Energy Research & Social Science 82 (2021) 102292

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Turning a coal state to a green state: Identifying themes of support and opposition to decarbonize the energy system in the United States

Deidra Miniard *, Shahzeen Z. Attari

O'Neill School of Public and Environmental Affairs, Indiana University Bloomington, Bloomington, IN, USA

ARTICLE INFO

Keywords:
Climate change
Energy transition
Perceptions
Public opinion
Partisan differences
Indiana

ABSTRACT

Decarbonizing the energy system is necessary to address climate change, yet the transition to low-carbon energy resources has been slow, and climate change continues to be a politically polarizing issue in the United States. Past research has shown that people want a future energy mix that is decarbonized but disagree on the policies to get there (Miniard et al., 2020). How do residents of Indiana, a historically Republican state which primarily relies on fossil fuel resources, think about the current and future energy mix and energy policy at the state level? We surveyed and interviewed Indiana residents (N = 48) to identify the motivations and perceptions driving their preferences for energy resources and support or opposition to state and federal energy policies. We find that a majority of participants want a decarbonized state energy mix in 2050 that primarily relies on solar and wind and decreases the use of fossil fuels. Support for decarbonization is driven by themes of protecting the environment and public health, reducing pollution, improving the economy, using low cost and available resources, and holding polluters accountable. We find that climate change is not a strong motivating factor. In contrast, opposition to decarbonization is driven by economic and employment concerns, fear, lack of familiarity, doubting the feasibility of renewable sources, and concerns about fairness. Thus, participants have nuanced reasons driving their support or opposition to decarbonizing the Indiana energy system, which are dependent on the energy source and policy and are not tied to climate change.

1. Introduction

Decarbonizing the energy system by moving away from fossil fuel resources towards low-carbon energy resources is necessary to address climate change and achieve environmental, social, and economic sustainability [1]. The transition to a low carbon energy system is driven by technological, economic, political, and social factors [2,3], and requires support and social acceptance for new industries such as solar or wind [4]. Social preferences for different technologies and societal demands for reduced pollution can influence policies that are passed to support the transition to cleaner energy resources and away from fossil fuels [2,5]. Thus, building public support and salience for a decarbonized energy transition is an important step to mitigating climate change.

Despite the urgent need to address climate change, the current transition to decarbonized energy resources has been slow [6]. This is partially attributed to the growing partisan divide on climate change. In the United States, the Democratic Party and the Republican Party are the two major political parties, although minor political parties exist (e.g., Libertarian, Green). The Republican Party typically identifies with conservative values (e.g. limited government regulation, free market economy, no tax increases) and the Democratic Party tends to identify with liberal values (e.g. expanding government regulation, higher taxes for higher income brackets) [7]. Democrats are more likely than Republicans to think climate change is an important priority [8] and express higher levels of concern about climate change and support for climate action [9–11]. One solution to mitigating climate change, transitioning towards low-carbon energy sources, has widespread support and less partisan division than climate change. A survey of U.S. adults asked about the national energy mix they hoped for in 2050, and participants reported a future that relied heavily on low-carbon sources (particularly wind and solar) and far less on fossil fuel resources [12]. While there were political differences such that liberals reported hoping for a slightly higher contribution of low-carbon sources and lower contribution of fossil fuels than conservatives, these differences were minor [12]. Additionally, an analysis of three separate surveys on climate change, energy, and the environment finds strong support for alternative sources of energy, as well as support for policies that would reduce the use of fossil fuels and incentivize renewable development

* Corresponding author.
E-mail addresses: dminiard@iu.edu, niard@iu.edu (D. Miniard).

https://doi.org/10.1016/j.erss.2021.102292
Received 8 January 2021; Received in revised form 1 September 2021; Accepted 2 September 2021
Available online 14 September 2021

[13].

Renewable energy sources, particularly wind and solar, have broad support and are viewed more favorably than fossil fuel resources [14–16]. A survey of U.S. adults finds a majority (79%) support the development of alternative energy sources compared to only 20% who favor the expansion of oil, coal, and natural gas production [17]. A nationally representative survey on attitudes and perceptions of coal, wind, solar, biomass, and natural gas found differences in attitudes and perceptions by energy resource [18]. Wind and solar were viewed positively, and participants associated those sources with positive impacts on public health, climate change, the economy, and employment. Conversely, coal was viewed more negatively and perceived to be detrimental to air and water quality, climate change, and public health. Natural gas was reported to have positive effects on the economy and local employment, and biomass was viewed positively but not well understood [18]. These results suggest there are numerous factors that influence what energy sources people favor, and that these attitudes are resource dependent.

Although there is bipartisan support for a decarbonized future energy mix [12], partisan division was present for the energy resources that participants support from those who identified as Democrats and liberal compared to Republicans, Independents, and conservatives [14]. Political orientation is found to be a consistent and strong predictor of energy policy preferences [13,19]. Republicans are less supportive of policies that regulate the fossil fuel industry, promote renewable resources, and price carbon emissions than Democrats [13,15] despite the agreement on a decarbonized energy future [12], and political party affiliation is the strongest predictor for the level of support toward energy policies [13].

Concern for environmental harm and economic costs have been identified as the primary drivers of support for renewable resources compared to fossil fuels [20–22]. A survey of U.S. voters found 58% believe policies that transition away from fossil fuels towards renewable energy will create jobs and improve the economy, although a partisan divide was present (75% of Democrats compared to 39% of Republicans) [15]. Whether people support or oppose renewable energy is driven by whether it increases or decreases energy costs. A higher perceived cost of energy is associated with a decrease in public support [23,24]. In reference to the environment, three-quarters of those surveyed indicated reducing water and air pollution were very or extremely important reasons to transition to 100% renewable energy, although a partisan divide was present as well, with approximately a 30 percentage point difference between Democrats and Republicans [15]. While both environmental concerns and economic concerns are important factors that influence support for renewable development, emphasizing the economic costs of renewable energy sources can reduce support, even when environmental benefits are provided [24,25].

Perceptions of social, economic, and environmental risk as well as concerns about public health also influence support for energy resources and energy policy [26,27]. Solar and wind are perceived to be safer than coal and nuclear [16,26]. Sixty-two percent of U.S. voters consider coal energy to be harmful to public health compared to 5% who believe solar or wind is harmful. A slight majority (53%) think nuclear is harmful, followed by 42% for landfill methane gas, 38% for wood-fired power plants, 29% for natural gas, 11% for hydroelectric dams, 10% for geothermal [15].

Geographical location and historical associations with energy resources drive the energy policy positions and energy resource support [26,28]. Individuals in fossil-fuel dependent communities show greater favorability towards energy sources with which they have historical or current ties [28,29]. Individuals also report stronger support for climate policy when they perceive the solutions to be feasible and effective [15,30]. Additional drivers of support include whether the resource is renewable or finite [15], responsible stewardship of the earth driven by religion [31], and belief in and attitudes towards climate change [12,29,32].

1.1. Indiana as a case study

Our study focuses on a sample of Indiana residents. As of 2018, Indiana ranked 11 out of 51 (including Puerto Rico) in total energy consumed per capita in the U.S. and 8th in total carbon dioxide emissions per capita in the U.S. [33]. Indiana primarily relies on coal, ranking 7th in coal production and 2nd in coal consumption just after Texas [34]. The industrial sector within the state consumes the most energy, and Indiana is home to many energy-intensive industries including chemical manufacturing, steel making, food production, and refining crude oil. Renewables make up less than 7% of energy consumption in the state, primarily relying on wind power and biomass, with solar, hydropower, and geothermal together only accounting for 0.5% of energy generation [35].

Indiana is also a Republican leaning state, with 46% of those in Indiana identifying as Republican or leaning Republican compared to 38% who identified as Democrat or lean Democratic [36]. The state government also has a Republican Governor, and Republican control of both the House and the Senate. Indiana tends to fall below the national average for belief in global warming, with only 60% of Indiana residents reporting global warming is happening compared to 67% for the U.S. [37]. Half (50%) report worrying about global warming, and only 36% are worried that global warming will harm them personally [37]. Support for decarbonization policy varies considerably, with 82% of Indiana residents supporting funding research into renewable energy sources while 57% support requiring utilities to produce 20% of electricity from renewable sources, 60% supporting setting CO_2 limits on coal-fired power plants, and 59% support expanding offshore drilling for oil and natural gas [37].

While there is agreement on a future which relies primarily on low-carbon sources, particularly wind and solar, and less on fossil fuels, the underlying motivation for this desired decarbonized energy future is not clear. Past work shows considerable variation in the factors that drive support or opposition to energy resources and energy policies and have usually been asked in a piece-meal format: asking about one specific energy source or a subset of energy sources at a time [Examples: [16,18,22,38]]. The motivations underlying why individuals support the use of different energy sources have also been shown to differ by political affiliation [38,39]. Moreover, there is a disconnect between the energy future people hope for, and the policy pathways they support to reach that future [12]. Thus, it is important to understand why individuals want a decarbonized energy system, and how their motivations differ by partisan identity both for energy resources and energy policies. Here, we aim to address this gap in the literature by asking participants about all energy sources and use methods that allow participants to provide their own responses in an open format.

The present work offers three distinct contributions. First, we draw from a sample that is traditionally hard to reach, collecting data from individuals recruited in public locations in a conservative state in the U. S. This sample is unique and important because it is an example of the demographic where we need to garner support for climate action. Second, the present study collects rich, in-depth qualitative interview data along with a short quantitative survey from our sample to understand results from prior work [12]. Qualitative and quantitative research methods have complementary strengths and weaknesses [40]. Qualitative research is valuable to gain a deeper understanding of a problem and investigate in-depth beliefs, values, attitudes, and motivations as well as evaluate these constructs in the context of real-world scenarios [41,42]. The importance of using qualitative research to supplement quantitative work has implications for real world outcomes. One such example is understanding the gaps between polling data and actual election results in the United States for the 2016 and 2020 presidential elections. Finally, our study focuses on all the energy sources comprehensively. Where other studies ask about only one or a handful of energy sources or energy policy alone, the present work asks participants about all energy sources, as well as an array of policies at the state and federal

level.

The present study uses a paper survey along with a semi-structured face-to-face interview with a participant sample from Indiana, a fossil-fuel dependent state, to understand (1) perceptions of the current energy mix and the future energy mix people hope for at the state level, (2) the factors motivate people to want to use more, less, or the same amount of an energy resource, and (3) the factors that influence the energy policies individuals support or oppose in the context of partisan differences.

2. Methods

2.1. Participants

Data was collected between May 2019 and August 2019. Individuals were eligible to participate if they were over the age of 18, were currently living in the state of Indiana, and had lived in the state of Indiana for at least the last three years. Participants were recruited from urban, suburban, and rural locations in counties that voted majority Democrat in the 2016 election and surrounding counties that voted majority Republican to obtain variation in political beliefs. Participants were recruited and interviewed on site at 15 libraries, one church, one festival, and one shopping center. Additional recruitment information and a map of participant ZIP codes can be found in the SI text. Our sample includes 48 participants. Participants were paid $10 in cash after the interview for their participation.

Twenty-three participants identified as male, 24 identified as female, and one person preferred not to answer. The sample skewed older with a mean age of 52 years and a range of 18–86 years of age, compared to 38 for the Indiana population [43]. The sample was also skewed towards lower income with 66.7% of the sample reporting an annual household income less than $30,000, 10.4% reporting $30,000 to $50,000, and 14.6% reporting an income over $50,000. Four participants opted not to report their household income. A majority of the sample fell below Indiana's median household income of $54,325 [43]. For education, 39.6% reported having some high school or a high school diploma, 20.8% reported some college, and 39.6% reported having at least a college degree. This is slightly higher than the education level of the state where 25.9% report having a bachelor's degree or higher [43]. Participants were asked to self-report whether they lived in an urban, suburban, or rural area, 41.7% reported rural, 33.3% reported urban, and 25.0% reported suburban. The sample reports being more rural and less urban compared to the state distribution; 28% of the state population lived in rural areas as of 2010, 59% lived in urbanized areas, and 13% lived in urban clusters[1] [44]. Sixty-seven percent of participants had children and 40% had grandchildren.

Participants self-reported their political party affiliation with 43.8% identifying as Republican, 25.0% as Democrat, and 20.8% as Independent. Five participants (10.4%) identified as "other", opting instead to write in "bipartisan", "none", "not sure', "whoever fits the job", or "Tea Party". Participants were also asked for their political ideology, and 35.5% identified as conservative, 33.3% as moderates, 29.1% as liberal, and one person did not provide a response. (See SI Text Table 4 showing how ideology and party align.)

2.2. Procedure

After participants consented to taking part in the study, they were asked to complete a paper survey before the face-to-face interview. Participants were provided with an information sheet which gave short descriptions for all energy resources. The first set of questions asked participants to estimate the current energy mix of Indiana, provide estimates for the future energy mix that they hope for in 2050, and answer socio-demographic questions. The energy mix estimation questions were adapted from Miniard et al. [12]. The average time to complete the paper survey and interview was 37 min, ranging from 22 to 69 min. (See SI Text for all survey materials).

Next, participants were interviewed using a semi-structured interview protocol. All interviews were recorded and transcribed later for analysis. In a semi-structured interview protocol, participants are asked the same set of questions, and some discretion was used by the researcher to further probe ideas that emerge during the interview. For the interview, participants were provided with an additional information sheet which provided the actual energy mix for the state of Indiana (See SI text). During the interview, participants were asked whether they would like to increase, decrease, or maintain the contribution of each energy resource. No time frame was provided. Participants were asked to explain why they wanted to use more, less, or the same amount of an energy source, and their responses were further probed for clarification and greater depth. For example, if a participant described "its natural" as a reason to use more of an energy source, they were subsequently asked to explain what "natural" meant to them.

Next, participants were asked to indicate whether they support or oppose three state energy policies and three national energy policies. Similar to the energy resource questions, participants were asked why they supported or opposed each of the policies and were asked further probing questions about different aspects of each policy.

Finally, climate change questions were included at the end as to not prime participants to discuss climate change to see if the topic came up organically. Closed ended questions were included to assess the extent to which participants thought climate change was occurring, how important climate change was to them personally [45], and whether or not they believed energy resources used in the U.S. contributed to climate change. Three open-ended questions asked participants what issues outside of climate change were important to them personally, how they believed climate change would affect the issues they cared about, and what might cause climate change to become more important to them. The paper survey, semi-structured interview protocol, and both information sheets can be found in the SI Text.

This research was approved by Indiana University's Internal Review Board at the Office of Research Administration, and informed consent was received from all participants.

2.3. Interview data analysis

2.3.1. Analyzing political affiliation: Political party vs political ideology

Four participants verbally indicated while taking the survey that they did not understand what was meant by political ideology or the terms liberal and conservative, but still provided responses to the question. One participant did not provide an answer for political ideology. All participants provided a response for political party affiliation (Democrat, Republican, Independent, other). Political ideology and political party are generally highly correlated, and the relationship between political ideology and partisanship has been increasing, such that conservatives more consistently identify as Republican and liberals more consistently as Democrats [7]. In our data, we find there is a significant relationship between political party and political ideology, χ^2 (4, N = 48) = 14.8, $p < 0.01$. Most Republicans in our sample tend to identify as conservative and a majority of Democrats identify as liberal (See SI Text). A majority of those that identify as Independent also identify as moderate and more indicate liberal than conservative. The five individuals who identified as "other" are grouped together with Independents for subsequent analysis. Quantitative and qualitative analyses are presented by political party affiliation. Note that there are only minor differences based on whether the quantitative data is

[1] The U.S. Census Bureau delineates rural and urban based on population density. Urban areas are those with 50,000 or more people and urbanized clusters are those with between 2500 and 50,000 people. Rural is classified as all population not included in an urban area. Note that participants in the study self-reported urban vs rural classification.

analyzed based on political party or political ideology.

2.3.2. Analysis

Interviews were transcribed verbatim, and NVivo 12 was used to code and analyze the qualitative data. Data from the paper survey and responses to closed-ended interview questions were manually entered into a spreadsheet. Responses to closed-ended questions include the responses participants used to indicate what they wanted for each energy resource (more, less, or the same amount), support or opposition to energy policies, and belief in and importance of climate change.

Codes to analyze the qualitative data were developed and refined through an iterative process by a primary and secondary coder. First, the primary coder developed the codebook by reading through interview transcripts and identifying ideas and themes that emerged from the data. The codebook was modified and refined over the course of eight iterations of independent coding between two coders. This method is commonly used in content analysis to ensure validity in the coding process.

For the first two iterations, both the primary and secondary coders independently coded a single interview transcript. Coders then discussed areas of disagreement on coding as well as text that was difficult to code or codes that were difficult to apply. The primary coder used this feedback to further refine the codebook. The same process was used for the remaining six iterations in addition to calculating the Cohen's kappa values to measure intercoder agreement [46]. The codebook was finalized in the eighth iteration when Cohen's kappa indicated substantial intercoder agreement ($\kappa = 0.92$) and discussions indicated the codebook did not need further refinements.

Obtaining a Cohen's kappa value of 0.8 is considered sufficient to justify the use of a single coder for qualitative data analysis [47]. Through three additional rounds of independent coding, both coders coded a randomly selected subset of the interview transcripts which equated to 21% of the interviews. Four transcripts were coded for the first round ($\kappa = 0.89$), three transcripts were coded for the second round ($\kappa = 0.94$) and three for the third and final round ($\kappa = 0.87$). The total kappa value across all 21% of the interviews was 0.89. The criteria for a single coder was met, and the primary coder coded all remaining interviews.

During coding, text was flagged if it contained a unique idea which did not fit under the definitions of previously defined codes. After coding all 48 interviews, this text was categorized together by similar ideas and themes to see if new codes emerged, resulting in seven additional codes being added to the codebook. An eighth additional code was added (perceiving carbon dioxide as a harmful pollutant) based on the primary coder's observations when coding the transcripts. A ninth code (mention of non-energy related topics such as plastic or recycling) was added based on coder observations and themes that emerged in a separate ongoing qualitative study examining how people think about the future. The nine codes were defined in the codebook, and the primary coder applied the new codes to all 48 interview transcripts. In total, there were 60 codes applied to the data for analysis.

3. Results

3.1. Current and future energy mix perceptions

As of 2016, 35.5% of Indiana's energy consumption came from coal, 29.2% for natural gas, and 28.7% for oil[2]. For renewable energy sources, 4.4% of energy consumption was supplied by biomass, 1.7% from wind, 0.2% from geothermal, 0.2% from hydroelectricity, and 0.1% from solar. Nuclear energy was not consumed in the state. When estimating the current energy mix of Indiana, participants underestimated the contribution of oil, coal, and natural gas by a percent error of −55%, −40%, and −7% respectively, while solar, hydroelectricity, geothermal, and wind were largely overestimated (8741%, 3288%, 2457%, and 448% respectively). Biomass was slightly overestimated by 30%. Even though nuclear energy is not consumed in Indiana, participants estimated the contribution of nuclear to be ~6% on average (Fig. S2 in SI Text).

For the future energy mix for Indiana in 2050, participants on average prefer using less fossil fuels, more renewable energy sources, and almost no nuclear energy. Participants report a steep decline (i.e., future preference minus current estimate) in the use of coal (−16%), natural gas (−17%) and oil (−10%). In contrast, there is a steep increase in the use of solar (20%) and wind (15%) and slight increases for hydro (7%), biomass (3%) and geothermal (1%). Participants report a decrease in the use of nuclear (−3%) as they were unaware during the survey that nuclear is not consumed in Indiana. Overall, participants preferred a future which relied primarily on renewable energy sources, particularly wind and solar, and less on fossil fuels. This pattern was observed for Democrats, Republicans, and Independents (Fig. S2 in SI Text). These results replicate work by Miniard et al. [12] at the state-level.

3.2. Energy source direction

After being shown the actual energy mix for Indiana on a sheet of paper, participants were asked if they wanted to use more, less, or the

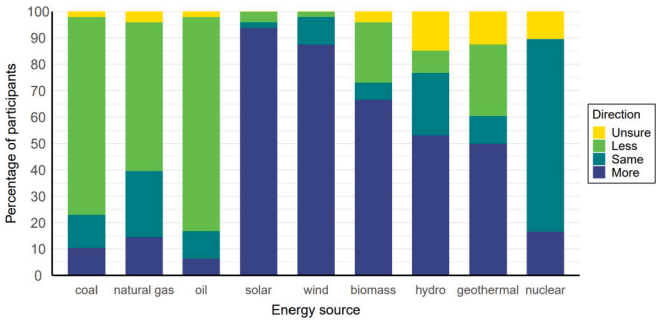

Fig. 1. Percentage of participants who wanted to use less, the same amount, or more of an energy source or were unsure for the state of Indiana. Note that the contribution of nuclear energy was 0% in Indiana as of 2016; therefore, using the 'same amount' of nuclear energy indicates not using any nuclear energy at all in the state.

[2] Percentage estimates for the energy mix of Indiana were obtained using data from the United States Energy Information Administration (EIA) state energy data system [35]. The 2016 energy consumption estimates were the latest available consumption estimates; the 2017 estimates were not available for petroleum or renewable energy sources at the time the study was conducted. The total energy mix of Indiana was calculated based on the 2016 total energy consumption estimates for coal, natural gas, petroleum, biomass, wind, geothermal, hydroelectricity, solar, and nuclear. Additional information can be found in the SI Text.

same amount of each energy resource (see Fig. 1). A majority of participants report wanting a decrease in the use of fossil fuels and an increase in the contribution of renewable resources, particularly solar and wind. A majority of participants also want to see an increase in the use of biomass, geothermal, and hydroelectricity, although these energy sources have more disagreement, with a greater percentage of participants indicating they were unsure or wanted to use less or the same amount. As nuclear energy is not currently used in Indiana, participants were asked if they did or did not want to use nuclear energy in the state, and a majority of participants did not want to use any nuclear in the state. Participants were also asked to explain why they wanted to use more, less, or the same amount of each energy resource, and the desire to decarbonize was not motivated by climate change or participants thinking about a sustainable energy transition. Rather, participants had nuanced motivations that were dependent upon the energy resource. When deciding how much of an energy source to use, participants primarily considered pollution and environmental harm, air quality, jobs and cost, public health, resource availability, familiarity, and risk.

3.2.1. Fossil fuel resources

A majority of participants reported a desire to use less fossil fuel resources, particularly for coal (75%) and oil (81%). Only a slight majority reported a preference for less natural gas (56%). A higher percentage of Democrats report wanting to use less coal, oil, and natural gas than Republicans or Independents, but there is partisan agreement on the use of less fossil fuels (See SI text Fig. S3). The largest partisan divide surrounds natural gas in which 38% of Republicans want to use less compared to 67% of Democrats. As shown in Table 1, the preference for an energy mix with less fossil fuel resources are driven primarily by a concern for pollution and environmental harm, public health, availability of resources, and risk. In contrast, the desire to use the same amount or more fossil fuel resources is economically driven, with a concern for jobs and economic impacts to the community and the state.

When asked to describe the reasons for wanting to use less fossil fuel resources, participants were primarily concerned about pollution, waste, or other hazards that might have negative impacts on the environment. As [P13, I][3] noted, "I think there's better resources out there. Natural gas again comes with issues as far as polluting the planet. The pipelines break. Actually, the oil does too, the oil also breaks - pipelines- and they all sink into the environment." Similarly, in reference to coal, [P22, R] states "Coal is terrible. It's terrible for the water and it's terrible for the air. It's just a heavy pollutant." Coal and oil were identified as particularly bad for air quality, and coal was deemed detrimental to public health. Participants were also concerned with availability and cost, stating fossil fuels were finite resources that would eventually run out, and describing natural gas as an expensive resource. Risk played a role as well, with participants noting a concern about the safety of the extraction and transportation of fuel resources, citing the potential for accidents such as oil spills or worry about processes such as mining or hydraulic fracturing.

Participants who chose to use more fossil fuel resources reported wanting to protect jobs and the economy and achieve energy independence. Using the same amount (13%) or more (10%) coal was motivated by wanting to protect jobs for those who worked in the coal industry. This idea was captured by [P1, R], "Like I said, there's so many people dependent on that, on the coal around this area especially. I hate to see them all lose jobs, and I think the economy would hurt if we lose coal." Participants also described coal as an inexpensive energy source which would bring money to the state of Indiana and would lead to positive economic impacts on communities. The desire to use more oil (6%) was driven by a goal of energy independence, which participants tied to improving the economy by selling oil to other countries instead of buying from them. Participants wanted to increase the use of oil and natural gas as cheaper and cleaner alternatives to coal.

3.2.2. Low-carbon resources

Renewable resources had more favorable views from all participants compared to fossil fuels, with participants showing a strong preference for an increase in the use of solar and wind. While most participants reported wanting to use more biomass, hydroelectricity, and geothermal energy (see Fig. 1), support was not as unanimous as it was for solar and wind. A similar pattern of political ideology is observed in which a higher percentage of Democrats report wanting to use more of these resources than Independents or Republicans, with a consensus to use more low-carbon sources across political party groups (see Fig. S3 in SI text). Nuclear did not have the same level of support, with most participants indicating they did not want to use nuclear within the state. Participants' reasons for how much of these energy sources to use centered around availability, environmental harm, air quality, risk, and familiarity.

3.2.2.1. Solar and wind. Participants who reported wanting to use more solar (94%) and more wind (88%) were driven primarily by the perception of these resources as available, natural, and free (see Table 2). Participants discussed solar and wind as free or low-cost because they are natural resources which are always available for use and do not need to be extracted or pulled from the ground. As [P21, I/O] noted about solar, "It's just like free. The sunshine is free you know. And it's a natural source of energy." This was reiterated by [P10, I/O] about wind, "Well it seems to be available and I think it's sustainable and it's cost-effective." Participants described solar and wind as being natural resources, and perceived natural resources to be those that are clean, better for the environment, and do not result in harmful or polluting substances being released, as described by [P40, R], "I would say something that the environment is already putting out towards us and us using it toward our advantage. Wind it just happens naturally. We have the flow of water from rivers. the sun shining using that solar energy to power things as opposed to us digging more for coal or digging for oil."

Only two participants wanted to use less solar energy, citing that the use of solar energy would damage the ozone layer and doubting whether solar could provide enough energy to power homes. One participant wanted to use less wind due to a concern for birds. Five participants sought to keep wind the same, describing being unfamiliar with wind energy and concerns as to whether there is enough space to build turbines or enough wind energy to reliably power people's homes, a theme summarized by [P2, R], "I'm not big on solar… That's just like the wind. Wind isn't blowing you're not gonna get any energy. And you can't watch tv."

3.2.2.2. Biomass, hydroelectricity, and geothermal. For biomass, 67% of participants indicated a desire to increase its use, primarily to avoid wasting resources that are readily available such as landfill gas, wood, and waste materials (See Table 3). As [P5, I] notes regarding using more biomass, "Well because they're renewable. … I believe in utilizing resources where you can find them. I don't believe letting things go to waste." Fourteen participants (29%) wanted to use the same or less biomass, primarily due to a concern about environmental harm and air pollution, described by [P29, R], "Well you know, you're still burning a source you know. Air pollution, that's what I look at."

The discussion of hydroelectricity was primarily focused on whether enough resources were available or whether the water resources in the state could be used for electricity. Twenty-five participants (52%) wanted to see an increase in the use of hydroelectricity, and the availability of water resources in the state was the reason described by the most participants and summarized by [P16, R]: "Well, we have it. There's an abundance of bodies of water here and another natural

[3] Brackets indicate the participant number followed by the letter of the party they identify with: R for Republican, D for Democrat, I/O for Independent/Other.

Table 1
Top five codes for fossil fuels by energy source and direction across all participants. More than five codes are presented in the case of a tie. An asterisk indicates more than five codes were tied and are not listed here. The code for anecdote or example indicates participants drew on personal experience of themselves or others to influence their response.

Energy Source	More		Same		Less	
Coal	*N = 5*		*N = 6*		*N = 36*	
	coal jobs, coal workers	40%	coal jobs, coal workers	33%	environmental harm, pollution	47%
	low-cost or free resource	40%	positive economic impacts	17%	air quality harm	42%
	provide anecdote or example	20%	status quo, no system change	17%	detrimental to public health, quality of life	28%
			renewable resource	17%	provide anecdote or example	17%
					coal jobs, coal workers	14%
					climate change, global warming	14%
					comparison of resources	14%
Natural gas	**N = 7*		**N = 12*		*N = 27*	
	clean or less dirty resource	43%	status quo, no system change	17%	environmental harm, pollution	41%
	low-cost or free resource	29%			expensive, high-cost	22%
					fear, risk, danger, accident	22%
					comparison of resources	19%
					finite resource, nonrenewable	11%
Oil	*N = 3*		*N = 5*		*N = 39*	
	positive economic impacts	33%	low-cost or free resource	25%	environmental harm, pollution	59%
	energy independence	33%	clean or less dirty resource	25%	foreign, international relations	18%
	foreign, international relations	33%	status quo, no system change	25%	finite resource, nonrenewable	15%
	status quo, no system change	33%	comparison of resources	25%	comparison of resources	15%
	finite resource, nonrenewable	33%			air quality harm	13%
					fear, risk, danger, accident	13%

Table 2
Top five codes for solar and wind energy sources and direction across all participants. More than five codes are presented in the case of a tie. An asterisk indicates more than five codes were tied and are not listed here.

Energy Source	More		Same		Less	
Solar	*N = 45*		*N = 1*		*N = 2*	
	available	44%			ozone	50%
	low-cost or free resource	31%			doubt efficiency, reliability, feasibility	50%
	protection of the environment	24%			comparison of resources	50%
	comparison of resources	22%			misconception	50%
	clean or less dirty resource	16%				
	natural resource	16%				
Wind	*N = 42*		*N = 5*		*N = 1*	
	low-cost or free resource	29%	unfamiliar, unknown	40%	wildlife, species protection	100%
	available	26%	aesthetics, space	20%		
	provide anecdote, example	26%	doubt efficiency, reliability, feasibility	20%		
	protection of the environment	19%	efficient, reliable, feasible	20%		
	natural resource	17%	provide anecdote, example	20%		
			misconception	20%		

resource we can use." Availability was contested however, as 20% of participants who wanted more hydroelectricity expressed doubt that the water resources in Indiana would be enough to provide electricity. Participants who wanted to use more hydroelectricity also described it as a low-cost resource because water was natural and freely available (note: similar themes emerged around solar and wind). Participants who wanted to use the same amount or less hydroelectricity expressed a concern that it was not feasible due to a lack of water resources. Participants were also concerned that hydroelectricity would cause environmental harm due to dam construction.

Half of participants (50%) indicated wanting to use more geothermal energy, although a third of these participants indicated this resource was unfamiliar to them. Of those that wanted to see more geothermal, 33% had personal experience, either by knowing someone who used it or using it themselves. Geothermal was also perceived to be a low-cost and natural resource which would be good for the environment. Five participants wanted to use the same amount (10%) and 13 participants wanted to use less (27%) geothermal. Those who wanted to use less were driven by a fear of using heat from within the Earth, as noted by [P16, R], "Well, because this coming from the Earth, makes me a little nervous tapping into our Earth." Participants also noted a concern for environmental harm, expressed by [P43, I/O]: "I think it's just something that we wouldn't want to keep using because it would be dangerous to the environment."

Two participants indicated they were not sure or undecided on whether to use more, less, or the same amount of biomass. This number went up to six for geothermal and seven for hydroelectricity. Yet, no participants were unsure of whether they wanted to use more, less, or the same amount of wind and solar. A theme of unfamiliarity emerged during interviews for biomass, hydroelectricity, and geothermal energy even for participants who indicated whether they wanted to use more or less. Participants expressed that these energy sources were unfamiliar or new to them. This is captured in responses such as those by [P6, R], "I don't know what that is. Biomass." and [P10, I/O] in response to hydroelectricity, "I don't know much about hydroelectricity, and I don't know where in Indiana we actually even use it." Similarly, as [P11, D] expressed, "I don't think I know enough about geothermal energy to really be able to make a determination." Individuals who were unsure were motivated primarily by lack of experience or familiarity with the energy resource and concerns about environmental harm, public health impacts, risk or possibility of accidents, and whether these resources could provide reliable electricity.

3.2.2.3. Nuclear. Thirty-five participants (73%) stated they did not

Table 3
Top five codes for low-carbon energy sources by energy source and direction across all participants. More than five codes are presented in the case of a tie. An asterisk indicates more than five codes were tied and are not listed here.

Energy Source	More		Same		Less	
Biomass	*N = 32*		*N = 3*		*N = 11*	
	avoid being wasteful	31%	air quality harm	33%	environmental harm, pollution	45%
	unfamiliar, unknown	22%	safety, safe resource	33%	air quality harm	36%
	available	16%	renewable resource	33%	avoid being wasteful	19%
	provide anecdote or example	13%			unfamiliar, unknown	19%
	comparison of resources	13%			comparison of resources	19%
Hydro	*N = 25*		**N = 11*		N = 4	
	available	40%	doubt efficiency, reliability, feasibility	55%	doubt efficiency, reliability, feasibility	75%
	provide anecdote or example	28%	environmental harm, pollution	18%	environmental harm, pollution	25%
	natural resource	24%	protection of the environment	18%	finite resource, nonrenewable	25%
	low-cost or free resource	20%	finite resource, nonrenewable	18%	comparison of resources	25%
	doubt efficiency, reliability, feasibility	20%				
	unfamiliar, unknown	20%				
Geothermal	*N = 24*		*N = 5*		**N = 13*	
	unfamiliar, unknown	33%	expensive, high-cost	20%	fear, risk, danger, accident	54%
	provide anecdote or example	33%	low-cost or free resource	20%	misconception	23%
	low-cost or free resource	13%	fear, risk, danger, accident	20%	environmental harm, pollution	15%
	protection of the environment	13%	unfamiliar, unknown	20%	provide anecdote or example	15%
	natural resource	13%	provide anecdote or example	20%		
	comparison of resources	13%	comparison of resources	20%		

Table 4
Top five codes nuclear energy direction across all participants. More than five codes are presented in the case of a tie. An asterisk indicates more than five codes were tied and are not listed here.

Energy Source	Use		Do Not Use	
Nuclear	**N = 8*		*N = 35*	
	clean or less dirty resource	38%	fear, risk, danger, accident	89%
	low-cost or free resource	25%	provide anecdote or example	31%
	efficient, reliable, feasible	25%	detrimental to public health, quality of life	20%
			comparison of resources	11%
			wildlife, species protection	9%

want to consume nuclear energy in Indiana. A fear of accidents or radiation was the top concern, mentioned by 89% of those participants (See Table 4). Examples of past incidents, particularly Chernobyl and Three Mile Island, were referenced, and nuclear was considered an unnecessary danger which could have negative impacts on public health and wildlife. These ideas were captured in this response by [P11, D], "Well I just watched Chernobyl. There's much more of a chance of catastrophic mistakes being made with nuclear energy and if that happens, it's very damaging. And so, I guess safety would be part of it. Radioactivity, I know that that can provide - that can cause illness. And so, I guess I'd rather stay away from something that's illness causing." Eight participants (17%) were in favor of using nuclear energy, describing it as a cleaner, cheaper, and more efficient alternative to fossil fuel resources. Motivations both in favor and against nuclear were captured by [P20, R], "I think it produces a lot of electricity and the cost is reasonable. There's that. I think it's clean, except for the nasty waste that we don't have a great way to deal with."

3.2.3. Anecdotes and comparing resources

Participants regularly relied on anecdotes and personal experience when making decisions about whether they wanted to use more, less, or the same amount of an energy resource. When discussing fossil fuels, participants would note their own personal experience or that of friends and family with coal mining, pollution, or health concerns. In reference to using less fossil fuels, participants described personal health concerns of themselves and family members, noting the dangers associated with

Table 5
Top five codes for support or opposition to pro-fossil fuel energy policies by percentage of participants who provided a response in that code category. More than five codes are presented in the case of a tie. An asterisk indicates more than five codes were tied and are not listed here.

Support		Oppose	
Building coal-fired power: support or oppose building new coal-fired power plants to use coal that can be mined in Indiana.			
**N = 14*		*N = 31*	
coal jobs, coal workers	57%	environmental harm, pollution	35%
low-cost or free resource	21%	detrimental to public health, quality of life	32%
positive economic impacts	21%	air quality harm	19%
comparison of resources	14%	increase renewable use	16%
		coal jobs, coal workers	13%
		fear, risk, danger, accident	13%
		finite resource, nonrenewable	13%
Relaxing Regulations on oil and gas: Support or oppose relaxing environmental regulations on oil and natural gas drilling in the United States.			
**N = 11*		*N = 33*	
positive economic impacts	18%	environmental harm, pollution	55%
status quo, no system change	18%	fear, risk, danger, accident	24%
		provide anecdote or example	18%
		protection of the environment	15%
		business, vested interest, profits	12%
		corruption of government or business	12%
		regulatory control	12%

polluting the air, captured by [P17, R], "Well I grew up near a coal mine and we had a significant amount of air pollution even though you probably wouldn't perceive that you would. In the wintertime you went past the coal mine, and you could see all these little fires that had ignited, smoking, and you knew you were breathing that." Participants also referred to historical accidents that have occurred both regarding big oil spills and nuclear energy. For low-carbon energy resources, participants noted whether they have seen or lived near solar panels, windmills, or dams. Participants who were familiar with geothermal also cited either using it themselves or knowing someone else who used it such as [P1, R], "I'm gonna say less, because I know people who have geothermal, and they don't like it and it's not always there for them to

use. It goes in and out."

Participants often compared and contrasted energy sources to make decisions. Coal, oil, and natural gas were grouped together as fossil fuels and referenced together when discussing negative impacts, although participants did distinguish a hierarchy in which natural gas and oil were cleaner than coal. Solar and wind also developed a natural grouping in which participants would reference them together, captured by [P11, D], "Solar is just like wind in that it's a renewable resource. It doesn't take anything." Biomass, hydroelectricity, and geothermal were tied together by being lesser known energy resources, in which participants would reference being unfamiliar or not knowing as much about them. Finally, nuclear was a source too risky to use in the state, and not comparable to its other low-carbon counterparts.

3.2.4. Political differences

No Democrats in our sample supported the use of more fossil fuels, and Republicans showed the most support for fossil fuel resources, largely driven by concerns for coal workers and the economy, and the perception that fossil fuel resources were availability and should be used. The perception of solar and wind as available, free, and environmentally friendly was pervasive across political party, though Republicans showed slightly less support than Democrats (see Fig. S3 in SI text). For those that support biomass, geothermal, and hydroelectricity, personal experience and familiarity were important regardless of political party, and there was a bipartisan view of these sources as low-cost, available, and environmentally friendly. More Republicans than Independents or Democrats wanted to use nuclear energy, and there was bi-partisan agreement for those who opposed nuclear, motivated by concern about risk and public health. Concerns about the environment and pollution, air quality, and public health were themes that emerged across all three political party groups. Climate change was only mentioned by Democrats and Independents in our sample, and a greater proportion of Republicans mentioned economic concerns, primarily in the context of support for fossil fuels. A more in-depth discussion of political differences can be found in the SI text.

3.3. Energy policy support

Overall, most participants supported policies that were beneficial toward low-carbon energy sources and opposed policies that would help fossil fuels (see Figs. 2 and 3). More Democrats supported decarbonization policies (i.e., supporting policies that helped decarbonization and opposing policies that helped fossil fuel development) than Republicans or Independents. Policy support for decarbonization was motivated by a desire to protect the environment and public health, lower energy costs and assist low-income individuals, and a need to regulate business and industry actors for outcomes that are better for the environment. Opposition to decarbonization was driven by a concern about negative economic impacts on individuals, questioning the feasibility of the policy, or a distrust of industry or government. The theme of fairness and accountability emerged in which policy support was motivated by how fair it was perceived to be for individuals and industry. Participants thought that those who pollute should pay, those struggling should be helped, and people or businesses that do their part to protect the environment should see benefits from their behavior.

3.3.1. Pro-fossil fuel policy

Most participants opposed building more coal-fired power plants in Indiana (65%) and opposed relaxing regulations on oil and natural gas (70%). Table 5 presents themes that emerged when participants were asked to describe the reasons why they supported or opposed each policy. Of 14 participants who supported coal, 57% list a concern for coal workers and the belief that coal provided jobs to Indiana residents, captured in this quote by [P7, I/O]: "The economy boosts. Brings more jobs. Definitely brings more income to certain towns that have it per say… Take your family out. I don't know. Jobs is everything. You got to have jobs." Economic reasons were largely driving this support for coal plants, with participants indicating that coal would be a cheap resource and would lead to positive economic impacts such as more income for the state. Opposition to building new coal-fired power plants was based on environmental concerns, with participants describing coal as a resource that pollutes the air and harms the environment, both through the burning of coal and the process of mining it. Public health concerns were also mentioned by nearly a third of participants, describing coal as harmful to those who work in the industry and the broader community who suffer because of pollution. Participants who oppose building more coal also cite reasons such as wanting to increase renewable energy use, concern that burning coal is unsafe, and noting that coal is not a renewable source and will eventually run out. [P10, I/O] captures these ideas in their response to why they oppose, "Because I don't believe coal is particularly safe. I don't think it's environmentally friendly. I don't think it's a sustainable resource, and I think the conditions for miners are not good."

Support for relaxing regulations on oil and natural gas was less clear than support for coal, with no more than two participants being describing reasons that fit into the same category. Overall, support was primarily driven by economic concerns, with participants describing reasons such as positive economic impacts, increasing jobs, and noting it might reduce energy prices. Like coal, opposition to relaxing regulations was based on a worry about environmental harm. In addition, 24% of participants noted the risk of accidents in the extraction and transportation process. Participants also cited anecdotes or examples of their

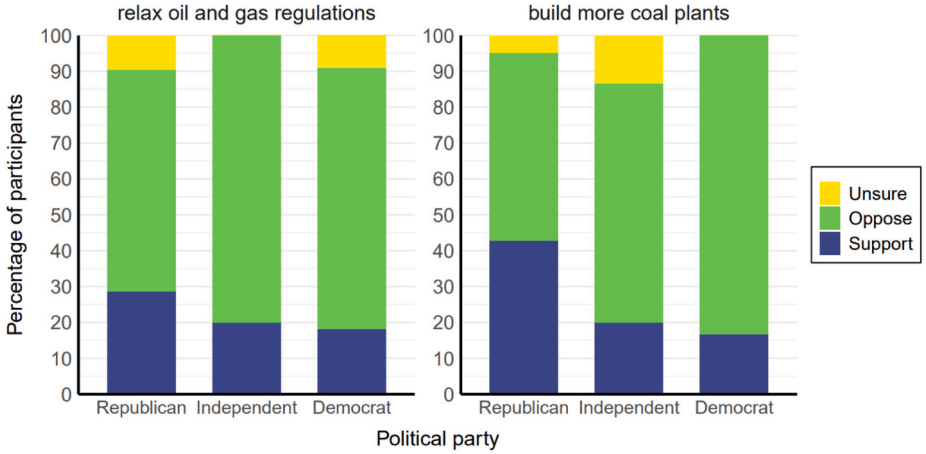

Fig. 2. Percentage of participants who supported, opposed, or were unsure about pro-fossil fuel policies separated by political party affiliation.

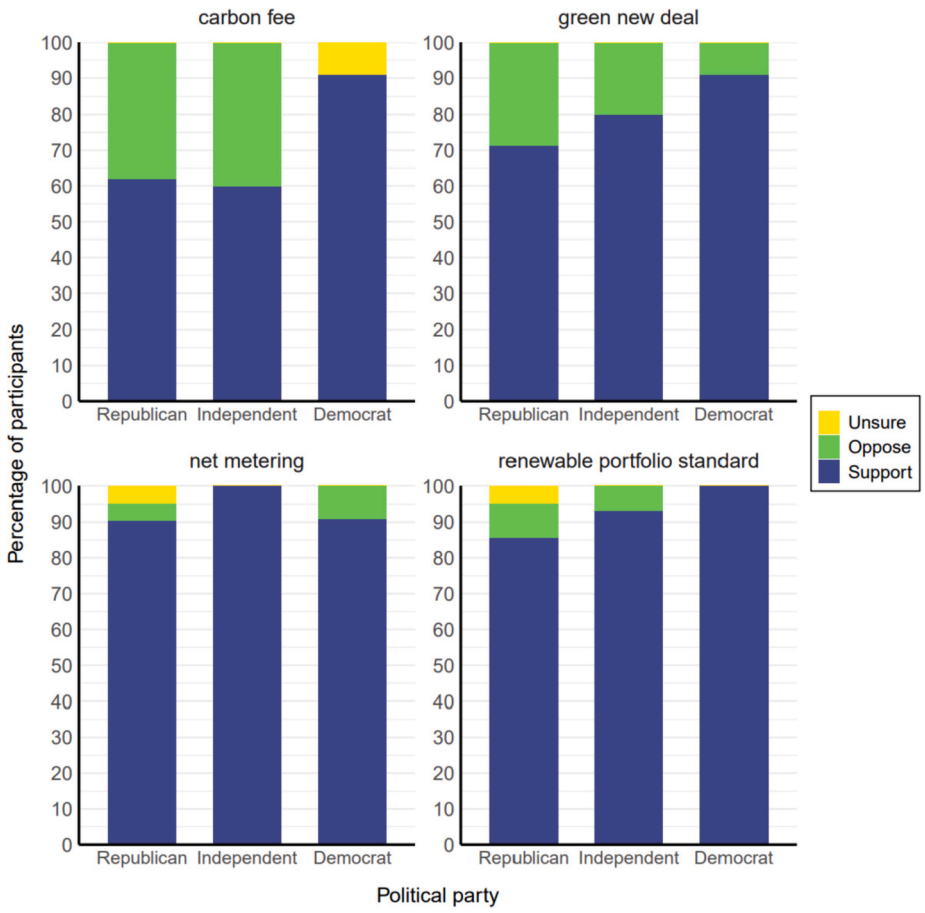

Fig. 3. Percentage of participants who supported, opposed, or were unsure about pro-decarbonization policies, separated by political party affiliation.

experience with oil and natural gas such as examples of accidents or experience with pollution related to oil and gas. The perception that businesses were primarily concerned with profit and not being held accountable also drove some of the opposition toward relaxing regulations, and participants indicated that regulatory control was necessary to keep businesses in check and prevent corrupt behaviors. [P34, I/O]'s response encapsulates these ideas, "Because the only ones that profit from that are the owners okay. Not just that. This oil has been the start of so many wars and disputes, it's unbelievable. So, I think they, and again it's very dirty, the energy supply. So, I think they should totally ban it."

3.3.2. *Pro low-carbon resource*

Participants were asked about four policies which would promote the use of low-carbon energy resources: A renewable portfolio standard (RPS), net metering, a carbon fee, and the Green New Deal (GND) (see Table 6 for a description of each policy). Most participants were in support of these policies, with the RPS and net metering garnering more support (92% and 94%, respectively) than that of a carbon fee (68%) or the GND (79%) (Fig. 3). A greater proportion of Democrats supported these policies than Independents or Republicans (Fig. 3) with the biggest political differences present for a carbon fee and the GND.

Participants supported an RPS as a policy to protect the environment and improve air quality. Participants also indicated an RPS would promote the use of cleaner and cheaper energy sources and would increase the contribution of renewable energy and move away from fossil fuels, as expressed by [P6, R], "I wish we could just [stop using coal completely]. We could just go to something else. Run air, you know, the solar." The three participants who opposed an RPS did so for economic reasons, citing concerns of negative impacts to the state economy through increased energy prices or job loss in the fossil fuel industry, which is encompassed in [P17, I]'s response: "The reasons, I think that would be very hard to monitor that and that it would hurt the state economically and might even end up with some companies going out of business and people losing their jobs." One participant cited a concern that an RPS was not feasible.

Support for net metering was influenced largely by economic reasons and fairness. Participants indicated that net metering would incentivize the use of solar energy by paying back those who took the initiative to install solar panels. Net metering was also expected to have positive economic impacts by helping people pay for their electricity through a means of "free energy" which ties back to the perception of solar as a "free and available" energy resource. Participants also supported this policy because they thought it would avoid waste, noting that people should be able to sell their excess electricity to the utility company to avoid wasting energy that someone else could use. Participants also believed this policy was more fair, allowing people to make money off the extra electricity they might produce by installing solar panels, and noted that if utility companies were making a profit, people should as well. Only two people opposed this policy, interestingly because they perceived this policy to be unfair. These participants described net metering as unfair because the utility companies were still making a profit from the energy that someone else produced.

Support for a carbon fee was driven primarily by polluter accountability. Forty-four percent of participants who supported this policy expressed a belief that those who pollute should pay for it, viewing carbon dioxide emissions as a harmful pollutant. Participants also indicated that this would help the environment by incentivizing a move away from fossil fuel resources towards renewable energy resources, with these themes being expressed by [P39,D]: "I know many companies and people are trying to move towards renewable resources. And that's

Table 6
Top five codes for support or opposition to pro-renewable energy policies by percentage of participants who provided a response in that code category. More than five codes are presented in the case of a tie. An asterisk indicates more than five codes were tied and are not listed here.

Support		Oppose	
Renewable portfolio standard: support or oppose requiring that a specified percentage of electricity comes from renewable energy resources.			
N = 44		*N = 3*	
protection of the environment	36%	job impacts	33%
low-cost or free resource	23%	negative economic impacts	33%
clean or less dirty resource	23%	natural resource	33%
increase renewable use	20%	business, vested interest, profits	33%
air quality protection	18%	energy independence	33%
		doubt efficiency, reliability, feasibility	33%
		increase renewable use	33%
Net metering: support or oppose allowing people who generate their own electricity to sell the extra electricity to their utility company.			
N = 44		*N = 2*	
incentive, market control	34%	perceived fairness	100%
positive economic impacts	27%	business, vested interests, profits	100%
avoid being wasteful	23%	corruption of government or business	50%
perceived fairness	18%	concern for those with low socioeconomic status	50%
business, vested interests, profits	18%		
regulatory control	18%		
Carbon fee: support or oppose a national carbon fee for the United States.			
N = 32		*N = 14*	
polluter accountability	44%	expensive, high-cost	29%
protection of the environment	22%	corruption of government or business	29%
incentive, market control	22%	concern for those with low socioeconomic status	29%
CO2 as a pollutant	16%	perceived fairness	21%
perceived fairness	13%	politics, political system	21%
increase renewable use	13%		
reduce fossil fuel use	13%		
Green New Deal: support or oppose the transition of the United States to energy sources that do not emit carbon dioxide, by the year of 2050.			
N = 37		*N = 10*	
protection of environment	30%	extremity or extreme action or outcome	40%
climate change, global warming	22%	politics, political system	30%
improve public health, quality of life	22%	coal jobs, coal workers	20%
environmental harm, pollution	19%	expensive, high-cost	20%
CO2 as a pollutant	16%	negative economic impacts	20%
		status quo, no system change	20%

expensive and so a carbon fee holds companies that don't want to do that accountable." In contrast, those who opposed did so for economic reasons, noting that a carbon fee would be expensive, particularly for lower income individuals, and would lead to unfair or burdensome taxes as suggested by [P16, R], "Because we are getting taxed for so many different things, this is just another tax that's added on us that's a burden." Participants also expressed concern about who would be implementing or benefiting from the fee, noting a concern for business and a distrust for government [P36, R], "I think there's a better solution than what they're creating. I think it's some representative's way of increasing funds to the US Government. That's what I see."

Support for the Green New Deal (GND) stemmed primarily from a desire to protect the environment and public health. Nearly half of the individuals in support noted a desire to protect the environment and indicated that the GND would decrease pollution and environmental harm caused by fossil fuel resources. Nearly a quarter of participants also indicated a concern for climate change as a driver of their support, although it is worth noting that climate change was referenced in the interview question for the GND which may have primed participants to list it as a motivation. The importance of policies addressing climate change was summarized by [P39, D], "The climate crisis. If we want the human species to continue living and be healthy, that's something that we need to do. It's not a question of wanting to do anymore." Participants also indicated a desire to protect public health, and perceived carbon dioxide to be a pollutant that was harmful to the environment and public health. In contrast, 21% of participants opposed the GND, describing it as too extreme or too ambitious. Participants also indicated it was too costly and would have negative impacts on the economy and coal workers. Three of the participants opposed described this policy as liberal, socialist, or an empty promise.

3.3.3. Political differences

More Republicans than Democrats or Independents supported policies that benefit fossil fuels, and support was generally driven by the desire to reduce energy costs, improve the economy, and create jobs, with one participant stating their reason for support as [P2, R], "Jobs. And cheap energy." For those in support of pro-fossil fuel policy, a concern for coal jobs was shared across political groups. Those that opposed were driven by concern about the environment, pollution, public health, and risk which spanned across political party. Support for low-carbon sources also saw bipartisan agreement on themes of environmental protection, pollution reduction, and protection of air quality. The partisan difference was in the proportion of participants for whom these concerns were prominent. More Democrats in our sample were concerned about increasing renewables and climate change, while more Republicans were concerned about economic impacts, fairness, and avoiding wasting resources.

3.4. Conclusion of findings

Most participants wanted to use more low-carbon energy resources and supported policy pathways of getting there. However, climate change is not the motivating factor behind this shared decarbonized vision. Rather, participants are motivated by a variety of factors that differ by energy source and energy policy, as shown in the summary Fig. 4. Those hoping to see an increase in fossil fuel use are motivated by jobs and energy costs, whereas opposition is driven by a concern for the environment and pollution, resource availability, and public health. Solar and wind see nearly unanimous support, driven by the perception of these resources as available, natural, and free. Participants also want to see an increase in biomass, geothermal, and hydroelectricity but these energy sources are less familiar to participants than other sources. Participants are still risk averse to nuclear energy, with more support from Republicans than Democrats.

Support for decarbonization policy was similarly driven by a desire to protect the environment and public health, lower energy costs and help low-income individuals, and a recognized need to regulate businesses and industry actors to protect the environment. Opposition to decarbonization policy was driven by fear of negative economic impacts, questioning the feasibility of the policy, and distrust of industry and government. Participants were also concerned about fairness, noting that those who pollute should pay, individuals struggling with energy costs should be helped, and people and businesses that take actions to protect the environment should be rewarded.

Our results show that a greater proportion of Democrats support decarbonization than Republicans and Independents. There were also surprisingly little differences in participants' reasons for supporting or opposing decarbonization. Participants generally agreed, regardless of political party, on themes of protecting the environment and air quality,

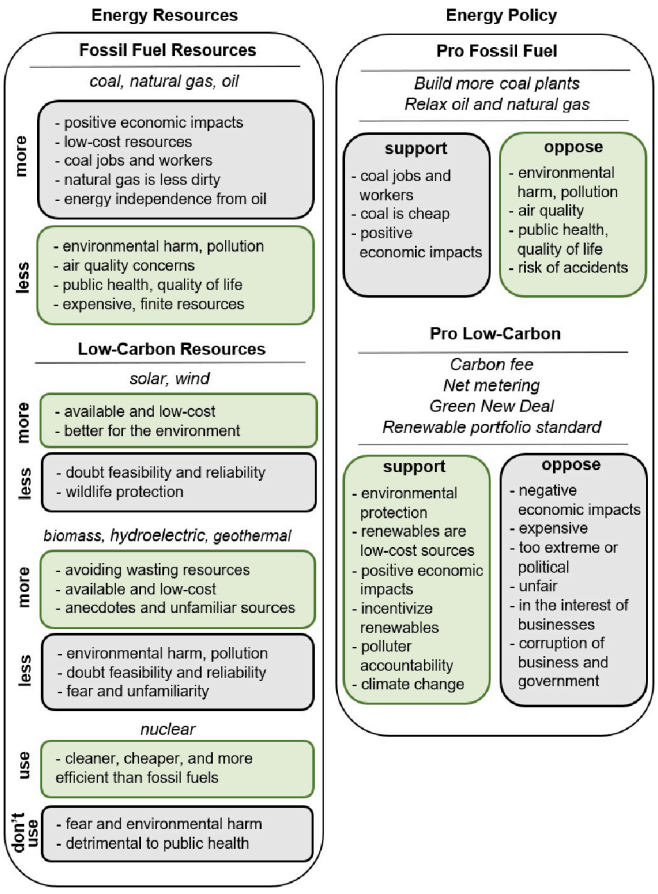

Fig. 4. A summary of our findings broken down by energy resource and energy policy showing motivations for support and opposition to decarbonization. Green boxes indicate themes associated with actions that promote decarbonization, and grey boxes indicate themes for actions that hinder decarbonization. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

reducing pollution, protecting public health, and using resources that are available. The primary observable partisan difference was that of Republicans focusing more on economic impacts, and Democrats focusing more on environmental impacts. These factors were described by both groups, but in different proportions. Moreover, climate change was not a strong motivating factor, and it was primarily discussed by only Democrats and Independents (one Republican mentioned climate change in reference to an RPS and the GND). Thus, our participants have nuanced reasons for wanting to decarbonize, dependent upon energy source and policy, which are not necessarily tied to climate change or reaching a sustainable energy future.

4. Discussion

Our research method used both a paper survey and an interview designed to clearly understand the support for energy decarbonization in Indiana. We found that a majority of participants support using low-carbon energy sources, both through the paper survey and interview questions. We also find that participants underestimate the amount of fossil fuel resources and overestimate the amount of renewable resources that are used within the state of Indiana, a similar pattern observed for the national energy mix [12] and found in energy perceptions more generally [48].

Identifying open-ended reasons for support or opposition in real-world problems can vary by context [49]. Gustafson et al. [39] examined 16 potential reasons people support transition to renewable energy (e.g. air pollution, reducing energy costs, reducing global warming). They found reducing climate change was the most important reason for Democrats and the least important to Republicans. We partially observe this pattern in the present study where more Democrats than Independents and Republicans mention climate change. However, climate change was not mentioned often, and rarely made it into the top five codes for each energy source or energy policy (see Fig. 4), suggesting that while climate change may be an important factor when listed on a survey (as found by Gustafson et al. [39]), in a face-to-face interview climate change is not a salient concern. Similarly, Hazboun et al. [50] found stronger support for renewable policy when it is framed to promote energy security, energy portfolio diversification, and reduced pollution than when framing promotes climate change mitigation which suggests climate change may play a smaller role for energy choices. While Indiana will experience warming temperatures, heavy precipitation, and flooding due to climate change [51], other states are and will continue to experience more severe effects such as extreme weather events, increased wildfires, or sea-level rise. Thus, climate change may not be as salient to Indiana residents, and future work should examine whether climate change is a more prominent factor in locations where climate change effects are presently experienced (like Texas, Florida, and California). Future work could investigate how exposure to extreme climate impacts affects motivations for decarbonization, and how Republican and Democrat majority states with fossil fuel strongholds decarbonize over time.

Environmental and economic concerns were prominent themes that emerged throughout the interviews. A decrease in fossil fuel resources and an increase in the use of solar and wind were driven by a desire for low-cost, clean energy sources that do not pollute the environment or negatively affect public health. This fits with previous work that finds public opinion on energy is driven by a desire for cheap energy sources that do not cause environmental harm [20]. In the present work, economic concerns were discussed more by Republicans than Democrats, and largely drive Republican support for fossil fuel resources and pro-fossil fuel policies.

In both Miniard et al. [12] and the present study, solar and wind have greater support than other low-carbon energy sources such as hydroelectricity, biomass, and geothermal energy. Participants expressed concern about the environmental impacts of these sources, as well as describing them as less familiar, relying heavily on anecdotal experience to determine support or opposition. One possible explanation for less support of these low-carbon sources is that participants simply are not as familiar with them, which has important implications as more unfamiliar and new low-carbon technologies are integrated into our energy system. Future work can investigate how motivation for less familiar or new low-carbon energy sources (such as hydrogen or carbon capture and storage) changes as people become more familiar with the technology over time.

Availability of resources was an important factor driving the energy sources individuals wanted to use. Risk perceptions also played a role, particularly in reference to nuclear energy and the potential for oil spills. Feasibility also emerged in the present study, particularly for renewable energy resources and policies like the Green New Deal which were considered too extreme. Feasibility may be important for addressing partisan differences as perceived feasibility is associated with stronger policy support [39]. Participants, especially Republicans, expressed a concern about coal workers and coal jobs which may be attributed to being a state that relies on coal as geographical and historical ties to an energy source can increase support [28,29]. While energy independence, religious reasons, and a concern for future generations has emerged as important motivations in previous work [15,31,39], those themes were not as prominent in our data.

Regarding policy, participants were particularly concerned about fairness, and expressed distrust of government and business. Utility companies were not viewed favorably, and businesses were thought to prioritize profit. Moreover, participants thought those who pollute

should pay. Thus, the policies that participants support may be influenced by the group they believe will benefit from those policies, and whether they fairly admonish those who do the polluting. Future work should include these themes in quantitative studies that try to predict or explain support for energy sources and energy policies. Throughout data analysis, over 50 codes emerged explaining participants' positions on energy resources and energy policy. Subsequent studies should seek to identify a more nuanced picture of how participants are making decisions and trade-offs on the energy resources and policies they support or oppose, to more effectively build widespread public support for rapid decarbonization. This is important particularly in light of a recent study which found that attitudes towards unconventional gas development in Colorado were explained not only by partisan identification, but also by the perceived risks and benefits (e.g. causes pollution vs creates jobs) [52].

Fig. 4 provides a roadmap for understanding the themes that motivate people's energy resource and policy preferences, which emerged organically through conversations about what the energy mix should look like in the future. Our work identifies themes related to support and opposition to decarbonization. Themes related to support can be used in communication strategies to the public and incorporated into policy design to increase acceptance across partisan lines, as the themes presented here were prominent for both Republican and Democrat participants. The themes driving opposition identify beliefs that will need to be overcome to garner support for a low-carbon transition.

Our present study has many limitations. First, our findings are based on a convenience sample in which participants opted into the survey and interview. Second, participants were surveyed with a researcher present and the interview was recorded, therefore responses may be subject to social desirability and interviewer effects. Third, participants were not completely matched with the Indiana population and were older with lower income than the state average. This is important to note as demographic factors including gender, education, and socio economic status influence opinions towards the energy system [13,29], and younger Republicans show greater support than older Republicans for development of renewable resources [17]. Finally, we cannot generalize our results about motivations to the national level or to other states. Future work will need to probe these motivations for a shared decarbonized future in more representative samples and in different states, regions, and countries.

Qualitative work can be used to supplement and shape quantitative studies with more diverse participant samples. The present study offers considerations for future quantitative studies. First, climate change often appears as an important concern for participants in quantitative closed-ended studies, but future work could expand on why this is the case and why there is a mismatch between qualitative and quantitative results on this issue. Next, many studies group renewable energy sources together, but we find some distinct patterns in the data where solar and wind have broad support but geothermal, hydroelectricity, and biomass are viewed with apprehension or unfamiliarity. As new low-carbon technology becomes integrated into the system, it will be important to investigate how attitudes and acceptance of these energy resources evolve over time separately. Finally, our work identifies motivations that vary by energy source, energy policy, and partisan identity (see Fig. 4) which can be used to build support for action on climate change.

Our study finds bipartisan support for a decarbonized state energy mix for Indiana in 2050, in a state which is primarily reliant on fossil fuel resources for energy. Participants across all political groups hoped for a future energy mix which relied primarily on wind and solar and far less on fossil fuel resources. Most participants also supported policies that promote decarbonization and opposed those that help fossil fuel resources, although partisan differences were present. Addressing climate change will require a rapid energy transition and large-scale societal changes such as changing energy consumption patterns or adopting new technologies. Understanding why people want a decarbonized future, and where there is partisan agreement, is a necessary step to continue to build public support for a decarbonized energy future. Here we find that climate change is not the most important factor to participants, yet there remain many other motivations for decarbonization on which major bipartisan support exists.

We need rapid decarbonization of the energy system to address climate change, which will require public support. Our work is a case study of a fossil fuel dependent state with a history of conservative and Republican leadership. Yet we see the desire to have a decarbonized energy future, though not necessarily motivated by climate change impacts. We find that not all energy sources are equal, and participants articulate their own hierarchies and groupings, and have nuanced reasons that vary by energy resource and policy. For example, natural gas is perceived to be a preferred energy resource compared to coal and oil, and solar and wind are grouped together and viewed more positively compared to other low-carbon energy resources. Identifying themes that lead to support or opposition for decarbonization will allow us to understand the narratives people formulate for themselves around decarbonization. These themes can also help us better communicate with people about the energy transition, formulate policy in a way that it aligns with people's values and concerns, and bring the public together to achieve bipartisan action on climate change.

Author contribution

D.M. and S.Z.A. designed research; D.M. performed research; D.M. analyzed data; D.M. and S.Z.A. wrote the paper.

Data deposition

The data collected and analyzed for this study are available in the openICPSR repository, https://www.openicpsr.org/openicpsr/project/122561/version/V1/view.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

This work is supported by NSF grant SES-1658804 from Decision, Risk and Management Sciences. Additional support comes from Indiana University's Graduate and Professional Student Government, the Integrated Program in the Environment and Office of Sustainability, and by the Environmental Resilience Institute. We thank all our survey participants for their valuable time and data, and Anagha Gore and Joseph Kantenbacher for research assistance.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.erss.2021.102292.

References

[1] IPCC Global Warming of 1.5 °C: An IPCC Special Report on the Impacts of Global Warming of 1.5 °C Above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change Sustainable Development, and Efforts to Eradicate Poverty. 2018 https://www.ipcc.ch/sr15/.

[2] R. Fouquet, P.J.G. Pearson, Past and prospective energy transitions: Insights from history, Energy Policy 50 (2012) 1–7, https://doi.org/10.1016/j.enpol.2012.08.014.

[3] F.W. Geels, F. Berkhout, D.P. van Vuuren, Bridging analytical approaches for low-carbon transitions, Nat. Clim. Change 6 (2016) 576–583, https://doi.org/10.1038/nclimate2980.

[4] F.W. Geels, B.K. Sovacool, T. Schwanen, S. Sorrell, Sociotechnical transitions for deep decarbonization, Science 357 (2017) 1242–1244, https://doi.org/10.1126/science:aao3760.

[5] C.A. Miller, A. Iles, C.F. Jones, The social dimensions of energy transitions, Sci. Cult. 22 (2013) 135–148, https://doi.org/10.1080/09505431.2013.786989.

[6] V. Smil, Examining energy transitions: A dozen insights based on performance, Energy Res. Soc. Sci. 22 (2016) 194–197, https://doi.org/10.1016/j.erss.2016.08.017.

[7] M. Dimock, C. Doherty, J. Kiley, R. Oates, Political Polarization in the American Public, Pew Research Center, 2014.

[8] PEW, D. 20036USA202-419-4300 | M.-857-8562 | F.-419-4372 | M. Inquiries, Public's 2019 Priorities: Economy, Health Care, Education and Security All Near Top of List, Pew Res. Cent. - US Polit. Policy. (2019). https://www.pewresearch.org/politics/2019/01/24/publics-2019-priorities-economy-health-care-education-and-security-all-near-top-of-list/ (accessed August 28, 2020).

[9] T. Bolsen, J.N. Druckman, F.L. Cook, The influence of partisan motivated reasoning on public opinion, Polit. Behav. 36 (2014) 235–262, https://doi.org/10.1007/s11109-013-9238-0.

[10] T. Bolsen, J.N. Druckman, Do partisanship and politicization undermine the impact of a scientific consensus message about climate change? Group Process. Intergroup Relat. 21 (2018) 389–402, https://doi.org/10.1177/1368430217737855.

[11] P.J. Egan, M. Mullin, Climate change: US public opinion, Annu. Rev. Polit. Sci. 20 (2017) 209–227, https://doi.org/10.1146/annurev-polisci-051215-022857.

[12] D. Miniard, J. Kantenbacher, S.Z. Attari, Shared vision for a decarbonized future energy system in the United States, Proc. Natl. Acad. Sci. U.S.A. 117 (2020) 7108–7114, https://doi.org/10.1073/pnas.1920558117.

[13] P. Bergquist, D.M. Konisky, J. Kotcher, Energy policy and public opinion: patterns, trends and future directions, Prog. Energy 2 (2020) 032003, https://doi.org/10.1088/2516-1083/ab9592.

[14] M.T. Ballew, A. Leiserowitz, C. Roser-Renouf, S.A. Rosenthal, J.E. Kotcher, J. R. Marlon, E. Lyon, M.H. Goldberg, E.W. Maibach, Climate change in the American mind: data, tools, and trends, Environ. Sci. Policy Sustain. Dev. 61 (2019) 4–18, https://doi.org/10.1080/00139157.2019.1589300.

[15] A. Leiserowitz, E. Maibach, S. Rosenthal, J. Kotcher, A. Gustafson, P. Bergquist, M. Ballew, M. Goldberg, Energy in the American Mind, December 2018, (2019). https://osf.io/bdq25/ (accessed August 28, 2020).

[16] J.W. Stoutenborough, A. Vedlitz, X. Liu, The influence of specific risk perceptions on public policy support: an examination of energy policy, Ann. Am. Acad. Pol. Soc. Sci. 658 (2015) 102–120, https://doi.org/10.1177/0002716214556472.

[17] A. Tyson, B. Kennedy, Two-Thirds of Americans Think Government Should Do More on Climate, 2020. https://www.pewresearch.org/science/2020/06/23/two-thirds-of-americans-think-government-should-do-more-on-climate/ (accessed August 28, 2020).

[18] T. Sharpton, T. Lawrence, M. Hall, Drivers and barriers to public acceptance of future energy sources and grid expansion in the United States, Renew. Sustain. Energy Rev. 126 (2020) 109826, https://doi.org/10.1016/j.rser.2020.109826.

[19] J.N. Druckman, E. Peterson, R. Slothuus, How elite partisan polarization affects public opinion formation, Am. Polit. Sci. Rev. 107 (2013) 57–79, https://doi.org/10.1017/S0003055412000500.

[20] S. Ansolabehere, d. Konisky, Cheap and Clean: How Americans Think about Energy in the Age of GLobal Warming, The MIT Press. (2014). doi:10.2307/j.ctt9qf94b.

[21] M. Greenberg, Energy sources, public policy, and public preferences: Analysis of US national and site-specific data, Energy Policy 37 (2009) 3242–3249, https://doi.org/10.1016/j.enpol.2009.04.020.

[22] H. Klick, E.R.A.N. Smith, Public understanding of and support for wind power in the United States, Renew. Energy 35 (2010) 1585–1591, https://doi.org/10.1016/j.renene.2009.11.028.

[23] J.E. Aldy, M.J. Kotchen, A.A. Leiserowitz, Willingness to pay and political support for a US national clean energy standard, Nat. Clim. Change 2 (2012) 596–599, https://doi.org/10.1038/nclimate1527.

[24] L.C. Stokes, C. Warshaw, Renewable energy policy design and framing influence public support in the United States, Nat. Energy 2 (2017) 17107, https://doi.org/10.1038/nenergy.2017.107.

[25] O. Bayulgen, S. Benegal, Green priorities: How economic frames affect perceptions of renewable energy in the United States, Energy Res. Soc. Sci. 47 (2019) 28–36, https://doi.org/10.1016/j.erss.2018.08.017.

[26] H.S. Boudet, Public perceptions of and responses to new energy technologies, Nat. Energy 4 (2019) 446–455, https://doi.org/10.1038/s41560-019-0399-x.

[27] P. Slovic, E. Peters, M.L. Finucane, D.G. MacGregor, Affect, risk, and decision making, Health Psychol. 24 (2005) S35–S40, https://doi.org/10.1037/0278-6133.24.4.S35.

[28] J.A. Crowe, R. Li, Is the just transition socially accepted? Energy history, place, and support for coal and solar in Illinois, Texas, and Vermont, Energy Res. Soc. Sci. 59 (2020) 101309, https://doi.org/10.1016/j.erss.2019.101309.

[29] S.K. Olson-Hazboun, "Why are we being punished and they are being rewarded?" views on renewable energy in fossil fuels-based communities of the U.S. west, Extr. Ind. Soc. 5 (2018) 366–374, https://doi.org/10.1016/j.exis.2018.05.001.

[30] C. Roser-Renouf, E.W. Maibach, A. Leiserowitz, X. Zhao, The genesis of climate change activism: from key beliefs to political action, Clim. Change 125 (2014) 163–178, https://doi.org/10.1007/s10584-014-1173-5.

[31] M.H. Goldberg, A. Gustafson, M.T. Ballew, S.A. Rosenthal, A. Leiserowitz, A social identity approach to engaging Christians in the issue of climate change, Sci. Commun. 41 (2019) 442–463. https://doi.org/10.1177/1075547019860847.

[32] M.H. Goldberg, A. Gustafson, M.T. Ballew, S.A. Rosenthal, A. Leiserowitz, Identifying the most important predictors of support for climate policy in the United States, Behav. Public Policy. (undefined/ed) 1–23. https://doi.org/10.1017/bpp.2020.39.

[33] U.S. States - Rankings - U.S. Energy Information Administration (EIA), (2018). https://www.eia.gov/state/rankings/ (accessed August 28, 2020).

[34] Indiana - State Energy Profile Overview - U.S. Energy Information Administration (EIA), (2020). https://www.eia.gov/state/?sid=IN (accessed August 28, 2020).

[35] Indiana - SEDS - U.S. Energy Information Administration (EIA), (2019). https://www.eia.gov/state/seds/seds-data-fuel.php?sid=IN#DataFiles (accessed September 11, 2020).

[36] G. Inc, Democratic States Exceed Republican States by Four in 2018, Gallup.Com. (2019). https://news.gallup.com/poll/247025/democratic-states-exceed-republican-states-four-2018.aspx (accessed September 13, 2020).

[37] Yale Climate Opinion Maps 2019, Yale Program Clim. Change Commun. (2020). https://climatecommunication.yale.edu/visualizations-data/ycom-us/ (accessed August 28, 2020).

[38] C. Horne, E. Huddart Kennedy, Explaining support for renewable energy: commitments to self-sufficiency and communion, Environ. Polit. 28 (2019) 929–949, https://doi.org/10.1080/09644016.2018.1517917.

[39] A. Gustafson, M.H. Goldberg, J.E. Kotcher, S.A. Rosenthal, E.W. Maibach, M. T. Ballew, A. Leiserowitz, Republicans and Democrats differ in why they support renewable energy, Energy Policy 141 (2020) 111448, https://doi.org/10.1016/j.enpol.2020.111448.

[40] A. Queirós, D. Faria, F. Almeida, Strengths and limitations of qualitative and quantitative research methods, Eur. J. Educ. Stud. 3 (2017) 369–387, https://doi.org/10.46827/ejes.v0i0.1017.

[41] B.K. Sovacool, J. Axsen, S. Sorrell, Promoting novelty, rigor, and style in energy social science: Towards codes of practice for appropriate methods and research design, Energy Res. Soc. Sci. 45 (2018) 12–42, https://doi.org/10.1016/j.erss.2018.07.007.

[42] J. Maxwell, Qualitative Research Design: An Interactive Approach. J.A. Maxwell. (2012).

[43] U.S. Census Bureau, American FactFinder. https://factfinder.census.gov/ (Accessed September, 2020).

[44] U. S. Census Bureau, Percent Urban and Rural in 2010 by State, (2010). https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/2010-urban-rural.html (Accessed September, 2020).

[45] P.D. Howe, M. Mildenberger, J.R. Marlon, A. Leiserowitz, Geographic variation in opinions on climate change at state and local scales in the USA, Nat. Clim. Change 5 (2015) 596–603, https://doi.org/10.1038/nclimate2583.

[46] J. Cohen, Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit, Psychol. Bull. 70 (1968) 213–220, https://doi.org/10.1037/h0026256.

[47] J.L. Campbell, C. Quincy, J. Osserman, O.K. Pedersen, Coding in-depth semistructured interviews: problems of unitization and intercoder reliability and agreement, Sociol. Methods Res. 42 (2013) 294–320, https://doi.org/10.1177/0049124113500475.

[48] S.Z. Attari, M.L. DeKay, C.I. Davidson, W. Bruine de Bruin, Public perceptions of energy consumption and savings, Proc. Natl. Acad. Sci. U. S. A. 107 (2010) 16054–16059, https://doi.org/10.1073/pnas.1001509107.

[49] S. Attari, D. Krantz, E. Weber, Reasons for cooperation and defection in real-world social dilemmas: (573552014-014), (2014). https://doi.org/10.1037/e573552014-014.

[50] S.O. Hazboun, M. Briscoe, J. Givens, R. Krannich, Keep quiet on climate: Assessing public response to seven renewable energy frames in the Western United States, Energy Res. Soc. Sci. 57 (2019) 101243, https://doi.org/10.1016/j.erss.2019.101243.

[51] U.S. Environmental Protection Agency (EPA), What climate change means for Indiana. https://archive.epa.gov/epa/sites/production/files/2016-09/documents/climate-change in.pdf (Accessed September, 2020).

[52] M.H.W. Lee, A. Clark, Partisanship does not tell the full story: The complexities of public opinion and fracking in the United States, Energy Res. Soc. Sci. 70 (2020) 101686, https://doi.org/10.1016/j.erss.2020.101686.