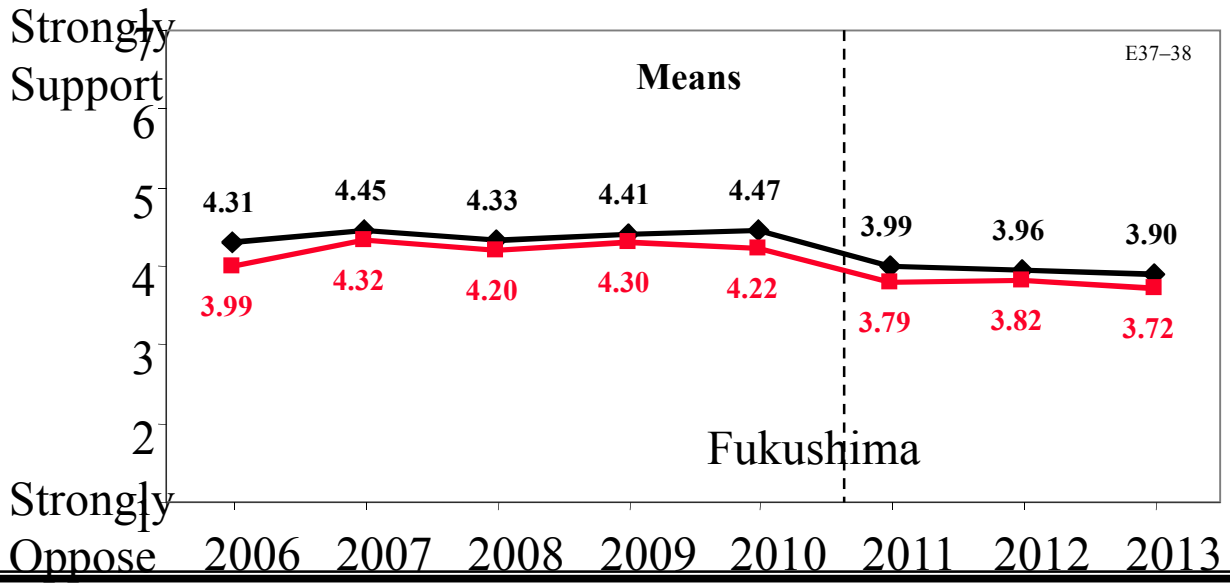


Mean Risk & Benefit Components: 2012–2013

0 = No Risk— 10 = Extreme Risk	2012	2013
Terrorist attack	6.57	**6.93**
Operational accident	6.43	**6.68**
Transportation accident	6.19	**6.49**
Diversion to weapons	5.68	**5.95**

0 = Not At All Beneficial— 10 = Extremely Beneficial	2012	2013
Energy independence	7.10	**7.22**
Less mining / extraction	6.81	**7.02**
Reliable power	6.81	**6.95**
No GG emissions	6.81	**6.80**

Additional Nuclear Generation



2006–2013

Existing: –9.5 %

New: –6.8 %

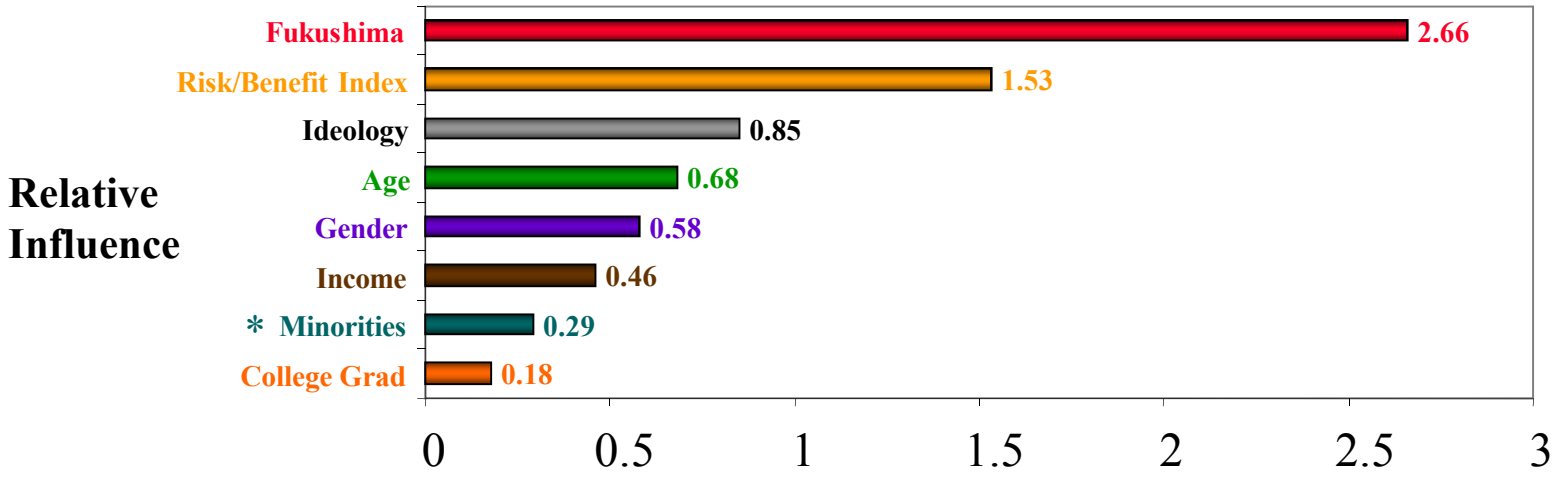
New Nuclear Generation Index: 2013 Means

AGE	EDUCATION	GENDER	RACE/ ETHNICITY	INCOME	POLITICAL IDEOLOGY
18–29: 3.70	< Col Grad: 3.64	W: 3.37	Minorities: 3.53	< 50K: 3.62	Liberal: 3.46
30–49: 3.71	Col Grad: 4.04	M: 4.25	Majority: 3.90	50–100K: 3.92	Mod: 3.74
50+: 4.00				> 100K: 4.28	Consv: 4.45

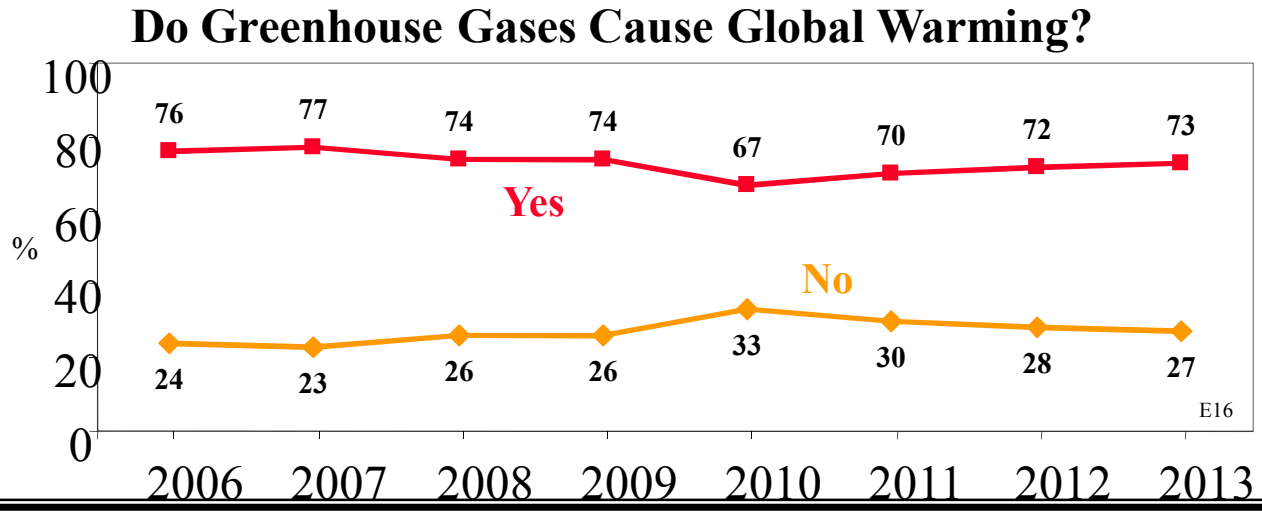
Implications of Fukushima

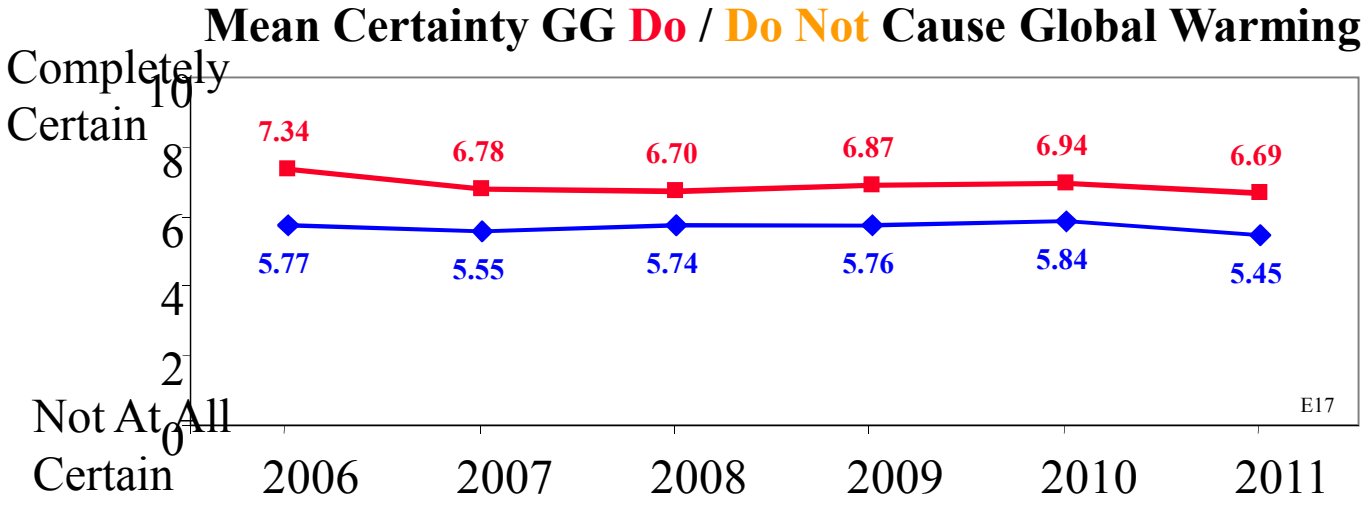
Dependent Variable: New Nuclear Generation Index (1–7)

(2013) Intercept = 0.859 Adj. R^2 = 0.38	Coef.	Std. Err.	t	*p*
Fukushima (–10 — +10)	0.133	.007	17.914	<.0001
Nuclear Energy Risk/Benefit Index (1–7)	0.255	.018	14.521	<.0001
Political Ideology (1–7)	0.141	.021	6.633	<.0001
Age (18–86)	0.010	.002	4.753	<.0001
Gender (W = 0 — M = 1)	0.581	.068	8.594	<.0001
Household Income 2012 (1–21)	0.023	.008	2.750	.0060
Minorities (Majority = 0 — Minorities = 1)	–0.289	.080	–3.600	.0003
College Graduate (< Grad = 0 — Grad = 1)	0.177	.071	2.502	.0124



Beliefs on Climate Change





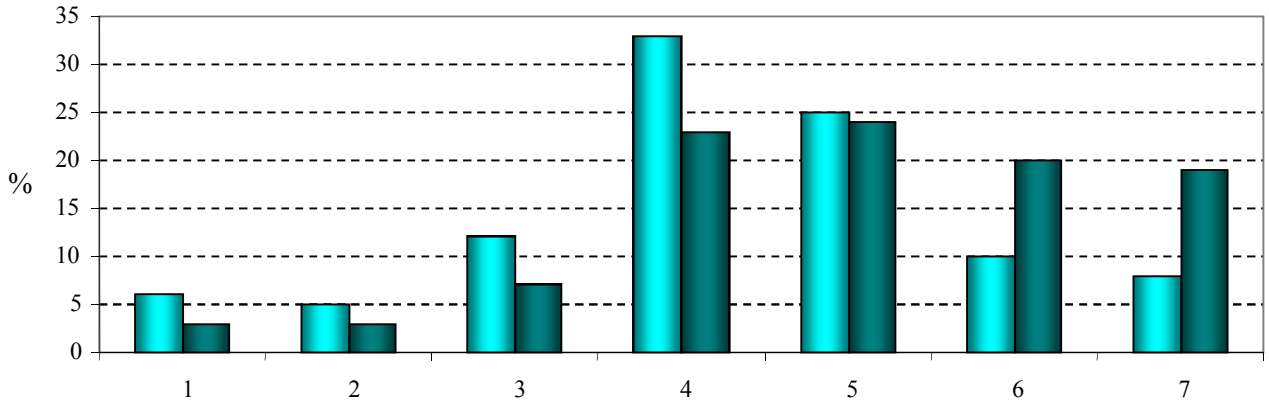
2006–2013

Yes: –8.9%

No: –5.5%

Additive vs. Discrete

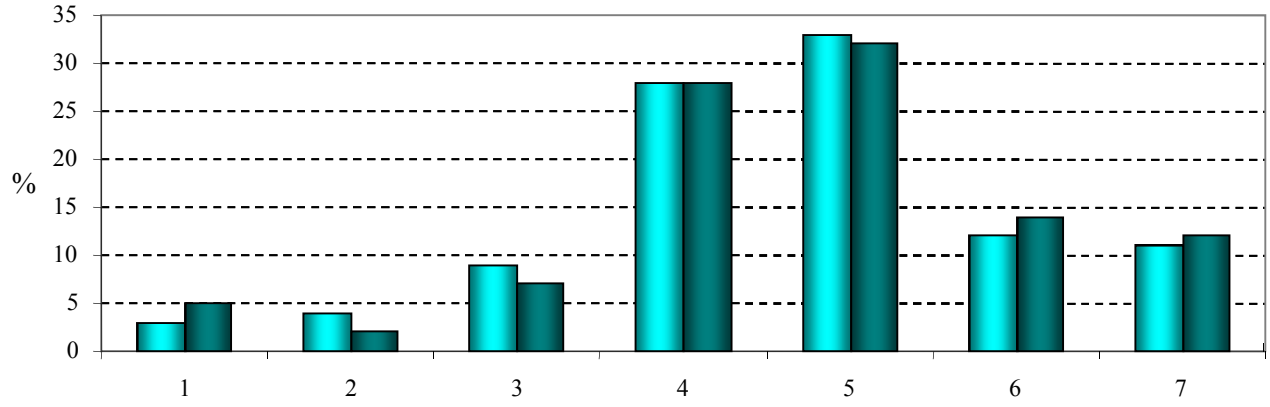
Additive Presentation



Means: 2012

- Base Design: 4.30
- Base + Lab: 4.98

Discrete Presentation



Means: 2013

- Base Design: 4.62
- Base + Lab: 4.70

Withdrawing "Consent"

When should host communities be allowed to withdraw consent?

	% Yes
Host community/state volunteers; site assessment is initiated (E65)	76
Scientific evaluation of site suitability is completed (E66)	72
Application for a license to construct a UNF facility is submitted to agencies (E67)	66
License is obtained; facility construction is initiated (E68)	43
Construction is completed; facility is prepared to receive UNF (E69)	32