Public Support for Community Microgrids

Contingent Valuation Evidence from Arizona, Colorado, New Mexico, and Utah

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Introduction

- The United States is rapidly modernizing it's electric grid
- In the American Southwest, policy objectives are for more renewable generation (NM Example)
- Rising natural and man-made disasters are impacting the electric grid (AZ Example)
- Need to harden the electric grid to insulate and take advantage of distributed energy resources
- **Community-level distribution-feeder microgrids are a potential solution**

Problem and Research Question

What is the problem?

- Public regulatory bodies oversee pricing and capital investments in the Southwest
- Broken link between public demand/support and the cost-benefit analysis
  - Non-market benefits are often not accounted due to lack of original research
- No current research on the public demand for microgrids in the Southwest

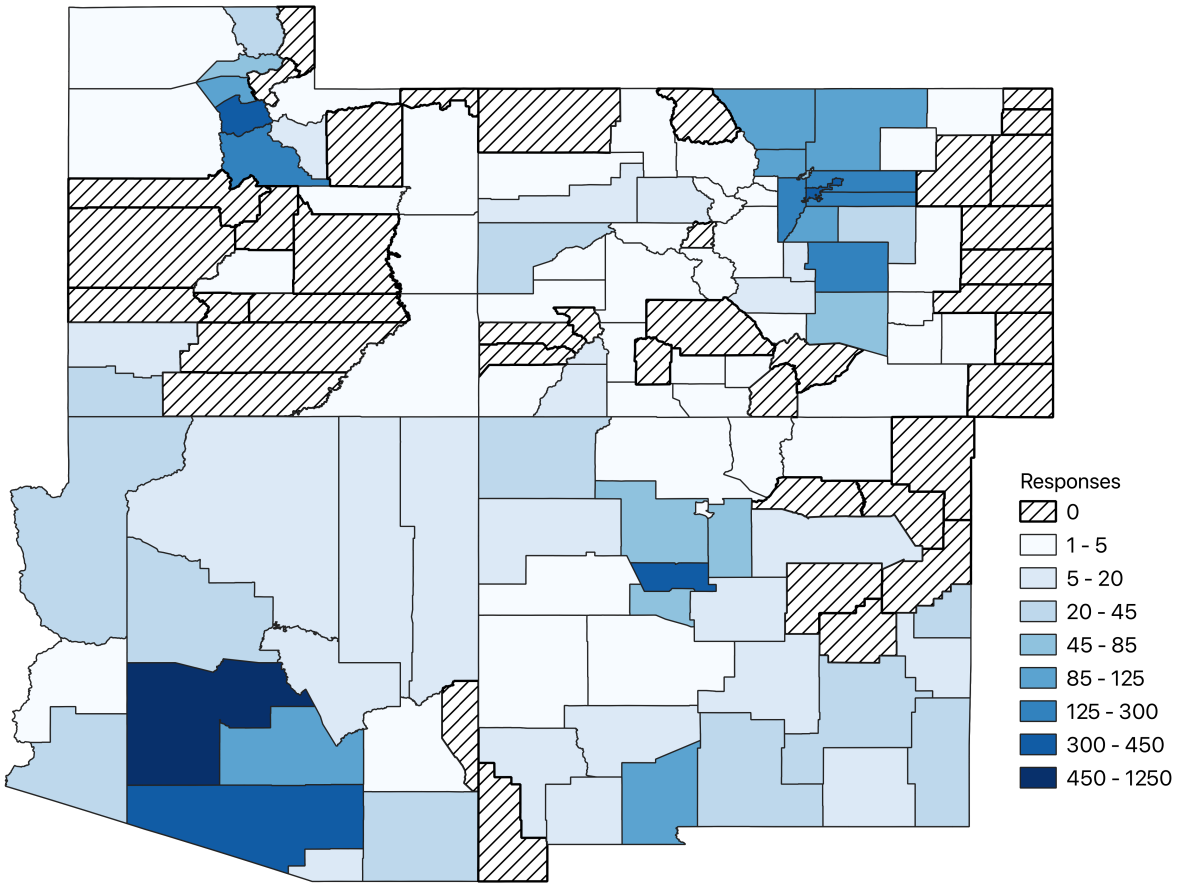
Research Question

What is the public demand for community microgrids in Arizona, Colorado, New Mexico, and Utah (Four Corners) contingent on the cost and level of benefits?

Survey Approach

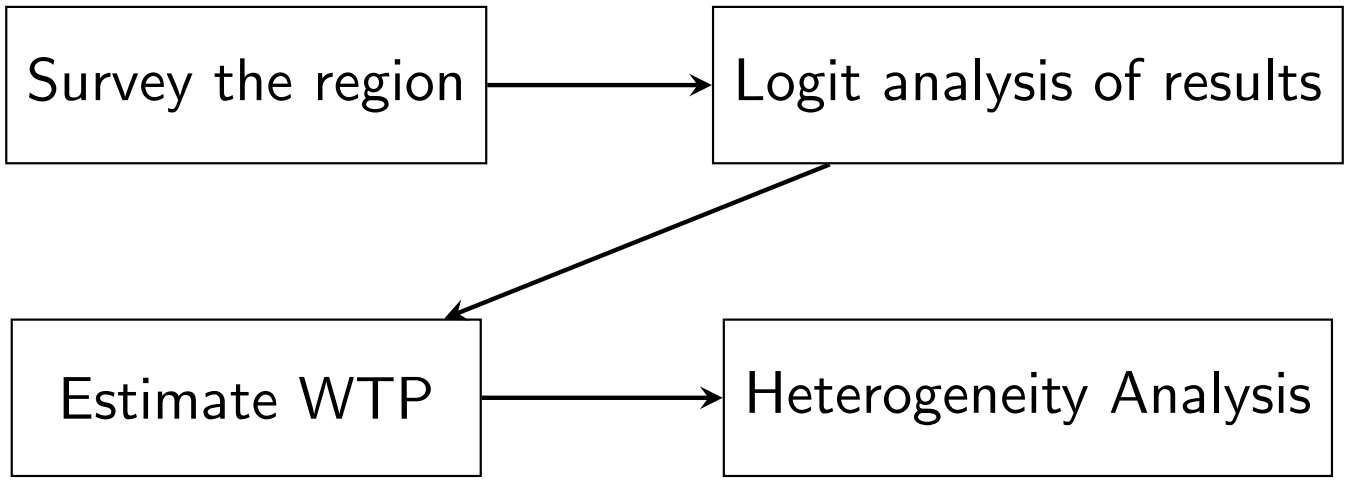
- Direct and indirect benefits of community microgrids warrant the use of contingent valuation (CV) methodology
  - Existence values, reduction in outages, etc.
- Survey of 4,782 ratepayers
  - Representative at the census level, web-based convenience, Aug 2020 - Jan 2021
- Collect observable characteristics such as attitudes and preferences, ideologies, sociodemographics, etc.
- Referendum style "closed-ended" valuation exercise with a split-sample variation in scope
- Elicit the median willingness-to-pay (WTP) for a community microgrid across the four-corners, for each state, and for customers of each ownership structure

Responses



Survey responses by county

Empirical Approach



Empirical approaches (Cameron and James, 1987; Carson et al., 1998; Haab and McConnell, 2002; Akter et al., 2008).

Information

Respondent's were informed of,

- What a community microgrid is and what will it do
- Benefits and costs of microgrids
- Why their opinion matters
- Real world examples of community microgrids

They were then provided with a cheap talk script to reduce hypothetical bias. Finally, they participated in a valuation exercise.

Valuation Question

Respondents asked to vote on a referendum to approve the installation of a community microgrid contingent on,

- A monthly increase in their customer surcharge for 24 months
- The level of benefits the respondent will receive from the microgrid

Split Sample Survey:

- Direct Benefits Group [n=2,385]: Customers' home and local critical infrastructure (police, hospital, grocery store, etc.)
- Indirect Benefits Group [n=2,397]: On the grid, no direct connection to home or local infrastructure, reduction in likelihood of disruptions

Surcharge Design: Based off the average monthly electric bill in the study region ($86.97). Explained in the next slide.

Voting Behavior

Table 1: Output

Payment Level	% Yes (Indirect)	% Yes (Direct)
$0.01	0.49	0.54
$0.50	0.56	0.58
$1	0.53	0.59
$3	0.43	0.48
$5	0.39	0.47
$9	0.31	0.34
$13	0.29	0.29
$17	0.21	0.29
Total	0.40	0.45

Note: All figures use a certainty re-coding scheme of 60% or higher on a numerical certainty scale to reduce hypothetical bias.

Median WTP Estimates

Table 2: Regional Monthly Median WTP Estimates

Region	Indirect Group	Direct Group
Four-Corners	\$0.58 (0.12) ***	\$1.06 (0.20) ***
Arizona	\$0.40 (0.14)***	\$0.98 (0.31)***
Colorado	\$0.39 (0.14)***	\$0.91 (0.33)***
New Mexico	\$0.77 (0.37)**	\$0.51 (0.27)*
Utah	\$1.02 (0.42)**	\$1.62 (0.71)**

Note: Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. All estimates include full specification of covariates (Appendix).

Median WTP Estimates

Using regional sales territory GIS data matched with respondent zip codes, I am able to match public utilities to each respondent,

Table 3: Ownership Structure Monthly Median WTP Estimates

Ownership Structure	Indirect Group	Direct Group
Investor-Owned	\$0.59 (0.16)***	\$1.05 (0.28)***
Cooperative	\$0.51 (0.27)*	\$0.77 (0.41)*
Municipal	\$0.69 (0.41)*	\$0.50 (0.28)*

Note: Standard errors in parentheses. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. All estimates include full specification of covariates (Appendix).

Main Conclusions

- First research attempting to evaluate public support for community microgrids using contingent valuation
- Across the four-corners, ratepayers WTP,
  - $25.44 for a microgrid that gives direct benefits (total 24 months)
  - $13.92 for a microgrid that gives indirect benefits
- Provides a baseline analysis of ratepayer WTP to be used in cost-benefit analysis
- Study harps on the need for utilities to conduct original research into their customer base
- 55% of No or Not Sure respondents would be more likely to vote for the microgrid if it used entirely renewable generation.

Covariates

Table 2: Summary Statistics for Observable Characteristics

Variable	Description	Coding	Mean	S.D.
Electricity Use and Provider				
Tracking	How carefully a HH tracks electricity use	1=Not carefully at all, 5=Very carefully	3.33	1.19
Ownership Structure	Knowledge of ownership structure	0 = Does not know, 1 = Knows the ownership structure	0.46	0.5
Best Interest	Does respondent think provider has their best interests in mind	0=No, 1=Yes	0.51	0.5
Confidence	How confident respondent is that provider will make correct decisions	1=Not at all confident, 5=Completely confident	3.49	1.02
Outage Length	Length of most recent outage	Categorical, varying timesteps range from never having an outage to outage lasting more than a month	1.76	1.74
Attitudes and Preferences				
Importance of Supply	"It is important to have as much electricity as I need when I need it"	1=Strongly disagree, 3=Neither agree nor disagree, 5=Strongly agree	3.98	0.98
Pollution	Concern for pollution from electricity generation	1=Not at all concerned, 5=Very Concerned	3.76	1.11
Ideological				
Political Ideology	Report political ideology	1=Strongly liberal, 4=Middle of the Road, 7=Strongly Conservative	4.11	1.74
Household				
Average Bill	Average monthly summer electric bill	Incremental by $50. 1=Less than $50, 3=$100-$150, 6=More than $250	3.56	1.88
Efficiency Upgrades	Ever made efficiency upgrades?	0=No, 1=Yes	0.53	0.5
Sociodemographic				
Income	Household income before taxes	Incremental, varying steps.	4.16	1.93
Covid Impact	Has HH income been affected by COVID	0=No, 1=Yes	0.43	0.49
Female	Respondent identifies as female	0=No, 1=Yes	0.51	0.49
Age	Age of respondent	Discrete: 18-93	46.84	17.8
Rural	Is household in rural environment?	0=No, 1=Yes	0.13	0.34

Note: All mean and standard deviation estimates are conducted using importance weights to mitigate oversampling in New Mexico.

Four-corners Regression

	Indirect	Direct
Logged Payment Level	-0.071***	-0.071***
	(0.007)	(0.007)
Income	0.022***	0.027***
	(0.007)	(0.007)
Tracking	0.016	0.004
	(0.010)	(0.011)
Ownership Structure	0.023	0.013
	(0.024)	(0.025)
Best Interest	0.021	-0.007
	(0.026)	(0.027)
Confidence	0.071***	0.080***
	(0.013)	(0.014)
Outage Length	0.001	0.020***
	(0.007)	(0.007)
Importance of Supply	0.084***	0.117***
	(0.012)	(0.013)
Pollution Concern	0.067***	0.062***
	(0.012)	(0.012)
Political Ideology	-0.008	-0.028***
	(0.007)	(0.007)
Average Bill	-0.005	-0.006
	(0.006)	(0.007)
Efficiency Upgrades	0.011	0.067***
	(0.024)	(0.025)
COVID-19 Impact	0.040*	-0.018
	(0.024)	(0.025)
Female	-0.055**	-0.041
	(0.025)	(0.026)
Age	-0.001	-0.001
	(0.001)	(0.001)
Rural	0.055	-0.003
	(0.034)	(0.037)
Monthly Median WTP	0.58	1.06
Total Median WTP	13.92	25.44
[95% CI]	[0.34, 0.82]	[0.67, 1.45]
p-value	0.000	0.000
Observations	2349	2336
(-2*LL)	2606.00	2585.80

Valuation Question

Now assume that your electric provider held a referendum style vote on whether to add a surcharge to your electricity bill for a duration of 2 years (24 billing cycles). This surcharge would pay for the installation of a microgrid. [Insert Variation of Scope] If more than 50% of respondents vote yes, your electric provider would install this microgrid and increase your electric bill (the amount is listed in the question below).
Taking into consideration your desire for the microgrid installation as well as your current disposable income, would you vote for the referendum to install the microgrids if the electric provider added a surcharge of $[Offered Payment] to your monthly electric bill for 24 billing cycles?