Is the just transition socially accepted? Energy history, place, and support for coal and solar in Illinois, Texas, and Vermont

Article *in* Energy Research & Social Science · September 2019

DOI: 10.1016/j.erss.2019.101309

2 authors:


Jessica Crowe
Southern Illinois University Carbondale


Ruopu Li
Southern Illinois University Carbondale

Energy Research & Social Science xxx (xxxx) xxx-xxx

Contents lists available at ScienceDirect

Energy Research & Social Science

Is the just transition socially accepted? Energy history, place, and support for coal and solar in Illinois, Texas, and Vermont

Jessica A. Crowe [a], Ruopu Li [b, *]

[a] Department of Sociology, Southern Illinois University Carbondale, Carbondale, IL 62901, United States
[b] Geography and Environmental Resources, School of Earth Systems and Sustainability, Southern Illinois University Carbondale, Carbondale, IL 62901, United States

ARTICLE INFO

1. Introduction

Energy has been at the top of the national and global political agendas along with other connected challenges, such as poverty, energy security, disaster relief and climate change. The availability, development and consumption of energy deeply affect all walks of our daily lives. Given a myriad of challenges and technological advancement, the energy system has been constantly evolving and transforming [1], which requires compatible adjustments in energy policies. Such policy adjustment, however, is often met with strong local opposition from concerned groups. Such social opposition sometimes can slow down or even halt the process [2]. For example, the envisioned green energy infrastructure overhaul by the European Commission has experienced numerous setbacks caused by the resistance of local groups in the vicinity to the projects [3]. Energy policy scholars refer to the disparity in presumed broad public support for a green economy and local resistance to renewable energy projects as the “social gap” in energy planning [4]. In a democratic society, public support and opposition can deeply influence the passage and success of energy policies. Scheer et al. [5] argues that social acceptance should be added as an energy policy objective. While, social perceptions about energy sources deeply affect our energy future [5], to be truly successful, energy policies must have social support, especially from local communities that endure the most from development [2].

Although researchers have devoted a significant amount of attention to understanding public opinion on a single energy source such as a preference of nuclear power (e.g., [6–9]) or unconventional oil and natural gas (e.g., [10–15]), trusts of a multitude of energy resources (e.g. [16-17]), and beliefs about energy system change [18], they mostly focus on public perceptions and acceptance of the energy sources. In the meantime, the effects of climate change are becoming more apparent with more frequent and more destructive natural catastrophes (e.g. California's Camp Fire of 2018; Hurricanes Harvey, Maria, and Irma of 2017), thus leading more federal and state politicians to call for a transition from fossil fuels to renewable energy.

With respect to just energy policy, several European countries lead the way in balancing the competing aims of economics (low-cost), energy security, and climate change mitigation—otherwise known as the energy trilemma [19]. Countries such as Denmark, the United Kingdom, and Germany score high on the Energy Justice Metric Index, thanks to policies such as the Danish Energy Agreement for 2012–2020 that aims to have at least half of power consumption supplied from wind energy [19]. On the other hand, the United States significantly lags behind with respect to the environmental and energy security aspects of the metric.

While the U.S. has yet to implement climate targets at the national level, several states and cities are beginning to set their own targets. Furthermore, conversations at the U.S. congressional level are beginning to gain traction as more members of Congress and the Senate view climate change as a danger that needs an immediate action to mitigate future impacts. For instance, Rep. Ocasio-Cortez's Green New Deal is a climate proposal whose media coverage has helped push climate change to be a top-tier issue among U.S. Democratic voters [20]. While a large portion of the proposed Green New Deal focuses on transitioning to 100% renewable energy, becoming more energy efficient, and finding other solutions to reduce greenhouse gases, a significant portion of the deal focuses on social, economic, and environmental justice. The proposal “guarantees a job with a family-sustaining wage, adequate family and medical leave, paid vacations, and retirement security to all people of the United States" and calls for "providing all people of the United States with — (i) high-quality health care; (ii) affordable, safe, and adequate housing; (iii) economic security; and (iv) ac-

* Corresponding author.
Email address: ruopu.li@siu.edu (R. Li)

https://doi.org/10.1016/j.erss.2019.101309
Received 30 December 2018; Received in revised form 13 September 2019; Accepted 19 September 2019

cess to clean water, clean air, healthy and affordable food, and nature" [21]. In other words, Rep. Ocasio-Cortez's Green New Deal calls for a socially, environmentally, and economically just energy transition, a transition that includes marginalized peoples in the decision-making process.

If the public is to be active in the process of an energy transition, then it is important for researchers not to just measure 'public perceptions' or 'acceptance' of different energy sources but also their 'support' for different energy sources [2]. Furthermore, it is important to measure the levels of support held by people living in places that will be most affected by an energy transition, by either losing jobs in energy sectors that are scaled down or eliminated or by serving as the sites for renewable energy.

In this article, we examine public perceptions of two energy sources, coal and solar energy, as well as the public's support for just transition policies that assist the transition from coal to solar. Coal mining has a long history in the United States that led to the creation of many communities that still exist today. Some argue that the coal industry has such a large presence in mining communities, that it is ingrained in a community's economic identity [22]. Solar power has a much shorter history in the United States, and currently a few states (e.g. California) dominate the solar industry. As a result, we ask the following questions:

Overall, how does the public perceive coal and solar energy, their respective effects on the environment, and support for public policy that assists in an energy transition away from fossil fuels toward sustainable energy sources?
How do attitudes about coal, its effects on the environment, and support for coal-related public policy differ for residents who live in a geographic location historically tied to coal mining compared to residents who live in places without a connection to coal mining?
How do attitudes about solar, its effects on the environment, and support for solar-related public policy differ for residents who live in a geographic location dedicated to 100% renewable energy compared to residents who live in places with little to no renewable energy?

To analyze public perception of coal and solar energy and support for public policy that assists in a just energy transition, we conducted a mail survey in the summer of 2018 among a random sample of residents in three regions of the United States: Houston, TX, a large city with close ties to the oil industry, Burlington, VT, a medium-sized city that is solely powered by renewable energy sources, and Saline County, IL, a rural area with a long history of coal mining.

2. Place, just energy transition, and social support

When it comes to geographical proximity and new development, many researchers have documented the tendency for local residents to express concern about and resist the siting of potentially hazardous industries and other pollution sources (including energy development) in their communities [23–25]. However, evidence suggests that residential concern may also occur with new development that is non-hazardous, such as wind farm development, as residents question the large scale of such projects as well as the impacts of such development on land use and wildlife, the visual landscape, and noise [26–28]

On the other hand, with respect to established facilities or development, other research has found that residents near such development often express less concern than people living further away [29–31]. This latter situation is important for what it can tell us about how sense of place and proximity affect the social acceptance of risk associated with particular energy sources. November [32] argues that to understand the links between space and risk, one needs to think in terms of relations of "connexity" rather than proximity. That is to think of the links that bind the various elements of risk networks, rather than solely the physical distance. Thus, one must think in terms of "place" rather than "space". For example, Burningham and Thrush [30] found that residents located near a chemical plant in Wales spoke of the plant in terms of a strong sense of local community—based on a historical relationship between the place, social networks between owners, workers, and residents, and the industry. In this case, residents focused on a representation of the plant in terms of a long-established collective identity. The association with risk was seemingly absent.

Thus, a community's sense of place, rooted in place attachment, landscape memory and land use history must be taken into account when developing energy policies that transition from fossil fuels to renewable energy sources. The term "transition" has gained increasing traction from politicians in moving from a high carbon to a low carbon future. Amongst academics, the term comes from literature on 'socio-technical' transitions, which refers to "deep structural changes in systems, such as energy, that involve long-term and complex reconfigurations of landscapes with technology, policy, infrastructure, scientific knowledge, and social and cultural practices towards sustainable ends" [33]. However, there is an increasing recognition that such a transition must be socially and environmentally just. Confronting climate change must require drastic changes in energy production and consumption. The decision to stabilize atmospheric concentrations of carbon dioxide at 450 ppm (due by 2030 to 2040 at the current rates at which emissions are climbing) or reduce current concentrations to 350 ppm (the number climate scientists agree is needed for a livable planet) will put some communities at greater risk.

In order to have a just transition to a low carbon society, energy justice must occur. To have energy justice, a society must apply justice principles to all aspects of energy, including policy, production, consumption, activism, and security. Researchers focus on three types of energy justice. First, *distributional justice* evaluates where injustices emerge. Second, *recognition justice* examines which affected sections of society are ignored or misrepresented. Finally, *procedural justice* investigates which processes exist for their remediation in order to reveal and reduce such injustice [34–35]. With respect to recognition justice, injustice can occur when the dominant group fails to recognize a specific group's (e.g. social, geographical, cultural, ethnic, racial, gender) viewpoints or distorts a group's views in ways that appear demeaning. Recognition justice is especially important for place-based communities who will endure the most from an energy transition by either losing energy related jobs (e.g. nuclear and fossil fuel) or by hosting the sites for renewable energy (not necessarily with their input or support).

The economy of places in the United States has historically been tied to natural resources including fossil fuels and biomass. While many rural communities have tight connections to timber, farming, drilling, and mining, other rural areas enjoy the pristine and relative "underdeveloped" character of their natural habitat. Therefore, individuals with a high level of place attachment, rooted in historical and cultural experiences, can become distraught when their traditional way of living becomes threatened. Their concerns need to be recognized, and a just transition framing will direct more policy attention to the creation of new jobs as fossil fuel and nuclear-based ones are phased out. In order to avoid post-fossil fuel "ecological refugees [36], a just transition must require jobs in the "green" sectors be created to replace recently abandoned fossil-fuel-based sectors [37, p.201]. For instance, when Germany dramatically reduced the burning of coal in the 1990s, the country used widespread programs to retrain coal industry workers to find new jobs, sometimes in the renewable energy sector [38]. Unless strong policies are advanced to support a just transition, communities whose economies are dependent on fossil fuels, may inevitably resist rapid decarbonization. However, a just transition entails matters more than job creation, including issues such as the kind of jobs, how secure they are, how long they last, and how they coincide with a community's economic identity and sense of place.

For communities whose sense of place is linked to natural resources, they have a desire to keep their identity intact. Studies show that social acceptance of energy sources are tied to how the energy source is suited to their daily lives. For instance, Evensen and Stedman [39], in their research on attitudes about shale gas development, show that general beliefs and values rooted in shared historical and cultural experiences are more highly predictive of attitudes about shale development (e.g. oppose or support) than specific beliefs about shale gas (e.g. it decreases water quality). These findings support in-depth interviews in the U.S. and Canada that showed that residents in areas with shale gas development cared less about the impacts of development, as such, but instead they cared about how development would impact the things they value, such as peace, quiet, local beauty, and community and family structure [40].

Similarly, Phadke [26] found that land use culture (an umbrella term that connects concepts such a sense of place, landscape memory and land use history) mattered greatly with whether or not residents were willing to accept large-scale wind farms on their landscapes. Residents in Minnesota were more likely to accept the trade-off of wind energy over worse alternatives. They rationalized that their landscapes were already in productive use from industrial agriculture. Therefore, wind turbines would fit in with these land uses. However, residents from Michigan were interested in much smaller scaled wind energy projects as they felt that large wind turbines would negatively affect the peaceful qualities of the region. Even further, many Massachusetts participants in the study opposed any wind turbines as they placed value on enjoying the ability to “interact with nature and natural habitat on its own terms” [26, p.252].

While studies of social acceptance of energy sources often evaluate the acceptance of an energy source in general, it is important to evaluate social support of specific policies. As Batel et al. [2] argue, ‘support’ is more action-oriented and implies engagement with something. Thus, according to Batel et al., if a just transition is to occur and renewable energy technologies are to be successful, then it must be “promoted and deployed through a multilateral and participatory approach, through which social actors are actively engaged in that process” (p.2). Therefore, if the support of renewable energy technologies is desirable, researchers must do a better job of understanding public support of different energy policies and not just acceptance. Batel et al. call for researchers to adopt a more critical, non-normative stance to people's relations with energy infrastructures and to examine other types of responses to energy infrastructures besides support or opposition. This is especially important for recognition justice to occur. By accurately recognizing how the energy history of a place influences residents’ perceptions of different energy sources and support of different energy policies, policy makers can then begin to identify strategies for a just transition.

Provided that coal and solar vary greatly with respect to each's impact on the natural environment and climate change, their history of production and consumption, and their embeddedness into a community's sense of place, landscape memory and land use history, we expect that geographical location will have the following effects on public perception of each energy source and support for just transition policies:

H1. : Residents of places without historical ties to coal will perceive coal less favorably than those who reside in a place with ties to coal.

H2. : Residents of places without historical ties to coal will more likely perceive coal to have a negative impact on the environment than those who reside in a place with ties to coal.

H3. : Residents of places without historical ties to coal will be less likely to support public policy that helps the coal industry.

H4. : Residents of places with 100% renewable energy will perceive solar more favorably than residents who live in places with little to no renewable energy.

H5. : Residents of places with 100% renewable energy will more likely perceive solar to have a positive impact on the environment than residents who live in places with little to no renewable energy.

H6. : Residents of places with 100% renewable energy will be more likely to support public policy that helps the solar industry.

3. Methodology and data

3.1. Study locations

Table 1 provides general population, economic and energy information for each study location. The U.S. state of Vermont lacks fossil fuel resources, with hydroelectricity and other renewables accounting for 99.5% of in-state electricity generation [41]. In 2014, Burlington, Vermont, Vermont's largest city, earned the status of the first city in the United States to source 100% of its electricity from renewable sources (mostly from wind, hydropower, and biomass). These factors combined, make in-state renewable energy development the primary option for Vermont to reduce its reliance on imported energy. Vermont aspires to obtain 90% of its total energy from renewable sources by 2050. The state's Comprehensive Energy Plan outlines a number of strategies for achieving this goal, while simultaneously protecting Vermont's natural resources. The plan advocates for increasing electricity generation and transmission capacities to produce lower-emission alternatives to fossil fuels, and to provide the necessary infrastructure for electric vehicles [42]. While solar accounts for a small percentage of the electricity generated in Burlington, the city encourages residents to purchase rooftop solar and has simplified the process for residents to adopt net-metering [43].

While the city of Burlington and state of Vermont are dedicated to renewable energy, not all residents are happy with the process for siting energy, particularly wind energy [44]. White analyzed public comments from a set of public hearings on energy siting in Vermont. Major differences existed between participants at the Burlington public hearing, versus participants at the public hearings in the more rural Vermont towns. Burlington participants were much more likely to discuss

Table 1
Population, economic, and energy indicators by study location.

	Saline County, IL	Burlington, VT	Houston, TX
Population	24,102	42,899	2464,124
Population Density (inhabitants/km^2)	105.6	6645	5893
Median Household Income	$40,722	$61,057	$63,802
Unemployment Rate	4.7%	1.7%	3.1%
Economy	Coal Mining, Health and Social Services	Education, Health Services, Trade	Oil and Natural Gas, Shipping, Aeronautics, Biomedical
Fossil Fuel History	Coal Mining	None	Oil Refineries and port for shipping oil and natural gas globally
Energy Supply Profile	Coal: 70% Oil and Natural Gas: 23%	Biomass: 36% Hydro: 36%	Natural Gas: 44% Coal: 34%
		Wind: 28%	Wind: 11% Nuclear: 11%

the benefits of wind and other renewables than were participants of the public hearings in rural regions. Burlington participants were more likely to discuss the political and environmental benefits of renewable energy while participants in the rural regions were more likely to discuss the risks, especially with respect to wind power [44].

Houston, TX is the fourth most populous city in the U.S. and whose growth beginning in the early 20th century was tightly connected to the discovery and development of oil [45–46]. Oil was discovered 145 km east of Houston in 1901; and by 1939, the East Texas oil field had 26,000 wells. The continuing oil boom led to refineries and office skyscrapers to be built in Houston. In the late 1930s, the oil industry accounted for over half the jobs in the Houston region [46]. While the oil industry continues to pave the way for increased growth, Houston has a diverse economy that includes biomedical research, aeronautics, manufacturing, health care, construction, and service jobs that allows it to withstand fluctuating oil prices [47]. The state of Texas has more wind power generation capacity than any other state in the U.S. and an increasing solar power generation capacity. In 2017, Texas had 12,494 wind turbines and 432 solar companies. Several renewable energy companies have located to Texas to capitalize on the infrastructure and talent it has to offer [48]. In addition, solar PV installations continue to increase, with a 19% gain in 2017 [49]. In one study, Houston ranked 34th for total solar capacity among the 69 U.S. cities studied, placing it in the middle. However, Houston's mayor is an advocate of solar and has adopted solar power purchase agreements to power 10% of the city's municipal operations [49].

Saline County, IL is a rural county in southern Illinois that has historically been reliant on coal mining. The county had 24,913 residents in 2010, a −10% change from the 2000 census [50–51]. In 2012, 15% of the 7616 total jobs in the county were in the mining, quarrying, oil and gas extraction sector [52]. Furthermore, neighboring counties also had significant numbers of jobs in the extraction sector. In a study of government leaders in several southern Illinois counties, including Saline County, Silva and Crowe [53] found that most government officials defined their communities by their experiences with mining or drilling natural resources, revealing that “extracting resources is part of the economic and social lifeblood of the communities they represent” (320).

Coal mining has historically been the biggest employer in the county for over 100 years; however, mining has been declining in recent years. While Saline County is Illinois's top coal producer, 1090 coal industry jobs were lost between 2012 and 2017 [54]. The decline in coal related jobs has led government officials to be receptive to other energy related jobs, such as shale development [53]. Indeed, leaders assumed that because of the regions “coal-mining ethic,” residents would be open to other sources of energy development as long as it provided a large number of good paying jobs. While no solar farms yet exist in the county, that very well may change in the upcoming years as Illinois implements the Future Energy Jobs Act of 2016 which set a goal for Illinois to get 25% of its electricity from renewable sources such as wind farms, solar farms and rooftop solar panel by 2025. Several solar companies are currently in the proposal stage of developing solar farms in other southern Illinois counties [55].

3.2. Survey design and general procedure

The survey consisted of six pages in which we asked residents about their perceptions about energy production and consumption, their support for specific energy policies, and basic demographic information. The survey began with a general question about attitudes about different types of energy sources, continued with specific attitudinal questions about (1) solar power and (2) coal power, then continued with questions about specific policies as they relate to the solar industry and the coal industry (see Appendix). The survey ended with questions about household energy consumption and demographic questions. When pre-tested, the survey took an average of 10 min to complete.[1]

Residents in three U.S. regions serve as the sample for the study. We sampled residents in Burlington, Vermont, a city that has transitioned to 100% renewable energy, Houston, Texas, a city with present and historical ties to the oil industry and an emerging solar industry, and in Saline County, Illinois, a county in southern Illinois with a long history of coal mining. We purchased a sample of 1500 addresses (with occupying resident's name) from a reputable company that specializes in survey sampling, 500 from each region. To ensure that the addresses were representative of each area, we employed a random cluster design, instructing the company to divide the cities (in the case of Burlington, VT and Houston, TX) into neighborhoods and Saline County into townships and randomly selecting an equal number of households from each neighborhood or township. We requested the sample be split evenly between male and female residents. We surveyed the residents from the sample during the summer of 2018.

We reached out to residents in the sample in three different waves. We implemented a Dillman approach, making contact with individuals in the sample several times by mail [56]. First, we mailed physical copies of the surveys to all residents along with a stamped return envelope and a personalized cover letter explaining who we were, how we received their name and address, and what the survey covered. In addition, we explained that we were gathering information about the public's perceptions of different types of energy sources with an emphasis on coal and solar and that we were surveying residents of places that had a historical or present tie to the energy sector. We explained that results from the survey would be used to help researchers and policymakers improve the quality of places tied to energy production and that information could also be used to help leaders and community members make informed decisions regarding their community's economic and environmental sustainability. Finally, we assured them that their answers were completely confidential, only people directly involved with the project would have access to the surveys, all survey material would be stored in a locked filing cabinet in a locked office and would be destroyed after it was electronically coded, and only summaries of the data would be released in which one's answers could not be traced back to a particular individual. Second, after a few weeks, we sent a postcard thanking those who had completed the survey and reminding those who had not yet to please fill it out and return it. After two more weeks, we sent a second set of physical surveys to the respondents who had not returned the first survey.

From the initial sample size of 1500 residents, 160 residents completed the survey, resulting in a response rate of 13%[2] (subtracting undeliverable surveys). Of the residents who completed the survey, 64 (40.5%) were from Saline County, Illinois, 67 (42.4%) were from Burlington, Vermont and 27 (17.1%) were from Houston, TX. Of the respondents, 44% were women and 56% were men; the mean age was 53 years. With respect to race and ethnicity, 84% identified as white, 5% identified as black, 6% identified as Latino, 2% identified as Asian, and 2% identified as some other race or ethnicity. Regarding political

[1] This study was approved by the lead author's university human subjects committee (IRB Protocol number 18141).

[2] Response rates for mail and phone surveys have been consistently declining, particularly for the general population [71–73]. This is most likely due to the increase in junk mail and spam calls as well as a loss of public trust in survey research. Response rates are even lower in areas with large numbers of single-parent households, families with young children workers with long commutes, and high crime rates–thus, why response rates in Houston were lower than the other two study locations [74]. The authors have been able to achieve much higher response rates when sampling community leaders (75% response rate) or students with the use of a $10 incentive (70% response rate). However, for seeking a random sample of households in three specific areas without the use of an incentive, the response rate of 13% is typical and even higher than the response rate for phone surveys [73].

affiliation, 39% identified as Democrat, 18% as Republican, 29% as Independent, and 14% as other. In terms of highest educational degree earned, 3% did not graduate from high school, 12% completed only high school, 16% completed some college but did not earn a degree, 13% earned an associate's degree, 25% a bachelor's degree, 20% a master's degree, and 11% a Ph.D. or professional degree.

3.3. Data analyses

To compare the effects of attitudes toward solar and coal by region, we categorized respondents into three main U.S. regions: Burlington, VT; Houston, TX; and Saline County, IL. In order to compare differences between respondents based on their region and their attitudes toward coal and solar, we conducted Kruskal-Wallis tests on 17 dependent variables. The appendix provides a list of the questions and attributes we use to operationalize dependent variables.

If the bivariate tests indicated meaningful differences among region, we performed ordinal regression on those dependent variables. To determine which control variables to include with our main independent variable, geographic location, we conducted Kruskal-Wallis tests on six independent variables.

The first set of regression models includes four dependent variables predicting general attitudes toward coal and solar energy. These variables are: overall perceptions of (1) coal and (2) solar, and attitudes of (3) additional/future coal development, and (4) additional/future solar development. All variables were measured on a five-point scale from very negative to very positive. These variables measure general perceptions of the two energy sources without measuring specific characteristics of the energy sources.

The second set of regression models includes two dependent variables predicting the government's support of the solar industry and one dependent variable predicting one's preference to personally use solar energy. We asked respondents whether they believed the U.S. government should do more to help the solar industry, if more effort should be made to employ more people in the solar industry, and if they would like to live in a home that is mostly powered through solar energy within the next 10 years. All variables were measured on a five-point scale from strongly disagree to strongly agree. These variables are important because they measure the public's support of specific actions that the government should or should not take with respect to solar energy as well as their own desire to personally use solar power.

The final set of regression models includes three dependent variables predicting support of public policy with respect to coal production and consumption. We asked respondents whether they believed the U.S. government should do more to help the coal industry, coal as a source of energy should be phased out, and more effort should be made to employ more people in the coal industry. All variables were measured on a five-point scale from strongly disagree to strongly agree. Similarly, to the policy questions about solar, these variables are important as they measure the public's support toward whether actions should be made to create policy that helps the coal industry and its workers.

To analyze the effect of one's place of residence on the dependent variables, we control for several individual-level variables. We include the following independent variables in the models: age (continuous, in years), sex (male as reference category), political affiliation (three dummy variables with Republican as reference category), education (dummy variable with bachelor's degree as the cut-off), race (white only as reference category), size of home (number of square feet), and an index of energy saving behaviors (how often one unplugs unused chargers and appliances, turns off the lights when not in a room, and washes clothes in cold water). Table 2 presents the descriptive sample statistics of the respondents by study location compared to the population. The sample is similar to the population with respect to race and gender. However, the sample is older and better educated than the population for each of the three study locations.

4. Results

Tables 3 and 4 present the univariate and bivariate statistics for the independent and dependent variables, based on respondents' geographical locations. Chi-square tests show that respondents significantly differ from each other based on their geographical location of residence with respect to their race and education. Respondents from Saline County, IL were significantly more likely to be white and significantly less likely to hold a bachelor's degree or higher than respondents from Burlington, VT or Houston, TX while respondents from Houston, TX were less likely to be white and respondents from Burlington, VT were significantly more likely to hold a bachelor's degree or higher than respondents from the other two locations (χ^2 = 11.85, p < .01; χ^2 = 24.14, p < .001, respectively).

Comparison of means of the dependent variables show that respondents significantly differ with respect toward their overall attitudes toward coal and solar as an energy source, in addition to their attitudes toward future coal and future solar based on respondents' geographical locations (χ^2 = 76.08, p < .001; χ^2 = 12.06, p < .01; χ^2 = 74.83, p < .001; χ^2 = 14.08, p < .001, respectively). With respect to public policies on solar and coal production and consumption, respondents' attitudes significantly differed based on geographic location. Comparison of means show that respondents significantly differ with respect to-

Table 2
Descriptive statistics of respondents by study location.

Category	Responses	Saline County, IL		Burlington, VT		Houston, TX		Total
		Population	Sample	Population	Sample	Population	Sample	Sample
Sex	Male	49.3	59	49.9	55	51.1	52	56
	Female	50.7	41	51.1	45	49.9	48	44
Age	In years	42.0	56	26.7	51	32.9	49	53
Education	Less than Bachelor's degree	83.6	67	48.7	25	68.3	44	45
	Bachelor's degree or higher	16.4	33	51.3	75	31.7	56	55
Political Affiliation	Republican		28		6		19	18
	Democrat		25		41		56	39
	Independent		20		41		11	29
	Other		27		12		14	14
Race	White	92.9	92.2	84.9	84	58.5	63	84
	Hispanic or Latino	1.8	1.6	2.9	4.3	44.5	18.5	5.6
	Black	3.9	4.7	5.6	4.3	22.9	7.4	5
	Asian	0.7	0	6.3	0	6.7	11.1	2
	Native American	0.1	0	0.0	0	0.1	0.0	1

Table 3
Univariate and bivariate statistics for independent variables by study location.

	Burlington, VT (n = 69)		Saline County, IL (n = 64)		Houston, TX (n = 27)		
	% or Mean	SD	% or Mean	SD	% or Mean	SD	Chi-square
Sex (%male)	55.00	—	59.00	—	52.00	—	0.50
Age	51.39	18.11	56.51	19.32	50.41	21.60	3.39
Bachelor's degree or higher (%yes)	75.00	—	33.00	—	56.00	—	24.14***
Race (%white)	84.00	—	92.00	—	63.00	—	11.85**
Save energy	8.35	1.51	7.82	1.66	7.63	1.73	5.61
Home size	1629.82	901.43	1735.22	977.44	1711.41	901.73	0.64

** $p < .01$.
*** $p < .001$.

Table 4
Univariate and bivariate statistics for dependent variables by study location.

	Burlington, VT (n = 69)		Saline County, IL (n = 64)		Houston, TX (n = 27)		
	% or Mean	SD	% or Mean	SD	% or Mean	SD	Chi-square
Overall attitude about coal	1.40	0.72	3.59	1.23	2.26	1.06	76.08***
Overall attitude about solar	4.69	0.72	4.19	1.05	4.56	0.64	12.06**
Attitude toward future coal development	1.36	0.84	3.57	1.30	2.15	0.99	74.83***
Attitude toward future solar development	4.66	0.77	4.19	0.95	4.52	0.58	14.08***
Solar impact on climate change	4.36	0.89	3.89	0.93	4.26	0.90	10.92**
Solar impact on air quality	4.44	0.81	4.10	0.86	4.44	0.80	7.67*
Coal impact on climate change	1.38	0.65	2.74	1.03	1.96	0.98	54.75***
Coal impact on air quality	1.29	0.55	2.57	1.09	1.85	0.95	52.06***
Coal hazardous to environment	4.35	1.25	3.28	1.35	4.04	1.25	27.59***
Help coal industry	1.53	0.91	3.57	1.46	1.89	0.93	58.56***
Help employ coal workers	1.65	0.94	3.43	1.42	2.04	1.19	48.47***
Coal should be phased out	4.23	1.27	2.34	1.44	3.78	1.22	46.89***
Help solar industry	4.25	1.10	3.70	1.34	4.19	1.27	8.66*
Help employ solar workers	4.19	1.07	3.95	1.16	4.44	0.85	4.88+
Live in a home powered by solar	4.40	0.92	3.66	1.36	4.41	0.75	12.35**

+ $p < .10$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

ward whether the government should help the coal industry, help employ more coal workers, phase coal out, help the solar industry, help employ more workers in solar, and whether they would like to live in a home powered by solar ($\chi^2 = 58.56, p < .001$; $\chi^2 = 48.47, p < .001$; $\chi^2 = 46.89, p < .001$; $\chi^2 = 8.66, p < .05$; $\chi^2 = 4.88, p < .10$; $\chi^2 = 12.35, p < .01$).

Table 5 displays the results for the relationship between geographical location and attitudes toward coal and solar while controlling for personal attributes. The ordinal regression findings show a significant relationship between geographical location and attitudes toward coal, with residents from Burlington, VT (β = 3.41, $p < .001$) and Houston, TX (β = 1.84, $p < .001$) less likely than residents from Saline County, IL to have a positive attitude toward coal. With respect to additional/future coal development, residents from Burlington, VT (β = 3.23, $p < .001$) and Houston, TX (β = 1.48, $p < .01$) were less likely than residents from Saline County, IL to have a positive attitude but respondents from Burlington, VT were more likely than residents from Saline

Table 5
Ordinal regression models predicting attitudes toward coal and solar development.

Independent and Control Variables	Overall attitude about coal[a]	Overall attitude about solar[a]	Attitude toward additional/future coal development[a]	Attitude toward additional/future solar development[a]
Burlington, VT	3.408***	−0.695	3.230***	−1.135*
	(0.493)	(0.473)	(0.492)	(0.471)
Houston, TX	1.836***	−0.155	1.483**	−0.385
	(0.503)	(0.538)	(0.495)	(0.525)
Democrat (yes)	2.253***	−1.140*	2.286***	−1.016*
	(0.492)	(0.509)	(0.500)	(0.497)
Independent (yes)	1.221*	−0.706	0.899	−0.706
	(0.485)	(0.513)	(0.481)	(0.510)
Other political (yes)	0.425	−0.70	0.202	−0.399
	(0.547)	(0.578)	(0.542)	(0.595)
Sex (male)	0.158	−0.155	0.164	−0.449
	(0.362)	(0.395)	(0.369)	(0.389)
Age	0.001	−0.015	0.002	−0.010
	(0.009)	(0.010)	(0.009)	(0.009)
Bachelor's degree or higher (yes)	0.485	−0.301	0.587	−0.009
	(0.362)	(0.400)	(0.366)	(0.394)
Race (white)	.595	.300	0.340	0.394
	(0.479)	(0.581)	(0.491)	(0.576)
Save energy	−0.274**	.277*	−0.189	0.439***
	(0.104)	(0.112)	(0.104)	(0.116)
Home size	.000	.000	.000	.000
	(0.000)	(0.000)	(0.000)	(0.000)
Pseudo R^2	0.562	0.173	0.533	0.232

Unstandardized coefficients reported with standard errors in parentheses.
[a] Ordinal regression was used. When conducting ordinal regression in SPSS, the last category is used as the reference category. For instance, Democrat (coded as 1) is the reference category and the coefficient is for Republican (coded as 0). This is the opposite for logistic regression.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

County, IL to have a positive attitude toward additional/future solar development (β = −1.14, $p < .05$).

Table 6 displays the results between geographical location and solar public policy while controlling for personal attributes. According to the ordinal regression findings, respondents from Burlington, VT (β = −0.89, $p < .05$) were more likely than respondents from Saline County, IL to prefer to live in a home that was mostly powered through solar energy. Table 7 displays the results between geographical location and coal public policy while controlling for personal attributes. The ordinal regression findings show a significant relationship between geographical location and one's perception of the federal government helping the coal industry. Residents of Burlington, VT (β = 2.56, $p < .001$) and Houston, TX (β = 1.82, $p < .001$) were less likely than respondents from Saline County, IL to agree that the U.S. government should do more to help the coal industry. Similarly, respondents from Burlington, VT (β = 1.85, $p < .001$) and from Houston, TX (β = 1.51, $p < .01$) were less likely than respondents from Saline County, IL to agree that more effort should be made to employ more people in the coal industry. While respondents from Burlington, VT (β = −2.14, $p < .001$) and Houston, TX (β = −1.57, $p < .01$) were more likely than respondents from Saline County, IL to agree that coal should be phased out as a source of energy.

5. Discussion

In this study, we surveyed respondents from three areas across the United States with contrastive present and historical ties to coal and solar to better understand how place influences their attitudes toward coal and solar energy and support for just transition policies. Saline County, IL has a long history of coal mining, but no current solar production. Houston, TX has long-standing ties to oil, no ties to coal, and an emerging solar industry. Burlington, VT has no historical ties to fossil fuel production of any kind and is solely powered by renewable energy. With these findings, we show that geographical location is a strong indicator of attitudes and support of coal and solar policies. The hypotheses (H1-H6) were found as true statements based on the survey and statistics. Regardless of demographic characteristics, respondents in Saline County, IL, an area with a long history of coal mining, had significantly more favorable attitudes toward coal than respondents of locations without a tie to coal. Respondents from Saline County, IL also were more favorable toward policies that benefitted the coal industry and workers and were less likely to believe that coal was hazardous to the environment than the respondents from other regions. Respondents from Burlington, VT and Houston, TX were significantly more favorable toward existing solar energy and solar positively affecting climate change. In addition, respondents from Burlington, VT were significantly more favorable toward policy that provided for additional solar energy and living in a home powered by solar energy.

Table 6
Ordinal regression models predicting attitudes toward solar policy.

Independent and Control Variables	Help solar industry[a]	Help employ solar workers[a]	Live in a home powered by solar[a]
Burlington, VT	−0.482	−0.147	−0.889*
	(0.416)	(0.424)	(0.434)
Houston, TX	−0.476	−0.649	−0.491
	(0.504)	(0.526)	(0.524)
Democrat (yes)	−1.965***	−1.927***	−1.986***
	(0.470)	(0.480)	(0.486)
Independent (yes)	−1.274**	−1.025*	−0.709
	(0.471)	(0.475)	(0.468)
Other political (yes)	−1.463**	−1.073	−1.210*
	(0.564)	(0.565)	(0.566)
Sex (male)	−0.023	0.539	0.629
	(0.349)	(0.361)	(0.370)
Age	−0.001	−0.005	−0.019
	(0.009)	(0.009)	(0.009)
Bachelor's degree or higher (yes)	0.306	0.789*	0.167
	(0.362)	(0.377)	(0.378)
Race (white)	0.927	.581	0.866
	(0.534)	(0.529)	(0.581)
Save energy	0.269**	.431***	0.325**
	(0.102)	(0.108)	(0.106)
Home size	.000	.000	.000
	(0.000)	(0.000)	(0.000)
Pseudo R^2	0.562	0.173	0.533

Unstandardized coefficients reported with standard errors in parentheses.
[a] Ordinal regression was used. When conducting ordinal regression in SPSS, the last category is used as the reference category. For instance, Democrat (coded as 1) is the reference category and the coefficient is for Republican (coded as 0). This is the opposite for logistic regression.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 7
Ordinal regression models predicting attitudes toward coal policy.

Independent and Control Variables	Help coal industry[a]	Help employ coal workers[a]	Coal should be phased out[a]
Burlington, VT	2.558***	1.853***	−2.136***
	(0.453)	(0.421)	(0.436)
Houston, TX	1.820***	1.513**	−1.571**
	(0.512)	(0.494)	(0.504)
Democrat (yes)	1.977***	2.364***	−2.457***
	(0.483)	(0.481)	(0.496)
Independent (yes)	0.717	1.406**	−1.038*
	(0.472)	(0.473)	(0.477)
Other political (yes)	0.365	0.886	−0.497
	(0.547)	(0.541)	(0.548)
Sex (male)	0.452	0.397	0.101
	(0.359)	(0.353)	(0.359)
Age	0.014	0.010	−0.018*
	(0.009)	(0.008)	(0.009)
Bachelor's degree or higher (yes)	0.662	.598	−0.583
	(0.364)	(0.355)	(0.367)
Race (white)	.306	.256	−0.801
	(0.502)	(0.472)	(0.496)
Save energy	−0.168	−0.150	0.330**
	(0.102)	(0.101)	(0.106)
Home size	.000	.000	.000
	(0.000)	(0.000)	(0.000)
Pseudo R^2	0.455	0.412	0.473

Unstandardized coefficients reported with standard errors in parentheses.
[a] Ordinal regression was used. When conducting ordinal regression in SPSS, the last category is used as the reference category. For instance, Democrat (coded as 1) is the reference category and the coefficient is for Republican (coded as 0). This is the opposite for logistic regression.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Thus, our results suggest that one's place of residence as it relates to energy production and consumption matters. Residents of regions with an economic identity tied to a non-renewable energy source may be less receptive to funding and other resources earmarked for renewable energy as they are skeptical that their communities will benefit from renewable energy. With respect to coal, the number of people employed in coal mining had dropped from 178,000 in 1985 to 52,000 in 2018, a reduction of 71% [57]. On the other hand, the number of solar workers was over 242,000 in 2018 and is projected to steadily increase over the next decade [58]. Unfortunately, a spatial mismatch occurs between places that are losing coal jobs and places that are seeing an increase in solar jobs. For instance, California ranks first for the number of solar jobs at 76,838 (32% of total U.S. jobs) but produces no coal. However, Wyoming and West Virginia (the top two coal producing states) had a combined 431 solar jobs in 2018 [59].

Illinois, where Saline County is located, ranks 5th in coal production and 13th in the number of solar jobs [58-59]. However, up until 2016 most of the solar jobs were located near Chicago in the northeastern part of the state. Southern Illinois had fewer than 20 jobs in each county [60]. Nevertheless, after the implementation of the Illinois' Future Energy Jobs Act, southern Illinois began to see more solar jobs. In 2018, two of the top ten counties for solar jobs were in southern Illinois, and Saline County had 98 solar jobs [61].The Illinois' Future Energy Jobs Act, has made a good faith effort to increase energy justice by introducing measures to help increase solar production in areas that are losing coal jobs. However, more is needed to ensure energy justice as Illinois weens itself from fossil fuels to sustainable energy. Therefore, we emphasize the importance of including regions with economic identities tied to non-renewable energy in the policy making process to ensure that their concerns are accurately recognized and that an energy transition is socially, economically, and environmentally just. By doing this, other major coal, oil, and natural gas states can begin to follow in the footsteps of Illinois by developing policies that assist in energy justice as the energy transition occurs.

Public support away from fossil fuels and toward sustainable energy mimics national (and global) agreements to reduce overall greenhouse gas emissions (one of the three competing aims of the energy trilemma). Increasing solar and other sustainable energy will be key to meeting these goals. While residents of places with historical attachment to coal mining have positive attitudes toward coal, our data show that they have even more positive attitudes toward sustainable energy sources (seeFig. 2). These attitudes hold for future development and government assistance. Thus, our survey results suggest that support for solar and coal are not at odds with each other in coal regions. Furthermore, respondents, regardless of place or political affiliation believe that the U.S. government should do more to help displaced coal workers and that there should be more effort to employ more people in the solar industry. Thus, our research shows that not only do people have more favorable attitudes about sustainable energy but also they want policies that provide for energy justice.

This study contributes to the study of recognition justice by highlighting that residents overwhelmingly support solar energy, even in places with a history of coal mining. It recognizes that rural people in places tied to fossil fuels tend to support renewable energy and policies that provide for energy justice. It is important that their perceptions are acknowledged as President Trump often travels to these rural areas and openly mocks solar and wind energy at his rallies making false claims such as solar is "very expensive" and that windmills cause cancer [62]. While the residents of Saline County, IL overwhelmingly voted for Trump in the 2016 presidential election (he captured 73.4% of the vote), we show that they are more likely to diverge from his stance on renewables. The viewpoints of rural people often are not discussed in the press. Instead, the focus is on President Trump with climate experts refuting his claims with scientific evidence. In addition to climate experts challenging his false claims, we believe it is important that the public's views on renewable energy are also widely acknowledged by the media.

The current study has several limitations that future research can improve. Response rates were low, although consistent with other mail surveys of the public without the use of an incentive[3] [63]. Unfortunately, budget constraints limited us to use an incentive or to sample a much larger number or residents from more communities. As online sampling techniques have improved and more people have access to the Internet with the spread of smart phones [64,65], a mixed-modal survey design in which mail surveys are supplemented with an online survey will increase the sample size and better reflect the population. While this study differentiates between perceptions and policy support of coal and solar, the policy questions are somewhat broad in scope. In future studies, researchers should assess what types of support the public wants for displaced coal workers in order to help with a just transition. For example, do they want financial support to retrain coal workers for other energy jobs or a guarantee that renewable energy jobs will come to the area and that displaced coal workers will have priority for the new jobs? In addition, researchers can ask whether the public supports specific bills introduced by state legislatures intended to combat climate change, including enforcing a just transition.

As Burlington, VT is powered by renewable energy, one may question whether a sense of place that partially identifies with solar has begun to develop. It is difficult to assess if positive attitudes of renewable energy preceded the change to 100% renewable energy or if transitions to renewable energy will lead to attitudes that are more positive. It may be a bit of both. At a political level, voters have selected leaders at the state and city levels who believe in the necessity of renewable energy in reducing climate change. However, at the process level, the decisions to transition to renewable energy and where to site renewable energy projects are made with very little public input [44]. To better address cause and effect, future research is needed to assess how residents' attitudes change over time toward renewable energy sources as their community or region supplies renewable energy to the grid or chooses to be powered solely by renewable energy sources.

Illinois would make a good study area for future research. The state passed the Future Energy Jobs Act of 2016 that set a goal for Illinois to get 25% of its electricity from renewable sources such as wind farms, solar farms and rooftop solar panels by 2025 and is poised to pass a second bill, Senate Bill 2132, that sets an aggressive target of decarbonizing the state's energy by 2030 and powering the state completely on renewable energy by 2050 [66]. The state currently receives 31% of its energy from coal and about 9% from renewable energy. To achieve 100% renewable electricity, it would require over 80% of the current energy production workforce to be displaced [66]. That is a huge social and economic change. To handle such a large energy transition, the new bill would create business incubators for energy contractors, with an emphasis on communities that would lose fossil fuel jobs.

While helping to create jobs in regions that have seen a loss in fossil fuel jobs is important, more may be needed to help develop a sense of place that identifies with renewable energy (i.e. to ensure procedural justice). One must take into consideration how renewable energy will fit in with the current landscape, especially in rural areas where the majority of large energy developments are located. Communities whose local landscapes do not have a recent history of natural resource and/or energy extraction and instead are principally consumed for recreation and relaxation will most likely be less receptive to any energy development, including renewable energy development. While communities with long-standing histories of energy development may

[3] Roscoe [75] developed rules of thumb with respect to sample size and behavioral research. For multivariate research, Roscoe recommends the sample size be at least ten times larger than the number of variables. As we have 11 variables in our model, our sample of 160 meets this rule. We have also checked sufficiency of the data by conducting a split half analysis of consistency [76]. With this analysis, the data is divided randomly into two halves, which are then analyzed separately. If both sets of data generate the same conclusions (as determined by a correlation coefficient higher than 0.7), then sufficient data has been collected.

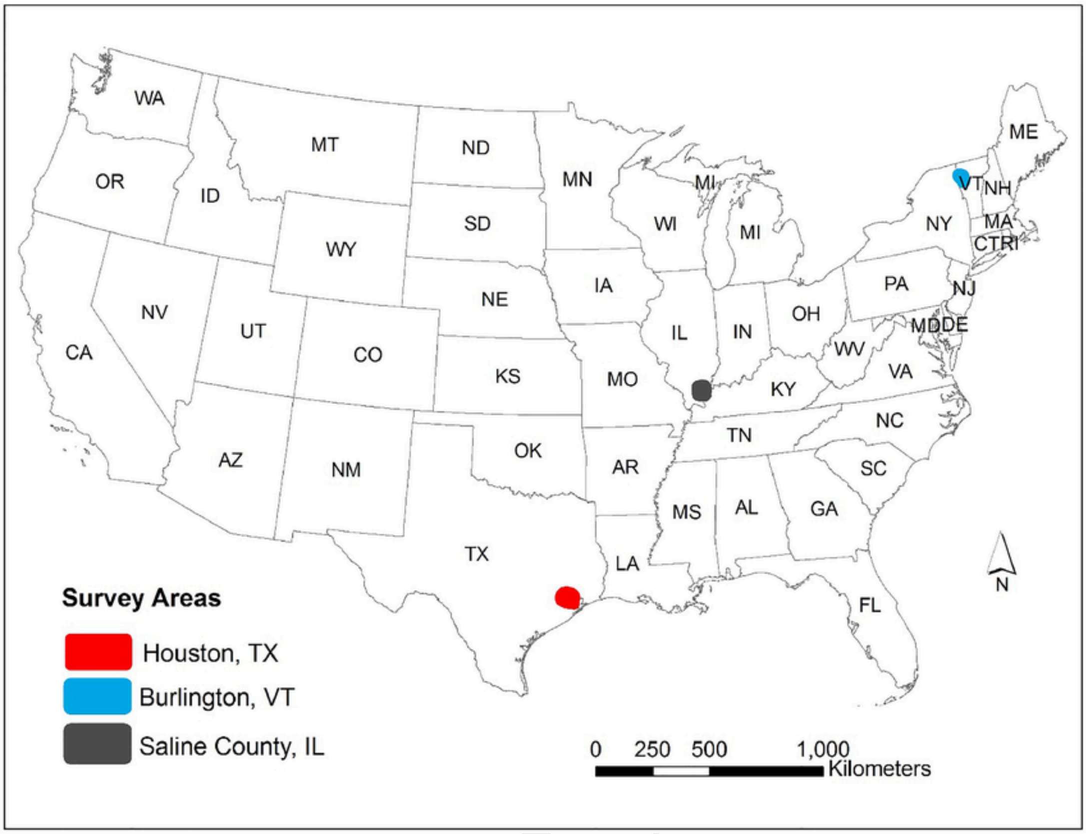

Fig. 1. Map of study locations.

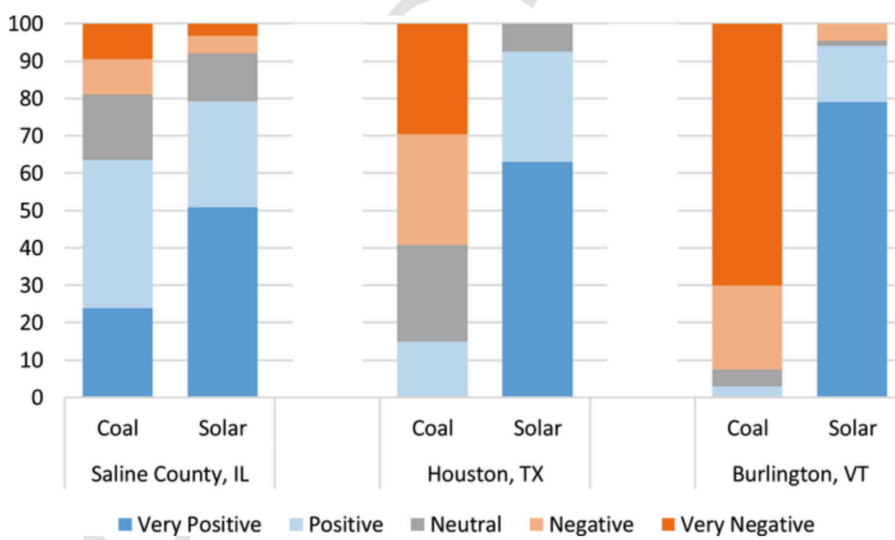

Fig. 2. Perceptions of coal and solar by study location.

be receptive to an energy transition, if it is economically and socially just. However, to ensure these communities' voices are accurately represented, future research is needed to expand the study area to include rural areas with other types of natural resource development as well as rural areas with little to no natural resource or agricultural development.

6. Conclusions and policy implications

In this research, we outline several policy recommendations for each of the three study locations (Table 8). With respect to Illinois, we recommend the state legislature pass and the governor sign into law Senate Bill 2132. Under this bill, the state would decarbonize by 2030 and run completely on renewable energy by 2050. This would include installing 40 million solar panels and 2500 wind turbines. The bill calls for cutting emissions from transportation and for vastly expanding the clean energy workforce [66]. Senate Bill 2132 would build on the Illinois' Future Energy Jobs Act that passed in 2016. The 2016 bill has led Illinois to become the 2nd highest ranked state in the U.S. too add solar jobs, with a growth of nearly 37% of total solar jobs in 2018 (an addition of 1308 jobs). Solar jobs are projected to grow by an additional 11% in 2019 [67]. This is impressive considering that solar jobs fell by

Table 8
Policy recommendations for each study location's state by specific actor.

	Illinois	Vermont	Texas
State Legislature	Pass Senate Bill 2132: Clean Energy Jobs Act	Pass House Bill 462: The Vermont Global Warming Solutions act	Hold a public hearing on Senate Bill 2069 and ultimately pass.
Governor	Sign into Law Senate Bill 2132	Sign into Law House Bill 462	Sign into law Senate Bill 20169
Environmental NGOs	Mobilize public pressure in collaboration with favorable media coverage to demand climate change action. Continue to produce detailed studies to inform policy makers.	Mobilize public pressure in collaboration with favorable media coverage to demand climate change action. Continue to produce detailed studies to inform policy makers.	Mobilize public pressure in collaboration with favorable media coverage to demand climate change action. Continue to produce detailed studies to inform policy makers.
Public	Call legislators and attend town hall meetings to insist they take bold action to address climate change including passage of Senate Bill 2132.	Call legislators and attend town hall meetings to insist they take bold action to address climate change including passage of House Bill 462.	Call legislators and attend town hall meetings to insist they take bold action to address climate change. Vote to elect state lawmakers that support climate change action and a just energy transition.

3.2% in the U.S. overall in 2018 due to President Trump placing a 30% tariff on imported solar components from China [68]. Passage of Senate Bill 2132 will lead to further job growth in both the solar sector and in other sustainable energy sectors. According to the executive director of the Illinois Solar Energy Association, the solar jobs growth in 2018 was just the beginning and the industry is on the verge of creating tens of thousands of new clean energy jobs in the coming years.

While southern Illinois is just beginning to see growth in solar jobs, a majority of solar jobs continue to be located in the Chicago metropolitan area in Northeast Illinois [67]. One major pillar that is included in Senate Bill 2132 is an amendment for energy justice. The Illinois Environmental Council, an NGO that is promoting the bill, is pushing for communities that have workers employed in the coal industry (mining and power) to see both financial and environmental benefits from the bill. Therefore, to achieve energy justice, a much higher percentage of future solar job growth will need to occur in the southern part of the state. Especially as coal jobs continue to decline in central and southern Illinois.

The media does not often report the fact that people living in "coal country" have positive attitudes for sustainable sources (as shown in our survey). We recommend that environmental NGOs collaborate with the media to report that a majority of the public, regardless of where they live, prefer sustainable energy sources. Therefore, it is important that studies focus on place-based communities tied to various forms of energy extraction and production so that their views are not ignored or misrepresented.

With respect to Vermont, we recommend the state legislature pass and the governor sign into law House Bill 462. While Vermont was one of the first states to set high goals to reduce climate change, these goals were not enforceable. The state took small steps over the last decade to increase wind and solar for electricity and make homes more energy efficient, but state greenhouse gas emissions are still 16% higher than 1990 levels. House Bill 462 makes Vermont's existing carbon pollution goals enforceable requirements. This requires policies and regulations to be in place to decrease emissions by 75% by 2050. It also allows for a transparent and inclusive process that gives impacted groups and communities a voice in designing solutions [69]. Vermont has a Democratic supermajority state legislature and a Republican governor. The governor believes it is necessary to reduce greenhouse gas emissions and to advance clean energy. Therefore, he may not veto the bill once it is passed. However, if he were to veto the bill, a supermajority would be needed to override it. To achieve a supermajority in the house, several legislators may need to be pressured by the public. Therefore, it is important that the public call their legislators and to attend town hall meetings to insist they take bold action to address climate change.

The state of Texas is politically different from Illinois and Vermont. While Illinois and Vermont have a majority pro-climate legislature and governors who want to reduce climate change, Texas has a majority state legislature and a governor that are anti-climate legislation. Despite several bills filed by Democratic legislators that address the need of studying the impacts of climate change and reducing climate change [70], the majority Republican congress will not hold hearings on any climate-related bill. While the Texas legislature and governor need to pass and sign these bills into law, such as Senate Bill 2069 that would require the development of a state-level climate adaptation plan, without a hearing being held, there is very little chance that any climate plan will be implemented under the current state government. Therefore, environmental NGOs need to mobilize public pressure in collaboration with favorable media coverage to demand climate change action. A recent poll by the University of Texas and the Texas Tribune found that 48% of Texans say the U.S. government should be doing "a great deal" or "a lot" about climate change [70]. NGOs can help drive this number up. Most importantly, Texans need to vote for state lawmakers that support climate change action. With Texas' long history of oil and natural gas production coupled with a Republican-controlled state legislature and governor, the likelihood of any climate change action is slim.

Fig. 3 displays the total number of solar industry jobs for each study location's state from 2015 to 2018. What is important to note is that public policies at the federal and state levels have a direct impact on the total number of solar jobs. The number of solar jobs fell from 2016 to 2017 at the national level and in each of the three states. This is a reflection of the tariffs placed on solar panels authorized by President Trump in 2016. However, while the tariffs were still in place in 2018, Illinois witnessed a large increase in solar jobs from 2017 to 2018 mainly due to the passage of the Illinois' Future Energy Jobs Act of 2016. Finally, notice that despite Texas not having any legislation promoting the solar industry, it had almost double the number of solar jobs than Illinois in 2018. This is partially due to companies taking advantage of Texas' sunny weather, large cities, and favorable business climate. However, it is still far behind California that is similar in size, population, and climate, yet has policies to reduce climate change. Thus, while several factors influence the growth of the solar industry, including economic viability, policies that enforce a transition to sustainable energy result in a growing solar industry.

While a transition to sustainable energy is imperative to reduce climate change, ensuring energy justice will make the transition go more smoothly for people and places who are tied to a fossil fuel industry. Creating a new sense of place around more sustainable energy sources and creating jobs for those displaced by the decline in nuclear and fossil fuel industries will help ease the hardship many face while transitioning to sustainable energy. We have made several policy recommendations for state government, NGOs, and the public to take that will help their states achieve a more balanced energy policy with respect to economics, politics, and the environment.

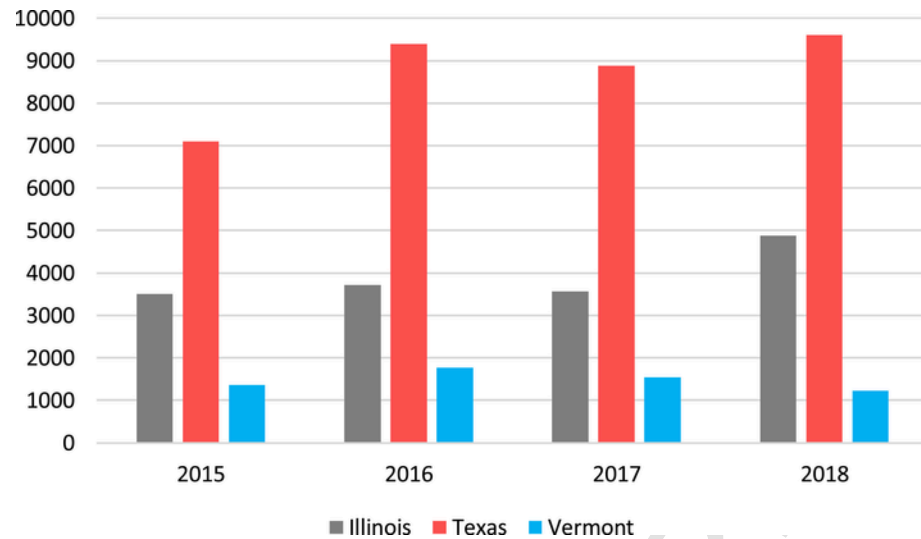

Fig. 3. Total number of solar industry jobs.

Declaration of Competing Interest

None.

Acknowledgment

This project was supported by the Energy Boost Seed Grant awarded by the Advanced Coal and Energy Research Center at Southern Illinois University Carbondale. We thank the following students, Astha Bista, David Leifer, Di Wu, Sourav Bhadra, and Yao Xue, for their help in printing, stapling and disseminating the surveys. None of the conclusions summarized here reflects views other than those of the authors.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.erss.2019.101309.

Appendix: Order of Dependent Variables in Questionnaire

Question	Responses
For each energy sources, please identify whether you have a negative or positive attitude toward the following:	1 = Very negative 2 = Negative 3 = Neutral 4 = Positive 5 = Very Positive
Coal Natural Gas Oil Nuclear Hydropower Wind Solar Geothermal	
Please identify whether you have a negative or positive attitude toward the following:	1 = Very negative 2 = Negative 3 = Neutral 4 = Positive 5 = Very Positive
Existing solar development Additional/future solar development Existing coal development Additional/future coal development	
Please identify how solar power has impacted (or has the potential to impact) the following:	1 = Very negatively 2 = Negatively 3 = Neutral 4 = Positively 5 = Very Positively
Climate change Air quality Water quality Local electricity bills Local tax revenue Area employment	
Please identify how coal power has impacted (or has the potential to impact) the following:	1 = Very negatively 2 = Negatively 3 = Neutral 4 = Positively 5 = Very Positively
Climate change Air quality Water quality Local electricity bills Local tax revenue Area employment	
In the United States, the number of people employed in the solar industry has increased by 168% since 2010, from about 93,000 to over 250,000 jobs in 2017. Please state your level of agreement or disagreement to the following statements:	1 = Strongly disagree 2 = Disagree 3 = Neither agree nor disagree 4 = Agree 5 = Strongly agree
The U.S. government should do more to help the solar industry. More effort should be made to employ more people in the solar industry. Within the next 10 years, I would like to live in a home that is mostly powered through solar energy.	

In 2017, United States coal production was at its lowest since the late 1970s. Employment in the U.S. coal industry has dropped from 90,000 in 2012 to 52,000 in 2018. Please state your level of agreement or disagreement to the following statements:	1 = Strongly disagree
	2 = Disagree 3 = Neither agree nor disagree 4 = Agree 5 = Strongly agree
The U.S. government should do more to help the coal industry.	
The U.S. government should do more to help displaced coal workers.	
Coal as a source of energy should be phased out.	
More effort should be made to employ more people in the coal industry.	
The production and consumption of coal is hazardous to the environment.	
More research is needed to clean coal.	
The production and consumption of coal is hazardous to one's health.	
The U.S. government should do more to assist with coal miners' medical treatments.	

References

[1] M. Child, C. Breyer, Transition and transformation: a review of the concept of change in the progress towards future sustainable energy systems, Energy Policy 107 (2017) 11–26, https://doi.org/10.1016/j.enpol.2017.04.022.

[2] S. Batel, P. Devine-Wright, T. Tangeland, Social acceptance of low carbon energy and associated infrastructures: a critical discussion, Energy Policy 58 (2013) 1–5, https://doi.org/10.1016/j.enpol.2013.03.018.

[3] J.J. Cohen, J. Reichl, M. Schmidthaler, Re-focusing research efforts on the public acceptance of energy infrastructure: a critical review, Energy 76 (2014) 4–9, https://doi.org/10.1016/j.energy.2013.12.056.

[4] D. Bell, T. Gray, C. Haggett, The social gap in wind farm siting decisions, Environ. Polit. 14 (2005) 460–477.

[5] D. Scheer, W. Konrad, S. Wassermann, The good, the bad, and the ambivalent: a qualitative study of public perceptions towards energy technologies and portfolios in Germany, Energy Policy 100 (2017) 89–100, https://doi.org/10.1016/j.enpol.2016.09.061.

[6] R. Wüstenhagen, M. Wolsink, M.J. Bürer, Social acceptance of renewable energy innovation: an introduction to the concept, Energy Policy 35 (2007) 2683–2691, https://doi.org/10.1016/j.enpol.2006.12.001.

[7] J.I.M. de Groot, L. Steg, W Poortinga, Values, perceived risks and benefits, and acceptability of nuclear energy, Risk Anal. 33 (2012) 307–317, https://doi.org/10.1111/j.1539-6924.2012.01845.x.

[8] M.R. Greenberg, NIMBY, CLAMP, and the location of new nuclear-related facilities: U.S. national and 11 site-specific surveys, Risk Anal. 29 (2009) 1242–1254, https://doi.org/10.1111/j.1539-6924.2009.01262.x.

[9] J. Van Der Pligt, Public attitudes to nuclear energy: salience and anxiety, J. Environ. Psychol. 5 (1985) 87–97, https://doi.org/10.1016/s0272-4944(85)80040-2.

[10] D. Venables, N.F. Pidgeon, K.A. Parkhill, K.L. Henwood, P. Simmons, Living with nuclear power: sense of place, proximity, and risk perceptions in local host communities, J. Environ. Psychol. 32 (2012) 371–383, https://doi.org/10.1016/j.jenvp.2012.06.003.

[11] H. Boudet, C. Clarke, D. Bugden, E. Maibach, C. Roser-Renouf, A. Leiserowitz, "Fracking" controversy and communication: using national survey data to understand public perceptions of hydraulic fracturing, Energy Policy 65 (2014) 57–67, https://doi.org/10.1016/j.enpol.2013.10.017.

[12] K.J. Brasier, D.K. McLaughlin, D. Rhubart, R.C. Stedman, M.R. Filteau, J. Jacquet, Research articles: risk perceptions of natural gas development in the Marcellus shale, Environ. Pract. 15 (2013) 108–122, https://doi.org/10.1017/s1466046613000021.

[13] J. Crowe, T. Silva, R.G. Ceresola, A. Buday, C. Leonard, Differences in public perceptions and leaders' perceptions on hydraulic fracturing and shale development, Sociol. Perspect. 58 (2015) 441–463, https://doi.org/10.1177/0731121414567355.

[14] C.E. Clarke, P.S. Hart, J.P. Schuldt, D.T.N. Evensen, H.S. Boudet, J.B. Jacquet, R.C. Stedman, Public opinion on energy development: the interplay of issue framing, top-of- mind associations, and political ideology, Energy Policy 81 (2015) 131–140, https://doi.org/10.1016/j.enpol.2015.02.019.

[15] T. Partridge, M. Thomas, B. Harthorn, N. Pidgeon, A. Hasell, L. Steveson, C. Enders, Seeing futures now: emergent US and UK views on shale development, climate change and energy systems, Global Environ. Change 42 (2017) 1–12.

[16] V.H.M. Visschers, M. Siegrist, Find the differences and the similarities: relating perceived benefits, perceived costs and protected values to acceptance of five energy technologies, J. Environ. Psychol. 40 (2014) 117–130, https://doi.org/10.1016/j.jenvp.2014.05.007.

[17] J. Jacquet, Landowner attitudes toward natural gas and wind farm development in northern Pennsylvania, Energy Policy 50 (2012) 677–688.

[18] C. Demski, C. Butler, K. Parkhill, A. Spence, N. Pidgeon, Public values for energy system change, Global Environ. Change 34 (2015) 59–69.

[19] R. Heffron, D. McCauley, G. Zarzua de Rubens, Balancing the energy trilemma through the energy justice metric, Appl. Energy 229 (2018) 1191–1201.

[20] R. Meyer, The green new deal has already won, 2019. https://www.theatlantic.com/science/archive/2019/06/bidens-climate-plan-mini-green-new-deal/591046/ (accessed June 6, 2019).

[21] D. Kurtzleben, Rep. Alexandria Ocasio-Cortez releases green new deal outline, National Public Radio (2019) https://www.npr.org/2019/02/07/691997301/rep-alexandria-ocasio-cortez-releases-green-new-deal-outline, (accessed March 11, 2019).

[22] S.E. Bell, R. York, Community economic identity: the coal industry and ideology construction in West Virginia, Rural Sociol. 75 (2010) 111–143, https://doi.org/10.1111/j.1549-0831.2009.00004.x.

[23] Facility Siting: Risk, Power and Identity in Land-Use Planning, in: A. Boholm, R. Lofstedt (Eds.), Facility Siting: Risk, Power and Identity in Land-Use Planning, Earthscan, London, 2004.

[24] A. Buday, The home rule advantage: motives and outcomes of local anti-fracking mobilization, Social Curr. 4 (2017) 575–593 https://doi.org/10.1177/2329496516686614.

[25] Managing Conflict in Facility Siting: an International Comparison, in: S. Lesbirel, D. Shaw (Eds.), Managing Conflict in Facility Siting: an International Comparison, Edward Elgar, Cheltenham, 2005.

[26] R. Phadke, Public deliberation and the geographies of wind justice, Sci. Cult. 22 (2013) 247–255.

[27] M. Wolsink, Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support, Renew. Energy 21 (, 1) (2000) 49–64.

[28] C. Warren, M. McFadyen, Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland, and Use Policy 27 (2010) 204–213.

[29] J. Baxter, D. Lee, Understanding expressed low concern and latent concern near a hazardous waste treatment facility, J. Risk Res. 7 (2004) 705–729.

[30] K. Burningham, D. Thrush, Pollution concerns in context: a comparison of local perception of risks associated with living close to a road and a chemical factory, J. Risk Res. 7 (2004) 213–232.

[31] S. Wakefield, S. Elliott, Environmental risk perception and well-being: effects of the landfill siting process in two southern Ontario communities, Social Sci. Med. 50 (2000) 1130–1154.

[32] V. November, Being close to risk. From proximity to connexity, Int. J. Sustainable Dev. 7 (2004) 273–286.

[33] P. Newell, D. Mulvaney, The political economy of the 'just transition', Geogr. J. (2013) 1–9.

[34] K. Jenkins, D. McCauley, R. Heffron, H. Stephan, R. Rehner, Energy justice: a conceptual review, Energy Res. Social Sci. 11 (2016) 174–182.

[35] D. McCauley, V. Ramasar, R. Heffron, B. Sovacool, D. Mebratu, L. Mundaca, Energy justice in the transition to low carbon energy systems: exploring key themes in interdisciplinary research, Appl. Energy 233 (2019) 916–921.

[36] A. Chomsky, Labor and the Environment in Latin America, Oxford Research Encyclopedia of Latin American History, 2016.

[37] N. Healy, J. Barry, Politicizing energy justice and energy system transitions: fossil fuel divestment and a "just transition", Energy Policy 108 (2017) 451–459.

[38] A. Miller, A. Iles, C. Jones, The social dimensions of energy transitions, Sci. Cult. 22 (, 2) (2013) 135–148.

[39] D. Evensen, R. Stedman, Beliefs about impacts matter little for attitudes on shale gas development, Energy Policy 109 (2017) 10–21.

[40] D. Evensen, R. Stedman, 'Fracking': promoter and destroyer of the'good life', J. Rural Stud. 59 (2018) 142–152.

[41] U.S. Energy Information Administration, Vermont state profile and energy estimates 2016, http://www.eia.gov/state/?sid=VT(accessed March 18, 2019).

[42] Vermont Department of Public Service, Comprehensive energy plan, 2011.

[43] Burlington Electric Department, Go solar!, 2019. https://burlingtonelectric.com/gosolar(accessed March 20, 2019).

[44] J. White, Renewable energy zoning, cutting green tape while improving ecological outcomes for renewable energy projects, Graduate College, 2014.

[45] U.S. Census, Quick facts, 2017. https://www.census.gov/quickfacts/fact/table/houstoncitytexas,US/PST045217(accessed March 18, 2019).

[46] J. Feagin, The global context of metropolitan growth: houston and the oil industry, Am. J. Sociol. 90 (1985) 1204–1230.

[47] J. Roper, Houston Economic Outlook: Steady Growth Ahead, Houston Chronicle, 2018 https://www.houstonchronicle.com/business/economy/article/Houston-economic-outlook-steady-growth-ahead-13442962.php, (accessed March 18, 2019).

[48] J. Mann, Renewable power cos. See potential home in Houston, Houston Bus. J. (2018) https://www.bizjournals.com/houston/news/2018/04/27/renewable-power-cos-see-potential-home-in-houston.html, (accessed March 18, 2019).

[49] A. Zabcik, Houston Solar Energy Grew 19% in 2017, Environment Texas, 2018 https://environmenttexas.org/news/txe/houston-solar-energy-grew-19-2017-0, (accessed March 18, 2019).

[50] United States Census Bureau, American factfinder, 2000. https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh = t
[51] United States Census Bureau, American factfinder, 2010https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh = t
[52] United States Census Bureau, County business patterns, 2012. http://censtats.census.gov
[53] T. Silva, J. Crowe, The hope-reality gap: rural community officials' perceptions of unconventional shale development as a means to increase local population and revitalize resource extraction, Commun. Dev. 46 (, 4) (2015) 312–328.
[54] B. Gray, Even in Illinois Coal Communities, Trump's Anticipated Impact on Industry is a Source of Debate, St. Louis Post-Dispatch, 2017 https://www.stltoday.com/business/local/even-in-illinois-coal-communities-trump-s-anticipated-impact-on/article_1d1890d6-3042-5b3f-9680-11d620861cf2.html, (accessed March 19, 2019).
[55] T. Maddox, Southern Illinois is Becoming a Hot Place for Energy Companies to Build Solar Farms, Belleville News-Democrat, 2018 https://www.bnd.com/news/local/article215363515.html, (accessed March 19, 2019).
[56] D.A. Dillman, J.D. Smyth, L.M. Christian, Internet, Phone, Mail, and Mixed-Mode Surveys: the Tailored Design Method, 4th edition, Wiley, Hoboken, 2014.
[57] U.S. Department of Labor, Databases, tables & calculators by subject, 2018. https://data.bls.gov/pdq/SurveyOutputServlet(accessed October 19, 2018).
[58] The Solar Foundation, Solar jobs census 2018, 2018. https://www.solarstates.org/#states/solar-jobs/2018(accessed August 16, 2019).
[59] U.S. Energy Information Administration, Coal data browser, 2016. https://www.eia.gov/coal/data/browser(accessed August 16, 2019).
[60] The Solar Foundation, Solar jobs census 2016, 2016. https://www.solarstates.org/#state/illinois/counties/solar-jobs/2016(accessed August 16, 2019).
[61] The Solar Foundation, Solar jobs census 2018, 2018. https://www.solarstates.org/#state/illinois/counties/solar-jobs/2018(accessed August 16, 2019).
[62] K. Gander, Donald Trump Bashes Solar Power and 'windmills': 'When the Wind Doesn't blow, Turn Off the Television darling,', Newsweek, 2019 https://www.newsweek.com/donald-trump-criticizes-solar-power-windmills-turn-television-1370707, (accessed August 20, 2019).
[63] R. Groves, E. Singer, A. Corning, Leverage-saliency theory of survey participation: description and an illustration, Publ. Opin. Q. 64 (2000) 299–308.
[64] H. Boudet, D. Bugden, C. Zanocco, E. Maibach, The effect of industry activities on public support for 'fracking,', Environ. Polit. (2016) 1–20.
[65] E. Howell, N. Li, H. Akin, D. Scheufele, M. Xenos, D. Brossard, How do U.S. state residents form opinions about 'fracking' in social contexts? A multilevels analysis, Energy Policy 106 (2017) 345–355.
[66] U. Irfan, An Illinois Bill Leans into the Most Contentious Part of the Green New Deal, Vox, 2019 https://www.vox.com/2019/3/7/18251566/green-new-deal-renewable-energy-illinois-bill, (accessed March 11, 2019).
[67] The Solar Foundation, Solar jobs census 2018: Illinois, 2018. https://www.thesolarfoundation.org/solar-jobs-census/factsheet-2018-il/(accessed August 15, 2019).
[68] A. Ruppenthal, Illinois Defies National Trend by Adding 1,300 Solar Jobs in 2018, WTTW, 2019 https://news.wttw.com/2019/02/13/illinois-solar-jobs-report, (accessed August 15, 2019).
[69] S. Levine, To Fight Climate change, Vermont Needs Strong Climate Laws, Conservation Law Foundation, 2019 https://www.clf.org/blog/vermont-strong-climate-laws/, (accessed August 15, 2019).
[70] C. Anchondo, Once again, Bills to Study the Impacts of Climate Change in Texas have Stalled, The Texas Tribune, 2019 https://www.texastribune.org/2019/05/10/climate-change-bills-do-not-get-hearings-this-session-in-texas/, (accessed August 15, 2019).
[71] N. Connelly, T. Brown, D. Decker, Factors affecting response rates to natural resource-focused mail surveys: empirical evidence of declining rates over time, Soc. Nat. Resour. 16 (2003).
[72] J. Boser, K. Green, Research on mail surveys: response rates and methods in relation to population group and time, In: Paper presented at the Annual Meeting of the Mid-South Educational Research Association, Memphis, TN, 1997.
[73] A. Kennedy, H. Hartig, Response Rates in Telephone Surveys Have Resumed Their Decline, Pew Research, 2019 https://www.pewresearch.org/fact-tank/2019/02/27/response-rates-in-telephone-surveys-have-resumed-their-decline/, (accessed March 20, 2019).
[74] Nonresponse in Social Science Surveys: a Research Agenda, in: R. Tourangeau, T. Plewes (Eds.), Nonresponse in Social Science Surveys: a Research Agenda, National Academy of Sciences, Washington, DC, 2013.
[75] J. Roscoe, Fundamental Research Statistics for the Behavior Sciences, 2nd ed., Holt, Rinehart and Winston, New York, NY, 1975.
[76] P. Martin, P. Bateson, Measuring Behavior: an Introductory Guide, 2nd ed., Cambridge University Press, Cambridge, UK, 1993.