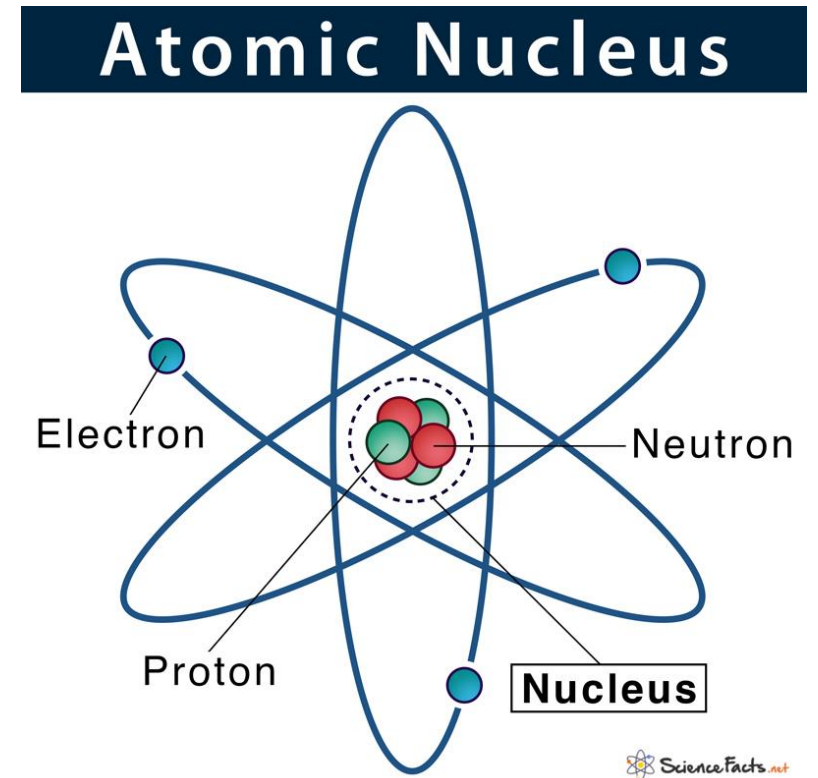


Perceptions and Understanding of Nuclear Energy

Allison Hamilton/Paul Ebel/Jim Marra

What is Nuclear?

- Nuclear Technology is ANY tech that uses energy from a reaction within an atomic nuclei
 - Radioactive Decay- Natural Process for unstable atoms
 - Fission- Splitting of 1 heavy nucleus into smaller parts
 - Fusion- combining small nuclei into larger ones



The Sun is a fusion reactor! All the energy in our solar system comes from a fusion reaction.

Group ↓

Period ↓

1

2

3

4

5

6

7

1

2

3

4

5

6

7

13

14

15

16

17

18

1.008

6.938

22.989

39.0983

85.4678

132.905

(223)

4.0026

9.012

24.304

40.078

87.62

(226)

10.806

12.0098

14.0064

15.999

18.998

20.1797

26.9815

28.084

30.974

32.059

35.446

39.948

44.9559

47.867

50.9415

51.9961

54.938

55.845

58.933

58.6934

63.546

65.38

69.723

72.630

74.922

78.971

79.901

83.798

88.9058

91.224

92.906

95.95

(98)

101.07

102.9055

106.42

107.8682

112.414

114.818

118.710

121.760

127.60

126.904

131.293

178.49

180.948

183.84

186.207

190.23

192.217

195.084

196.967

200.592

204.382

207.2

208.980

(209)

(210)

(222)

(267)

(268)

(269)

(270)

(277)

(278)

(281)

(282)

(285)

(286)

(289)

(290)

(293)

(294)

(294)

Hydrogen

Lithium

Sodium

Potassium

Rubidium

Caesium

Francium

Helium

Beryllium

Magnesium

Calcium

Strontium

Barium

Radium

Boron

Carbon

Nitrogen

Oxygen

Fluorine

Neon

Aluminium

Silicon

Phosphorus

Sulfur

Chlorine

Argon

Scandium

Titanium

Vanadium

Chromium

Manganese

Iron

Cobalt

Nickel

Copper

Zinc

Gallium

Germanium

Arsenic

Selenium

Bromine

Krypton

Yttrium

Zirconium

Niobium

Molybdenum

Technetium

Ruthenium

Rhodium

Palladium

Silver

Cadmium

Indium

Tin

Antimony

Tellurium

Iodine

Xenon

Lanthanoids*

Hafnium

Tantalum

Tungsten

Rhenium

Osmium

Iridium

Platinum

Gold

Mercury

Thallium

Lead

Bismuth

Polonium

Astatine

Radon

Actinoids**

Rutherfordium

Dubnium

Seaborgium

Bohrium

Hassium

Meitnerium

Darmstadtium

Roentgenium

Copernicium

Nihonium

Flerovium

Moscovium

Livermorium

Tennessine

Oganesson

Radioactive Element

*Lanthanoids

57 138.905 La Lanthanum	58 140.116 Ce Cerium	59 140.908 Pr Praseodymium	60 144.242 Nd Neodymium	61 (148) Pm Promethium	62 150.36 Sm Samarium	63 151.964 Eu Europium	64 157.25 Gd Gadolinium	65 158.925 Tb Terbium	66 162.500 Dy Dysprosium	67 164.930 Ho Holmium	68 167.259 Er Erbium	69 168.934 Tm Thulium	70 173.045 Yb Ytterbium	71 174.9668 Lu Lutetium
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**Actinoids

89 (227) Ac Actinium	90 232.0377 Th Thorium	91 231.036 Pa Protactinium	92 238.029 U Uranium	93 (237) Np Neptunium	94 (244) Pu Plutonium	95 (243) Am Americium	96 (247) Cm Curium	97 (247) Bk Berkelium	98 (251) Cf Californium	99 (252) Es Einsteinium	100 (257) Fm Fermium	101 (258) Md Mendelevium	102 (259) No Nobelium	103 (266) Lr Lawrencium
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Clean. Reliable. **Nuclear.**

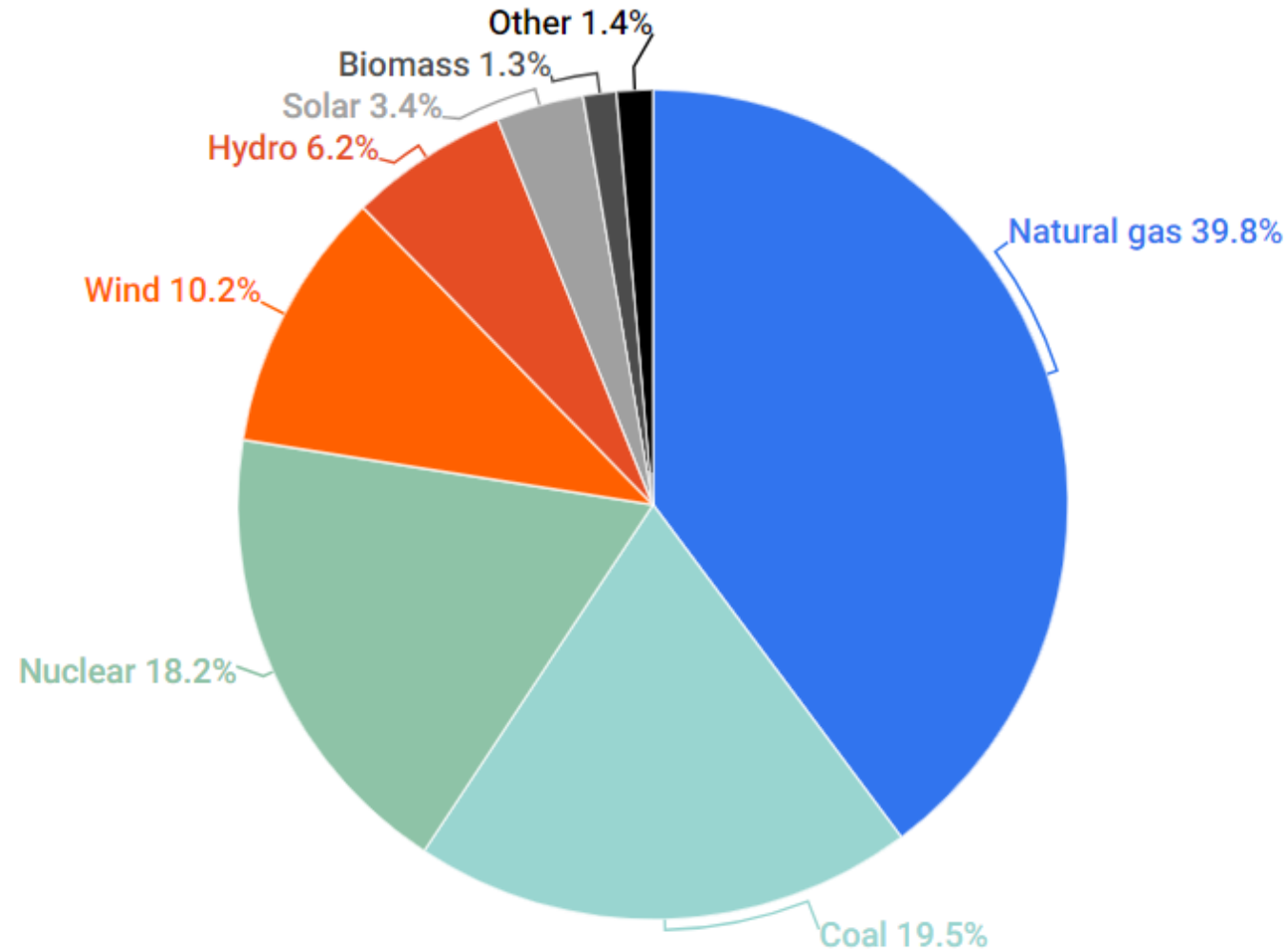
What is Nuclear Energy?

Nature created the first reactor

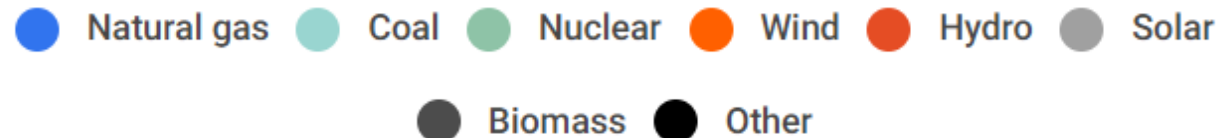
- 2 billion years ago in the region of what is now West Africa
- Uranium was exposed to seeping groundwater
 - Water was the moderator for a sustained chain reaction
 - When water evaporated reaction stopped
- Humans didn't create a sustained chain reaction until 1942.

<https://www.history.com/articles/nuclear-reactor-earth>

SHARE OF US ENERGY PRODUCED BY ENERGY SOURCE



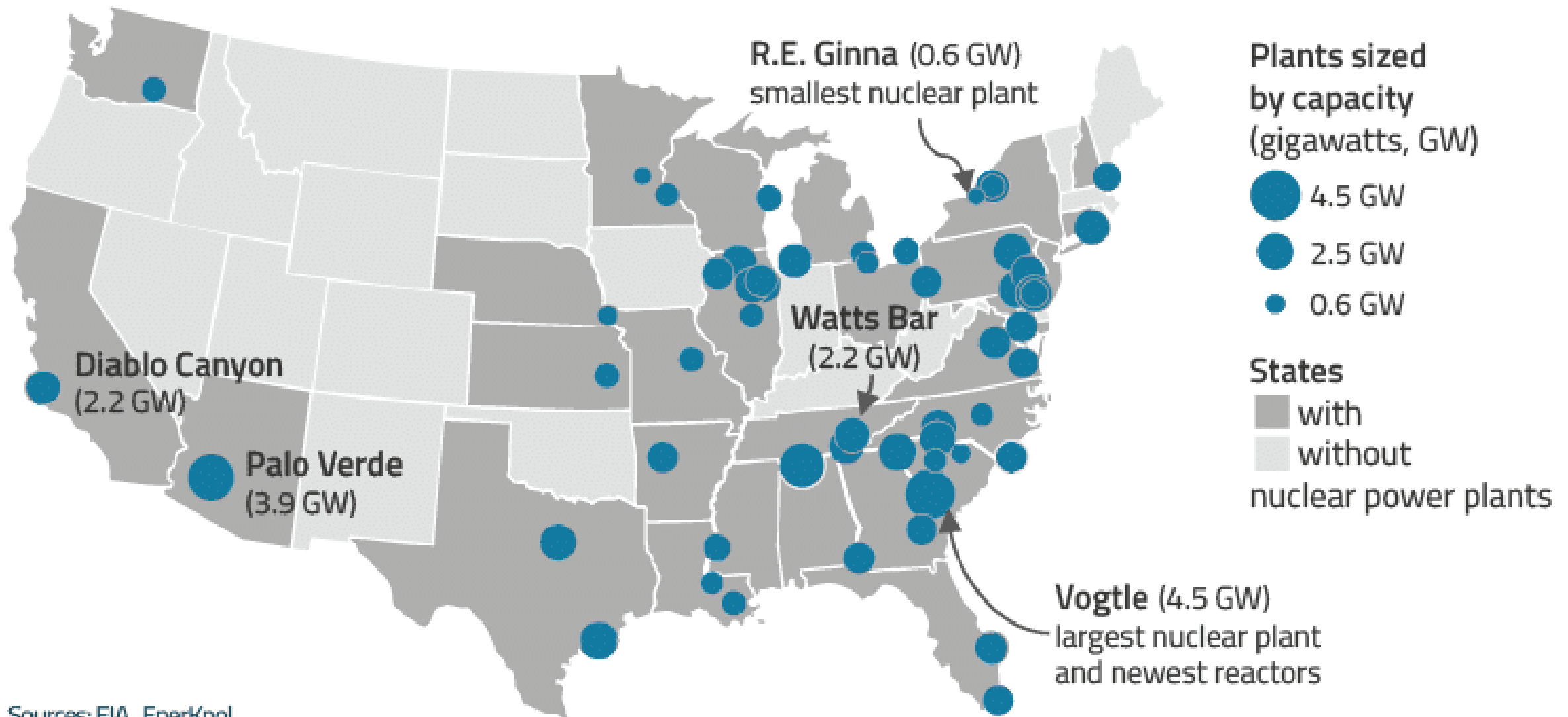
<https://www.epa.gov/energy/about-us-electricity-system-and-its-impact-environment>



Nuclear Energy in the US

- Nuclear currently accounts for 18% of the energy produced in the U.S. and 50% of our carbon-free electricity
 - In South Carolina accounts for 54% of our energy
 - 80% of all carbon-free electricity in Georgia (29% of electricity just from 2 plants)
 - Illinois has the most reactors; 22 states have none
- Have **94** currently operating reactors at **54** plants plans to restart several more (Palisades in MI, Duane Arnold in IA etc.)
 - Including discussion on whether to restart construction at V.C. Sumer
- Nuclear Energy is carbon-free, and its fuel sources can be reprocessed (will discuss next week)

U.S. nuclear power plants (as of February 2025)

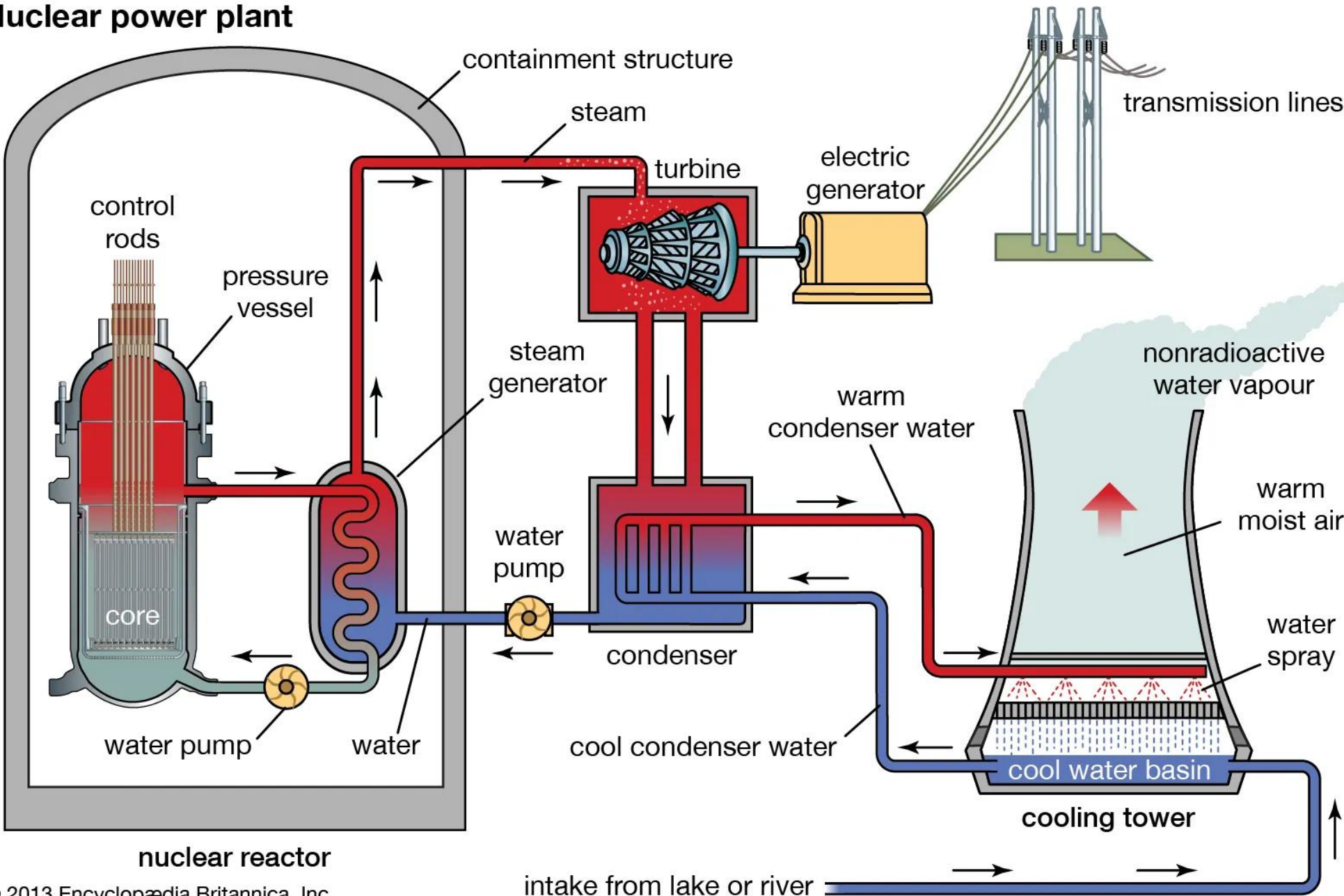


Sources: EIA, EnerKnol

Increasing Energy Demands = Opportunities

- In last decade energy demands have increased
 - Our increasing use of technology
 - Cloud based computing/ AI (4.1% in 2025, anticipate 8.5% next year)
 - Electric Cars
- Grid vulnerabilities and aging infrastructure becoming a safety and security risk (almost 70% of the grid is over 60 years old) <https://www.jpmorgan.com/insights/sustainability/climate/grid-resilience-neglected-no-more>
- Small Modular Reactors/Microreactors etc. viewed as a way to increase production, reduce grid vulnerabilities etc.

Nuclear power plant



Terminology

- Nuclear Reactor- heavy atoms like U-235 split in a controlled chain-reaction producing heat. Produces 1,100-1,200MW electricity
- SMR- Small Modular Reactor- Produce 300-500MW electricity per module. Factory built components for on-site assembly. Typically use uranium as fuel source.
- AMR- Advanced Modular Reactor- Subset of SMR's that use non-water cooling, high temp gas, molten salt etc. Varies on fuel source
- Microreactor- Produce under 20 MW. Small enough to be truck-transportable, can operate independently from a main grid
 - Designed for disaster relief or single industrial/military sites

Public Opinion on Nuclear Energy

- How you ask the question matters.
 - Word choice makes a difference in support for nuclear energy and ‘new projects’
 - Spent Fuel vs Nuclear Waste changes how people respond and their concerns
 - **Question wording:** can generate *measurement error*
 - Survey questions must be worded precisely, or this can jeopardize the reliability of the survey results.
- The basic standards for evaluating a valid poll are:
 - publicly displayed methodology statement
 - Who paid for the poll?
 - publicly posted questionnaire

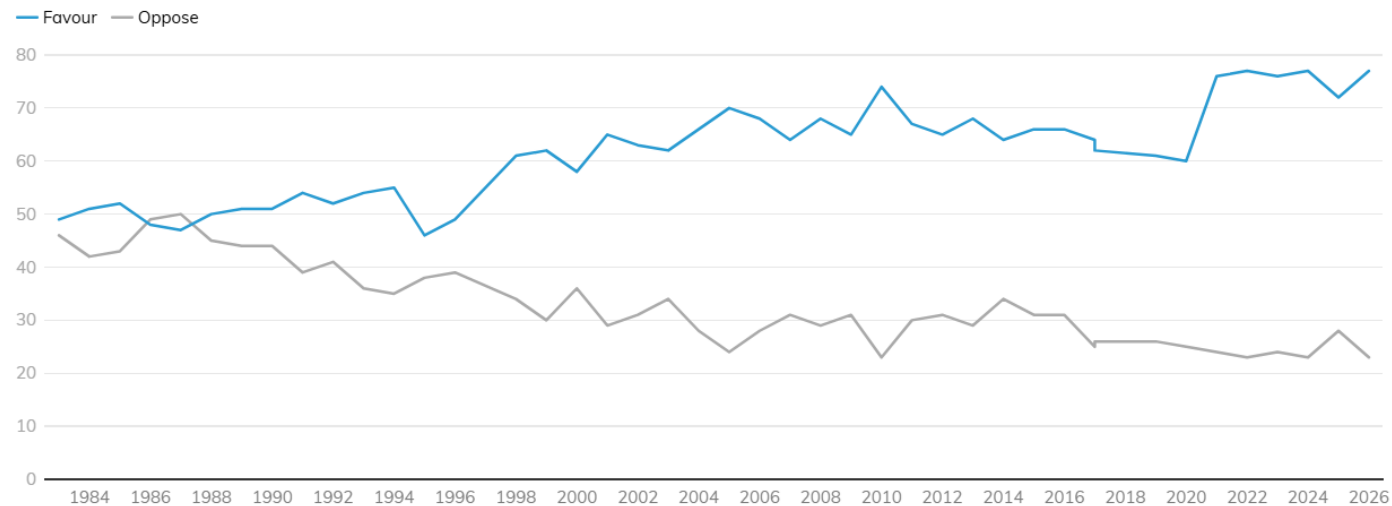
What to know about polls:

- **Evaluating a methodology statement:** sample size, sample technique, medium (online, robocall, live interviews), and other traits are important to know
- Poor question format, faulty ordering of questions, poor vocabulary, ambiguity of questions, or questions with built-in biases can also affect the reliability of the results.
- Have issues with getting true opinions on sensitive topics, have concern about 'interviewer effects' (Social Desirability Bias)

Shifting Opinion on Nuclear

- With increasing demand for energy and increasing options for design and size, public opinion is shifting.
 - Since 2021 More than HALF of US adults favor building new plants

Support for / opposition towards the use of nuclear energy for electricity in the USA, 1983-2026 (%)

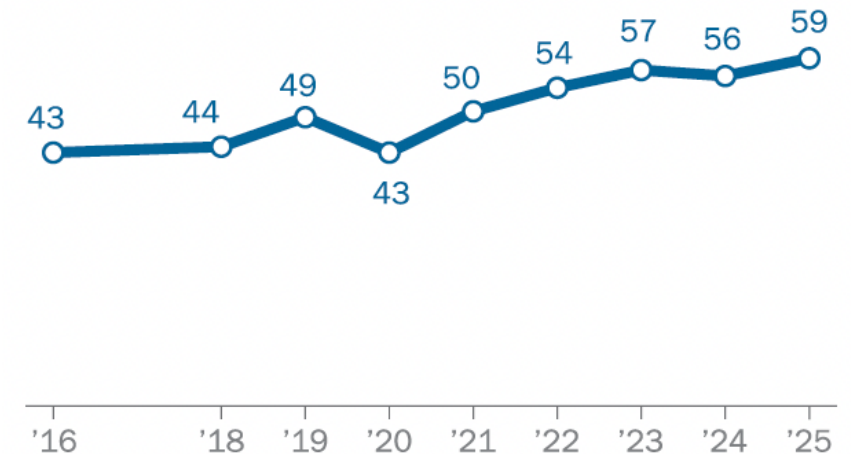


Question asked: Overall, do you strongly favor, somewhat favor, somewhat oppose, or strongly oppose the use of nuclear energy as one of the ways to provide electricity in the United States?

Source: Bisconti Research

Majority of Americans continue to support more nuclear power in the U.S.

*% of U.S. adults who **favor** more nuclear power plants to generate electricity in the country*



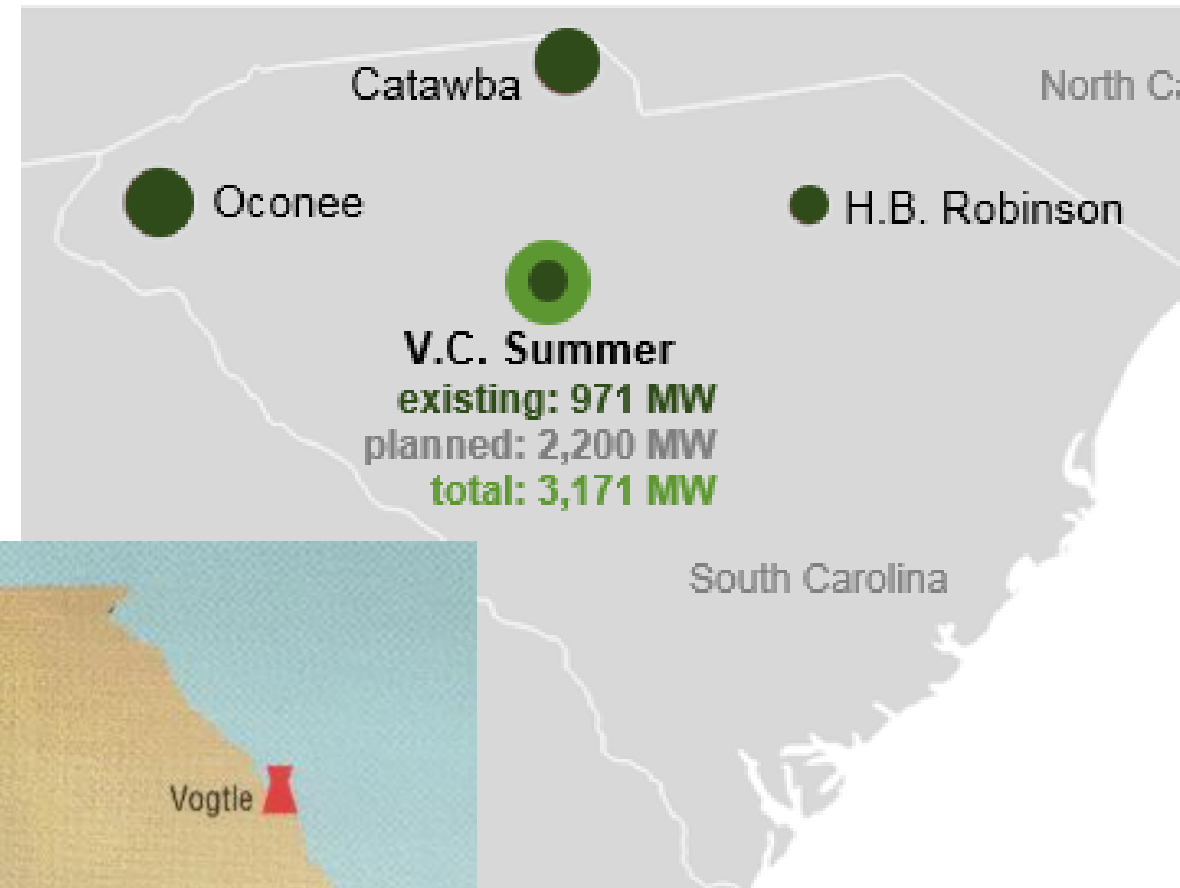
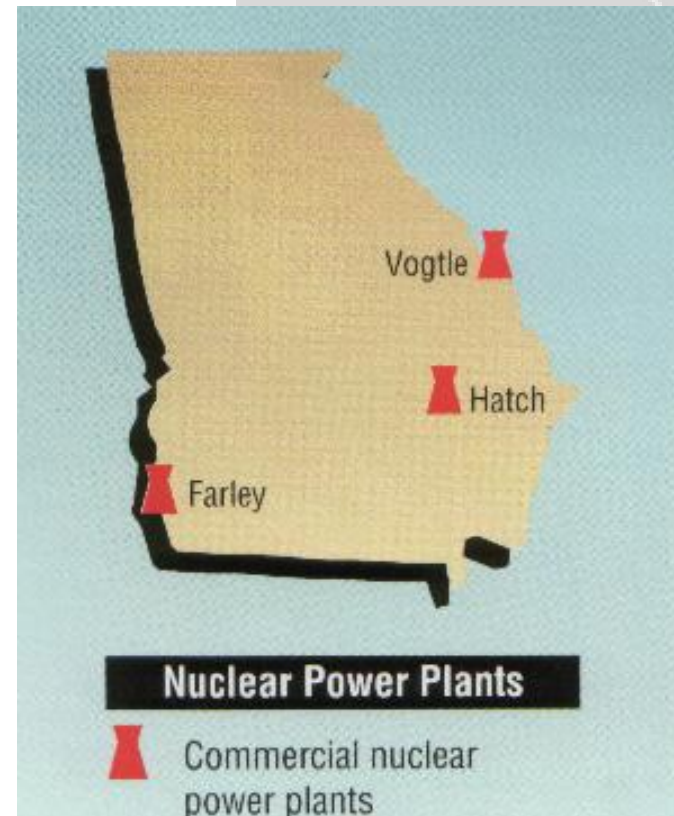
Note: Respondents who selected the response option "oppose" or did not give an answer are not shown.

Source: Survey of U.S. adults conducted April 28-May 4, 2025.

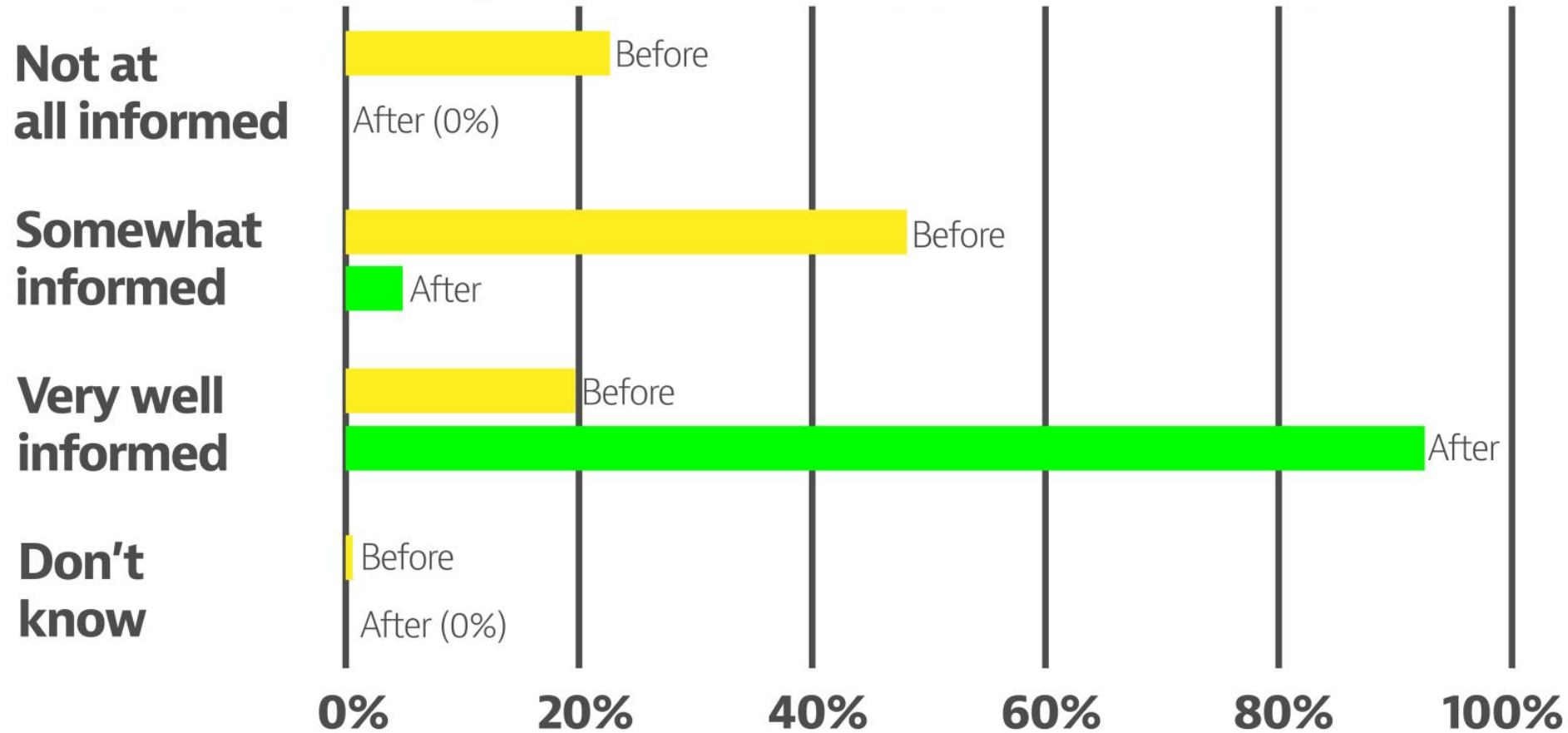
PEW RESEARCH CENTER

Closer to Home

- SC has 4 plants
 - Oconee has 3 reactors
 - Catawba has 2 reactors
 - H.B. Robinson has 1
- GA has 3 plants*
 - Hatch has 2 reactors
 - Farley (technically in AL) has 2
- Vogtle is the largest in the country with 4 operating reactors
- V.C. Summer has 1 operating reactor with 2 partially constructed and mothballed



Feelings about nuclear power before & after a tour



7

Data from tour attendees at Plant Vogtle in 2024-25

SNC 4Q 2024 Public Opinion Survey – Within 50 miles of Vogtle

Statement	Percentage
Associate nuclear energy with <u>reliable electricity</u> and <u>advanced technology</u>	93%
Had a generally <u>favorable impression</u> of the power plant closest to them (Vogtle) in the way it has operated recently	91%
Agree that the plant helps the local <u>economy</u>	87%
Regard the nuclear power plant closest to where they live as <u>safe</u>	76%

SNC 4Q 2024 Public Opinion Survey – Within 50 miles of Vogtle

Statement	Percentage
<u>Renewal of the licenses</u> of plants that continue to meet federal safety standards	92%
Nuclear power will be <u>important</u> to meet the electricity needs of the US	90%
<u>Overall favor</u> using nuclear energy to provide electricity	84%
Agree that there should be <u>more nuclear power</u> plants built in the future	74%

SNC 4Q 2024 Public Opinion Survey – Within 50 miles of Vogtle

Statement	Percentage
<u>Used nuclear rods</u> can be <u>managed safely</u> in facilities that meet regulations	84%
<u>Used nuclear rods</u> are <u>stored safely</u> at the plant site	75%
<u>Used nuclear rods</u> can be <u>transported safely</u>	80%

NuWaDi Clemson Survey Purpose

- This study is focused on understanding how language used to describe complex societal problem impacts how we understand and frame it.
- Prior surveys report that the majority of U.S. citizens support the use of nuclear energy, **however we do not have a permanent or long-term solution for handling nuclear waste in this country.**
- **Research Objective:** How does different terminology impact the public's understanding of a complex topic like nuclear waste storage?
- **Implications:** Can survey results help technical experts effectively engage with the public, enabling informed discussions once proposals for nuclear materials storage are in the public sphere.



Data Summary

1

Total Sample Size =
2014 respondents

2

Clean Sample Size =
1692

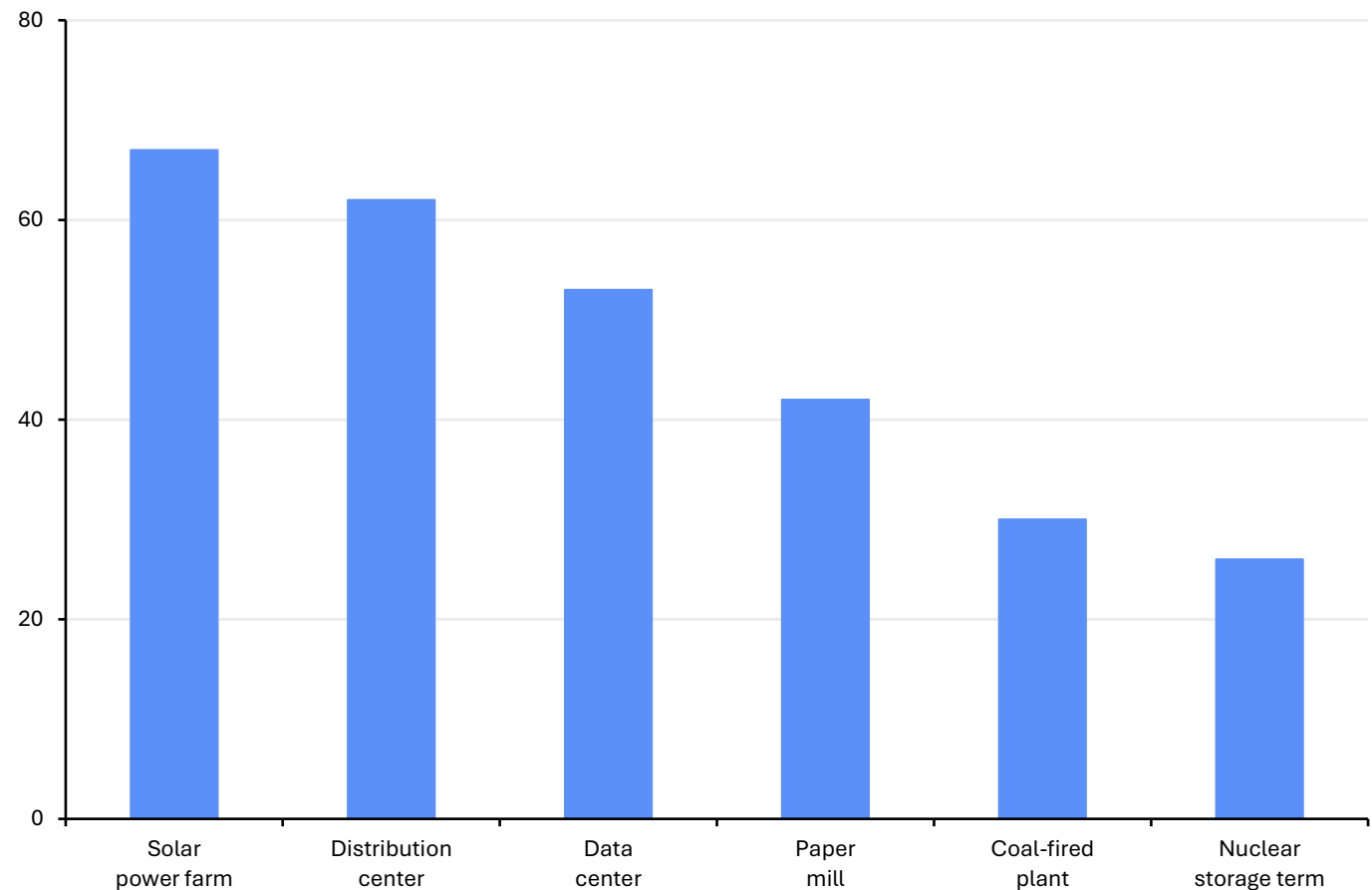
3

Sample size by state:

- South Carolina- 927
- North Carolina- 552
- Georgia- 213

Support for Nuclear Storage Sits Apart

Average support across the four terminology conditions



Public support is strongest for familiar economic-development projects, especially solar farms and distribution centers.

Nuclear storage terms receive the lowest support overall, averaging about one-quarter support.

This pattern frames nuclear storage as a distinct acceptance challenge rather than a generic development question.

Question Wording-

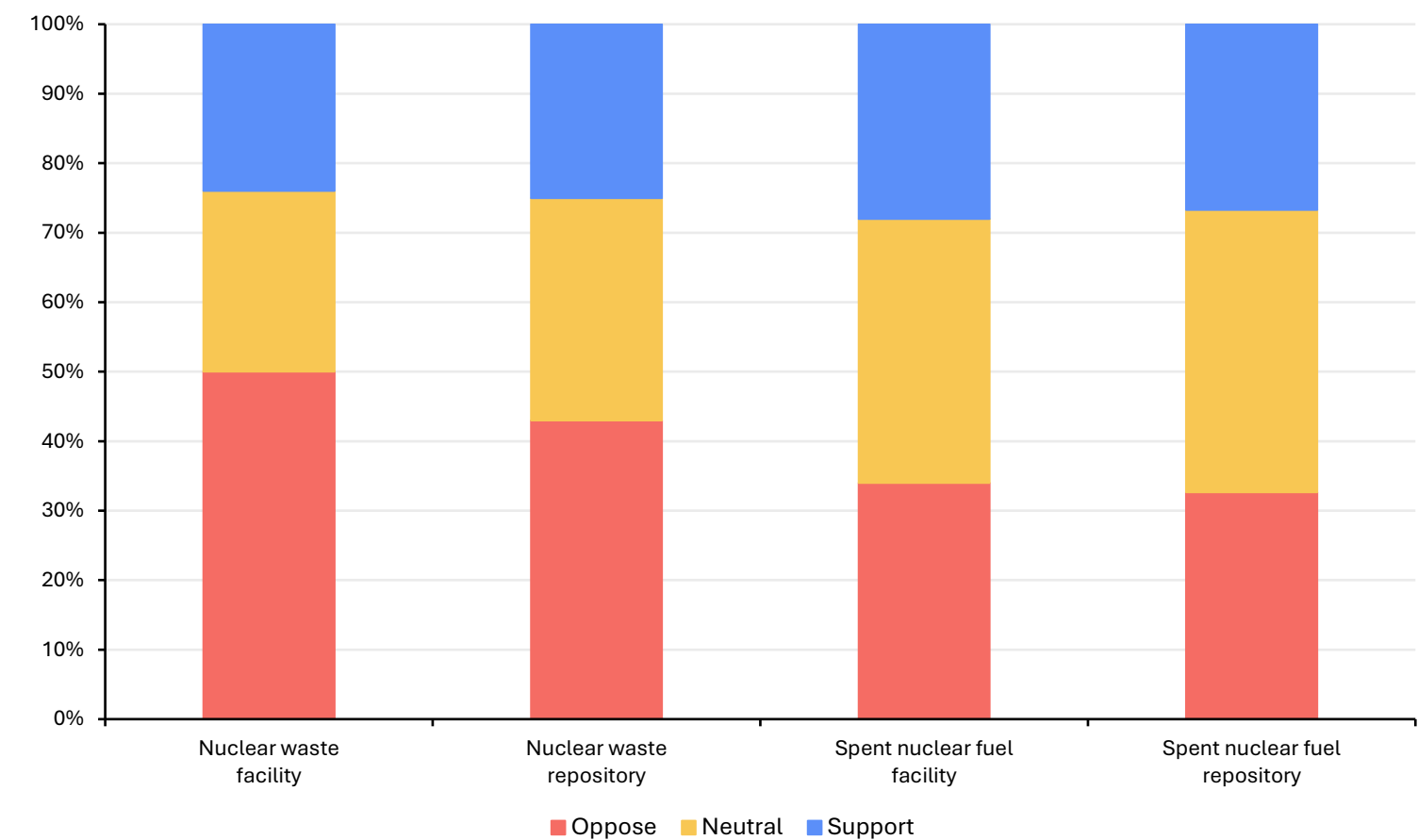
***Q4 (A,B,C, D).** Rate your level of support for each of the following industries a being built in your community?

- a. Data center
- b. **[Nuclear waste facility / Nuclear waste repository / Spent nuclear fuel facility / Spent nuclear fuel repository]**
- c. Coal fired power plant
- d. Regional distribution center
- e. Paper mill
- f. Solar power farm

Respondents split randomly into one of the 4 word choice options.
The order of the 6 industries was randomized.

Terminology Mainly Shifts Opposition and Neutrality

Nuclear storage support varies modestly, while opposition is lower under spent-fuel language



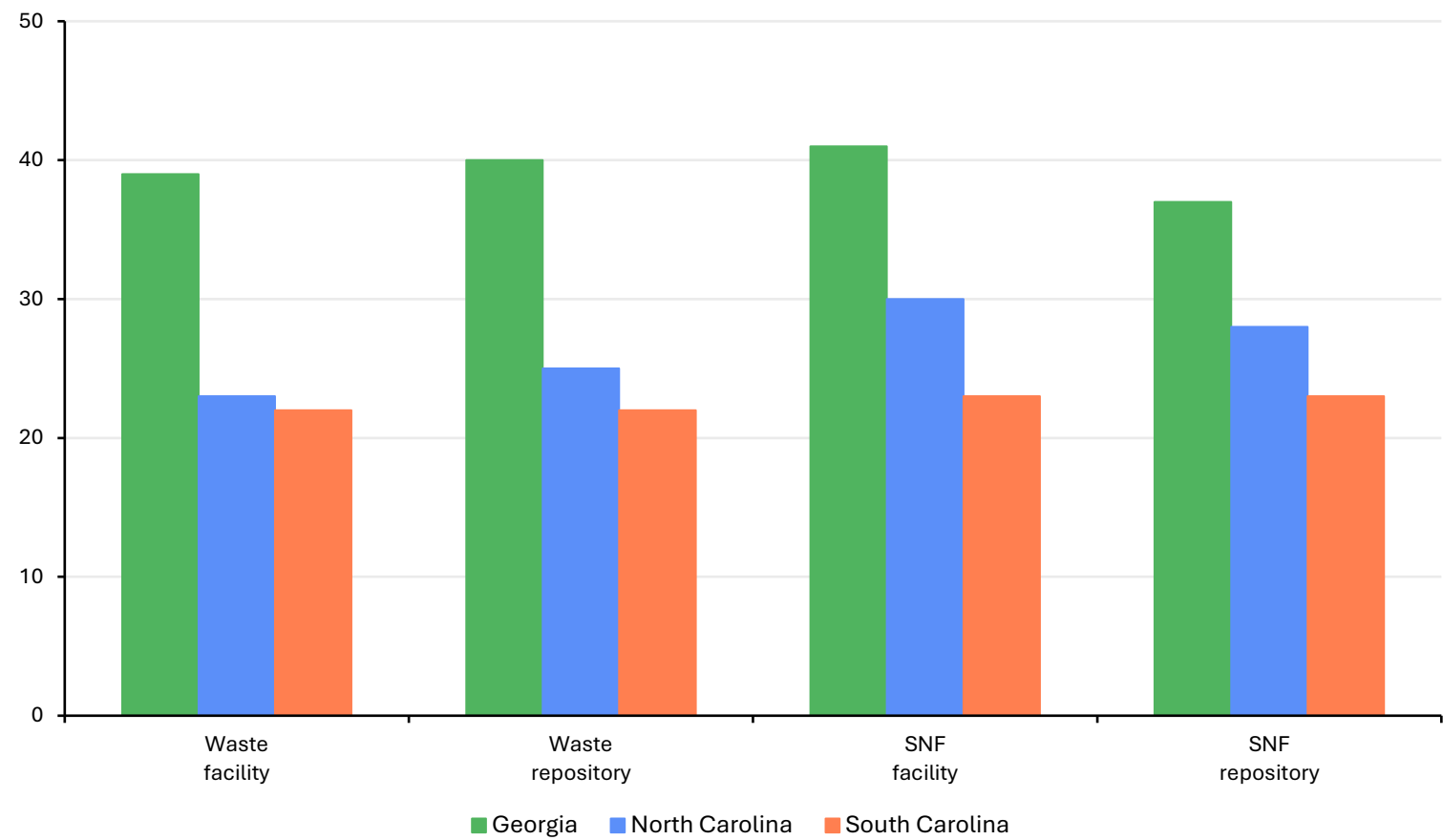
“Nuclear waste” framings show the highest opposition: 50% for facility and 43% for repository.

“Spent nuclear fuel” framings show less opposition and more neutrality.

Support remains relatively similar across the four nuclear terms: 24%–28%.

State Context Matters for Nuclear Storage Support

Georgia respondents show consistently higher support than respondents in North or South Carolina



Georgia support ranges from 37% to 41% across terminology conditions.

Support in South Carolina stays near 22%–23% across all four terms.

These differences suggest geography may be as important as terminology.

Does Nuclear have a NIMBY Problem?

- Most Americans support nuclear energy, but no one wants it in their neighborhood?
- This poll shows nuclear waste/spent fuel is even more divided.
 - What drives this concern?

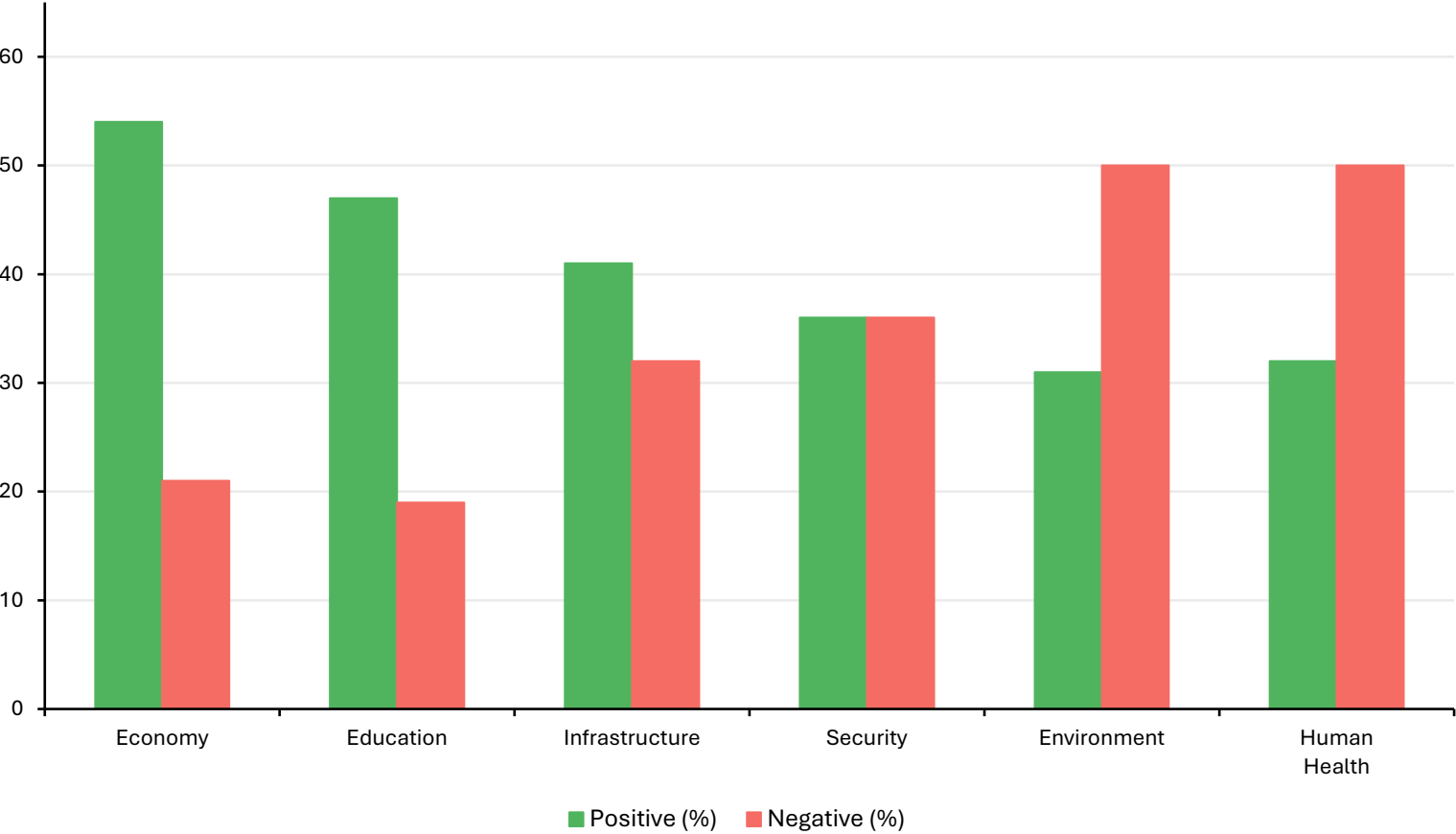
Question Wording-

***Q5 (A,B, C, D)-** If a project like a **[Nuclear waste facility / Nuclear waste repository / Spent nuclear fuel facility / Spent nuclear fuel repository]** were proposed for your community, identify the potential impacts for the following areas of our communities.

- a. Security
- b. Infrastructure
- c. Education
- d. Economy
- e. Environment
- f. Human Health
- g. Other (input answer)

Perceived Benefits and Risks Coexist

Average positive and negative impact perceptions across treatment conditions



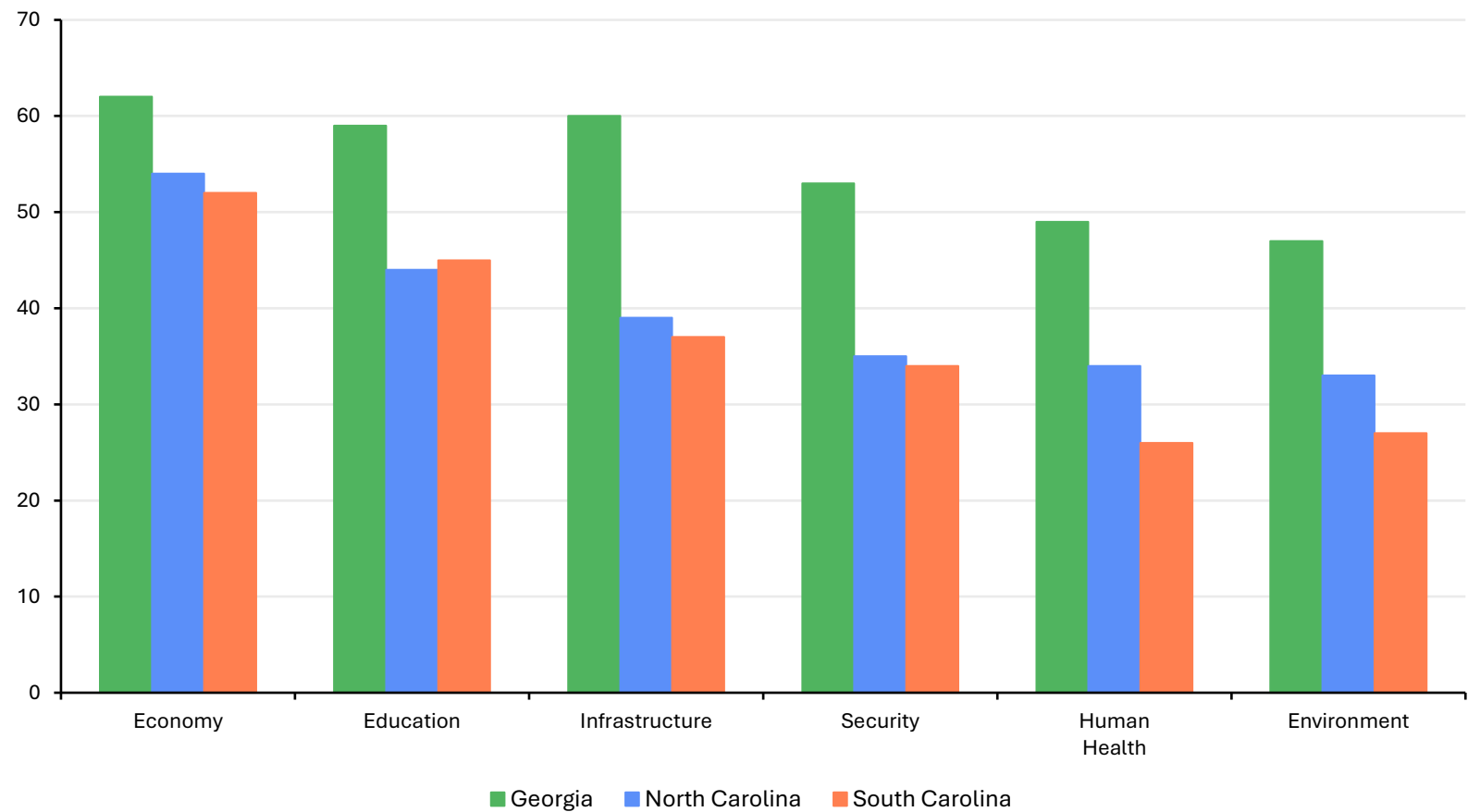
Economic and educational impacts are the most positively perceived.

Environmental and human-health impacts generate the most concern.

Respondents appear to weigh local benefits against perceived safety and environmental risks.

Perceived Impact Patterns Differ by State

Average positive impact perceptions across terminology conditions



Georgia respondents are more positive across most impact areas.

South Carolina respondents are least positive on health and environmental consequences.

This reinforces the need to analyze attitudes by state, not only by treatment term.

Summary of Treatment Group Data

Treatment A– Perceived Community Impacts of A Nuclear Waste Facility

Impact	Negative	Neutral	Positive
Economy	24%	24%	52%
Education	19%	39%	42%
Environment	55%	20%	25%
Human Health	55%	19%	26%
Infrastructure	35%	26%	38%
Other (Respondent specified)	33%	37%	30%
Security	38%	29%	32%

Treatment B – Perceived Community Impacts of A Nuclear Waste Repository

...

Impact	Negative	Neutral	Positive
Economy	24%	27%	49%
Education	23%	35%	42%
Environment	55%	16%	29%
Human Health	54%	17%	29%
Infrastructure	31%	32%	37%
Other (Respondent specified)	39%	34%	27%
Security	34%	29%	37%

Treatment C– Perceived Community Impacts of a Spent Nuclear Fuel Facility

impact	Negative	Neutral	Positive
Economy	21%	26%	53%
Education	15%	38%	48%
Environment	49%	18%	33%
Human Health	47%	18%	35%
Infrastructure	27%	29%	44%
Other (Respondent specified)	31%	33%	36%
Security	29%	29%	42%

Treatment D – Perceived Community Impacts of a Spent Nuclear Fuel Repository

Impact	Negative	Neutral	Positive
Economy	16%	24%	60%
Education	17%	30%	54%
Environment	42%	20%	38%
Human Health	44%	19%	36%
Infrastructure	34%	23%	43%
Other (Respondent specified)	20%	45%	35%
Security	42%	24%	33%

Next Steps: Explore and Refine

- Analyze the role of gender, income and education on support for different types of Industries.
- Analyze the role of gender, income, etc. on the perceived community impacts of different variations of nuclear waste storage phrasing.
- What is the role of political identity and community engagement on the support for various descriptions of nuclear waste storage?
- Examine whether there are important interactions between variables, political leaning, gender, income etc. and support for nuclear waste storage solutions?
- How does geography impact support for nuclear waste storage solutions?



- Next week will talk about the fuel sources and reprocessing. We have an article from *Nature* magazine for you to start the conversation.
- In two weeks will answer any questions you want us to answer!

SEND US YOUR QUESTIONS!

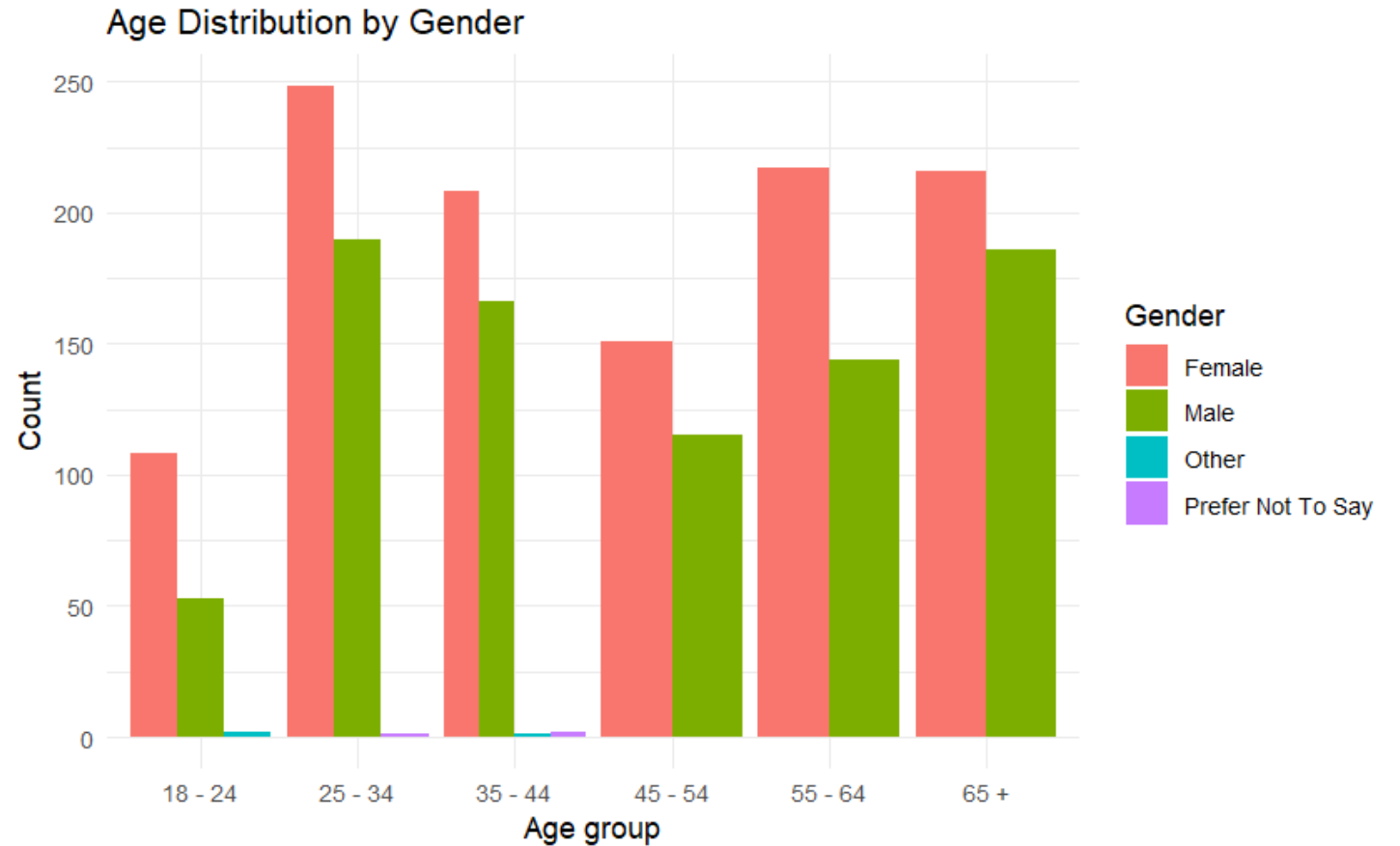
Email office@cntaware.org

Gender, Race and Age Summary

Georgia: Male = 115;
Female = 98

South Carolina:
Male = 242; Female = 308

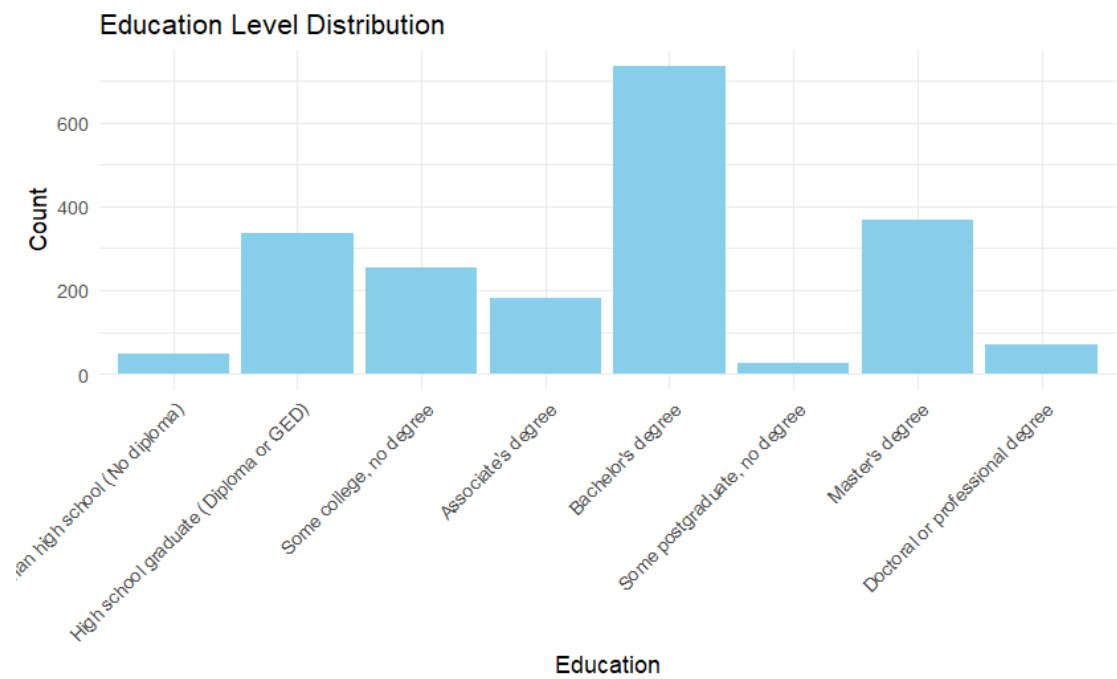
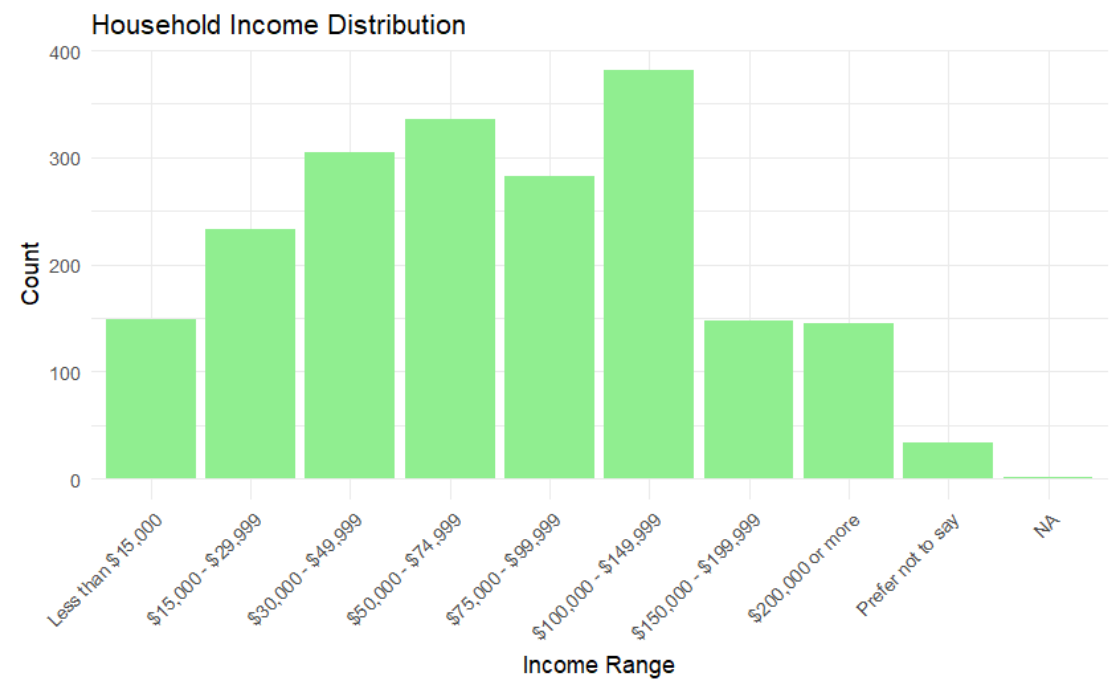
North Carolina:
Male 393; Female= 532



RACE: 75% White; 16% Black of African American; 3% Hispanic or Latino

Socioeconomic Profile of Respondents

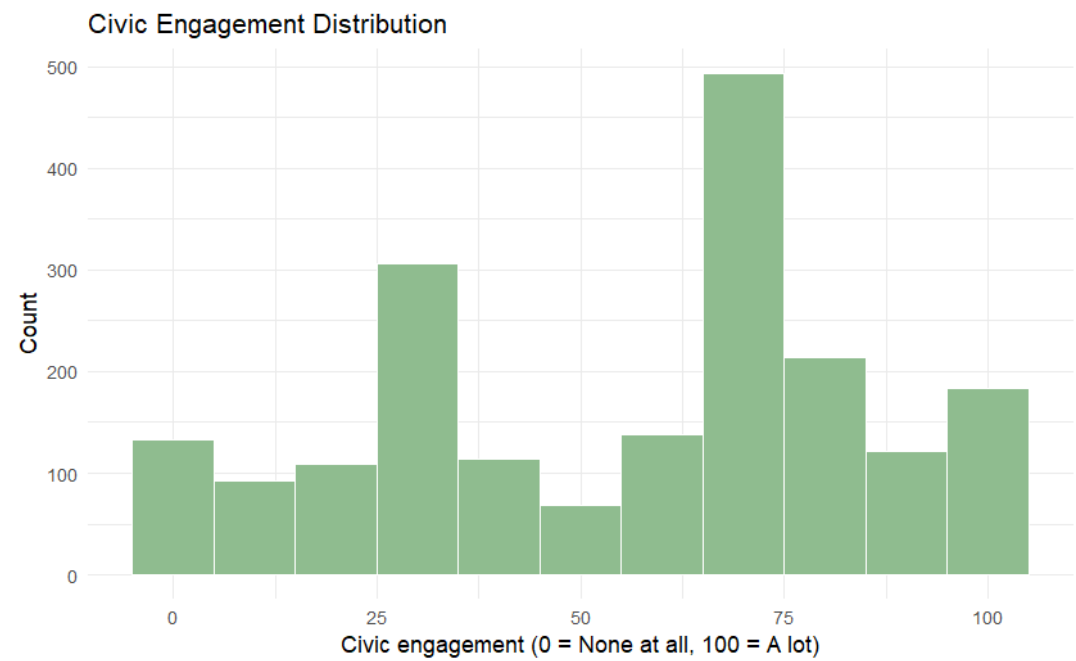
Income and education distributions provide context for interpreting support and perceived-impact patterns.



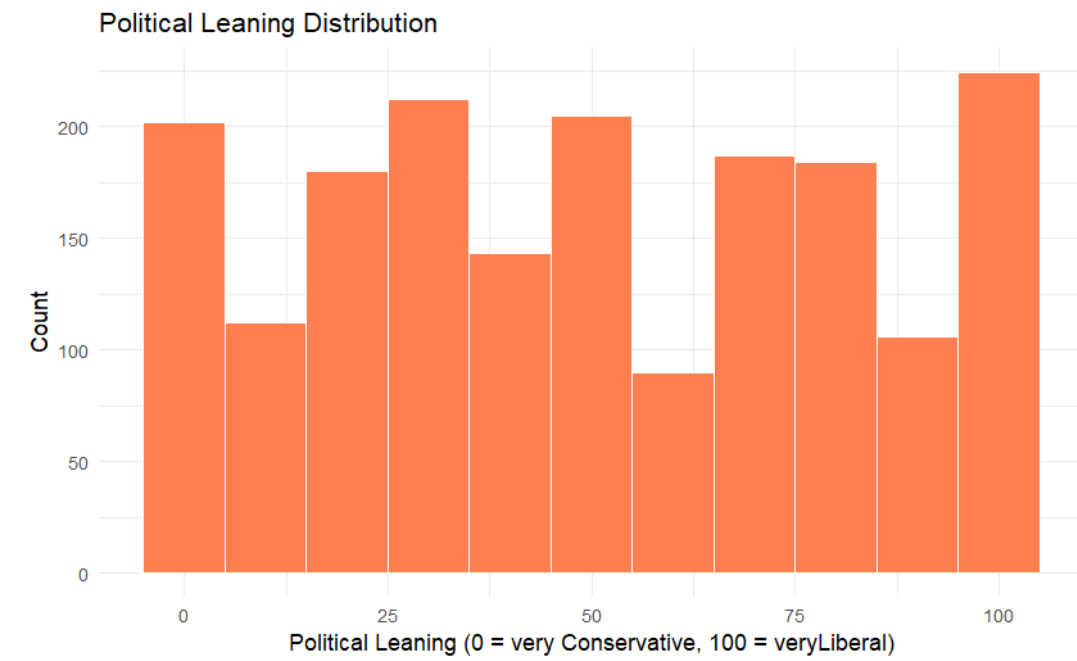
The sample combines broad income variation with a highly educated respondent pool; both variables should be treated as important context in later attitude models.

Civic Engagement and Political Leaning

Civic engagement and ideology help characterize the audience behind the treatment responses.



Civic engagement is concentrated in the moderate-to-high range, suggesting many respondents are attentive to public or community issues.



Political leaning spans the full 0–100 scale, indicating a politically heterogeneous sample rather than a single ideological bloc.

Treatment A: Nuclear Waste Facility

industry	Neutral	Oppose	Support
Coal-fired power plant	35%	37%	28%
Data center	26%	20%	54%
Distribution center	15%	13%	72%
Nuclear waste facility	26%	50%	24%
Paper mill	34%	29%	38%
Solar power farm	21%	13%	66%

Treatment B: Nuclear
Waste Repository

Industry	Neutral	Oppose	Support
Coal-fired power plant	30%	40%	30%
Data center	30%	18%	53%
Distribution center	37%	8%	55%
Nuclear waste repository	32%	43%	25%
Paper mill	34%	22%	43%
Solar power farm	25%	12%	63%

Treatment C: Spent Nuclear Fuel Facility

industry	Neutral	Oppose	Support
Coal-fired power plant	35%	34%	31%
Data center	28%	22%	50%
Distribution center	31%	7%	62%
Paper mill	30%	26%	44%
Solar power farm	17%	11%	72%
Spent nuclear fuel facility	38%	34%	28%

Treatment D: Spent nuclear fuel repository

Industry	Neutral	Oppose	Support
Coal-fired power plant	34%	34%	32%
Data center	27%	17%	56%
Distribution center	33%	8%	60%
Paper mill	30%	27%	43%
Solar power farm	22%	11%	67%
Spent nuclear fuel repository	41%	33%	27%