

Differences in Energy Preferences: Examining willingness to pay for energy plans in New Mexico

Kara Walter, PhD Candidate
Jennifer Thacher, Professor
Janie M Chermak, Professor

AUBER Fall 2017 Conference
October 22, 2018

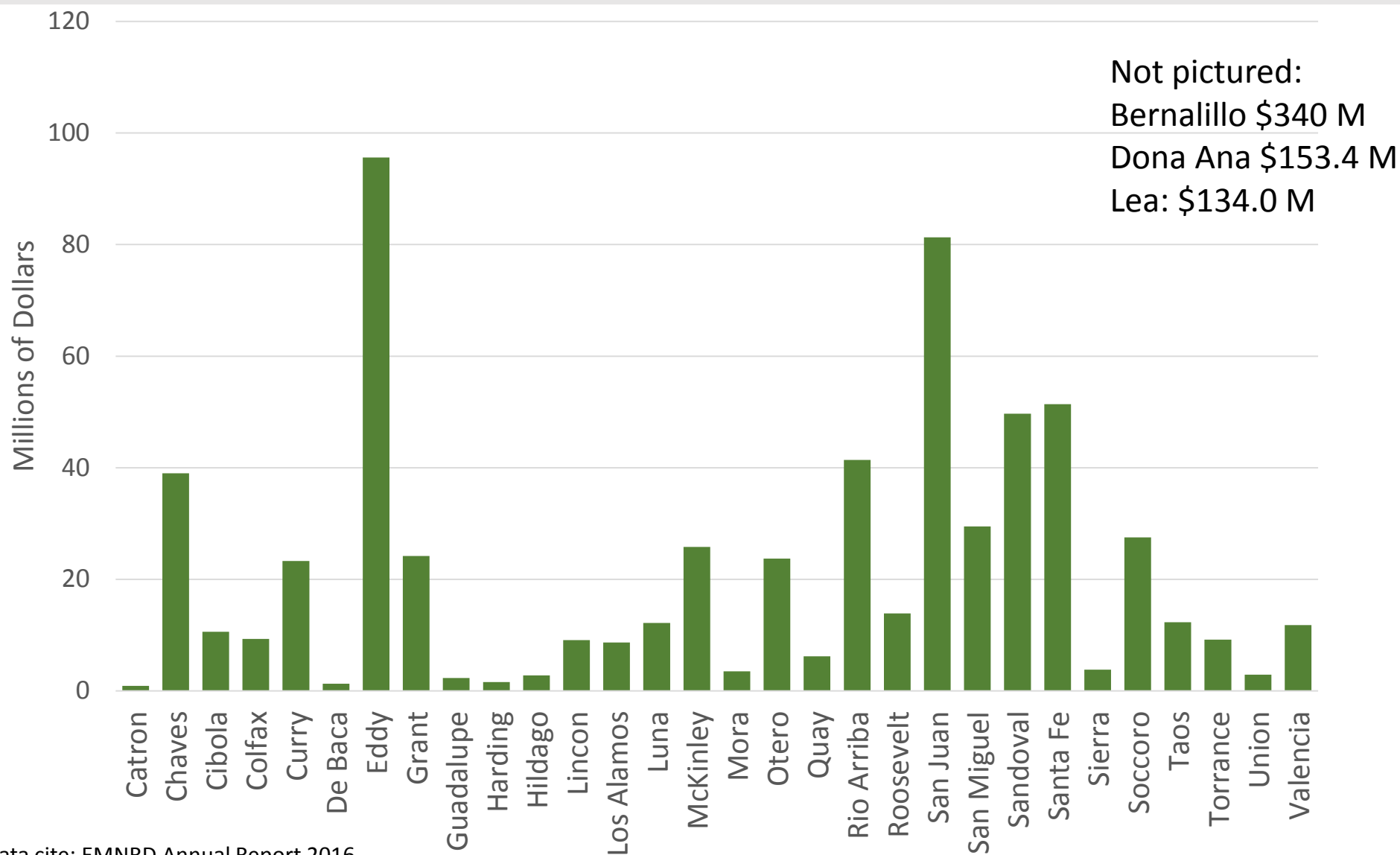
Literature



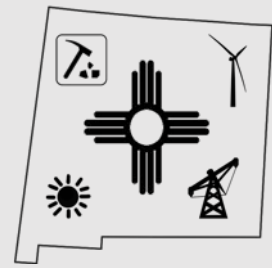
- Studies on preferences for renewable energy are easy to find
Borchers, Duke, and Parsons 2007; Van Rijnsoever and Farla 2014; Bergmann, Hanley, and Wright 2006; Cary and Kennedy 2016; Mozumder, Vásquez, and Marathe 2011; Ma et al 2015; Tvinnereim and Ivarsflaten (2016) ;
Bergmann, Colombo, and Hanley (2008)
- Most look at WTP to increase reliance on renewables or differences between renewable options
- We look at the MWTP of changing reliance on different potential sources including fossil fuels and renewables in a state with significant fossil fuel production



Study Area: New Mexico: County Tax Revenue from Oil & Gas Sector (FY 2013)



Survey

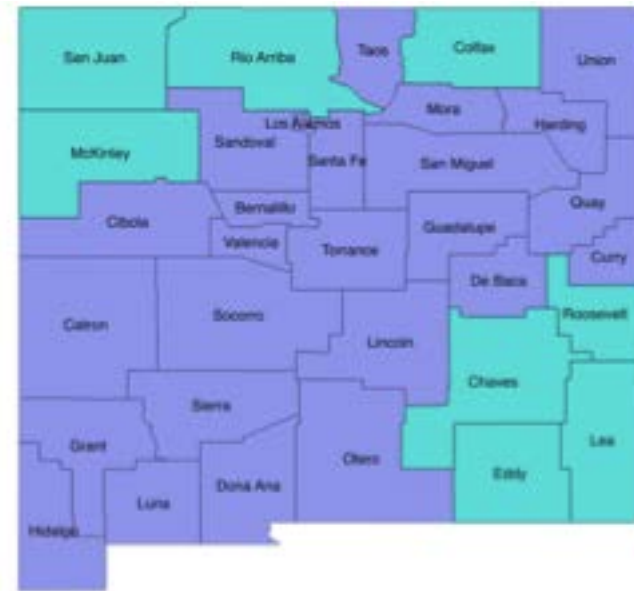


Followed Tailored Design Method
(Dillman et al 2014)

Oversampled in counties with
fossil fuel production

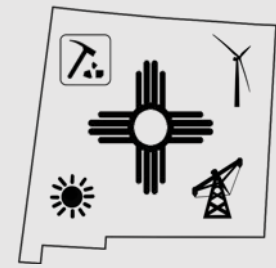
Sample: 1900

Response Rate: 28%



FF No Counties with fossil fuel production < \$1M
FF Yes Counties with fossil fuel production > \$1M

Survey and Choice Experiment



Directional Change:

- Carbon (2)
- Coal (3)
- Natural Gas (2)
- Nuclear (3)
- Renewable (2)

Numbered Change

- Jobs (3)
- Cost (6)

Consider the two following possible state plans for reducing carbon emissions. Which plan would you prefer? *Check State Plan A or State Plan B.*

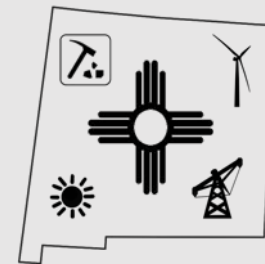
	State Plan A	State Plan B
Carbon emissions reduction	Reduce to required standard	Reduce to required standard
Electricity generation from coal	No change in coal. Improve plant efficiency.	Decrease in coal. No change in plant efficiency.
Electricity generation from natural gas	No change	Increase
Electricity generation from nuclear energy	Decrease	No change
Electricity generation from wind and solar	Increase	No change
Change in number of New Mexico jobs	Lose 2000 jobs	No change
Change in monthly electricity bill	\$10/mon increase	\$30/mon increase

I would choose Plan →

A

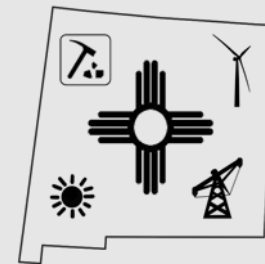
B

Model 1: Average Respondent



Carbon: Go Beyond CPP reductions	\$-4.94*
Natural Gas: Increase	\$-1.52
Renewable: Increase	\$7.48***
Nuclear Increase	\$-2.37
Nuclear: Decrease	\$2.36
Coal: Decrease and improve efficiency	\$10.43***
Coal: No change and improve efficiency	\$-0.28
Jobs: Increase by 2000	\$11.13***
Jobs: Decrease by 2000	\$-25.42***

Model 2: voteTrump Heterogeneity



voteTrump

- continuous variable that represents the percentage of the respondents county that voted for President Trump minus the state average of 40%

MWTP for respondents in county with 40% of vote to Pres Trump

- Renewables
- Jobs

Differences in MWTP for counties with more Pres Trump voters

- Natural Gas
- Nuclear (both)
- Coal
- Jobs (increase only)

Discussion



Agreement:

- Jobs, but at different levels for increasing
- Cost

Agreement among most groups

- Renewable
- Carbon emission reductions

Disagreement among some or all

- Natural Gas
- Nuclear
- Coal

Thank You!

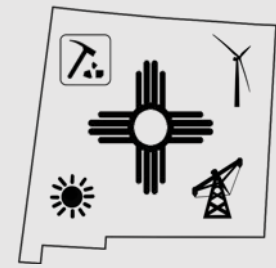
Thank you to NM EPSCoR for funding this research!

Kara Walter, PhD Candidate
Department of Economics at UNM
kawalter@unm.edu

Appendix 1

Slides people might request during presentation

Models and Interactions



Model 1: Average Respondent

- No interactions

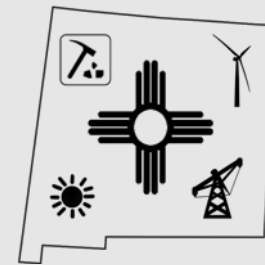
Model 2: FF & CC Heterogeneity

- FF County – dummy variable equal to 1 if person lives in fossil fuel county
- Climate No – dummy variable equal to 1 if person disagreed with climate statement: “Climate change is occurring and is made worse by humans.”

Model 3: voteTrump Heterogeneity

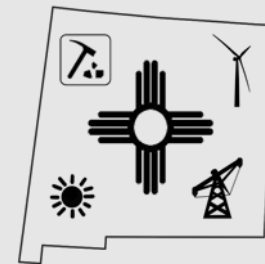
- voteTrump – continuous variable that represents the percentage of the respondents county that voted for President Trump minus the state average of 40%

Model 3: FF & CC Heterogeneity



Selected Interactions→	none	FF County	Climate No
Carbon: Go beyond CPP reductions	\$-1.96		\$-13.82***
Natural Gas: Increase	\$-6.31*	\$13.28***	\$1.34
Renewable: Increase	\$12.52***	\$-2.15	\$-18.87***
Nuclear: Increase	\$-2.57		
Nuclear: Decrease	\$3.04		
Coal: Dec & imp eff	\$12.33***	\$-2.58	\$-11.50*
Coal: No chg & imp eff	\$-5.5	\$4.62	\$14.8***
Jobs: Increase by 2000	\$8.30**	\$7.72*	
Jobs: Decrease by 2000	\$-23.97***	\$-2.76	

Model 5: voteTrump heterogeneity



Selected Interactions→	none	voteTrump
Carbon: Dec beyond standard	\$-2.32	\$0.29
Natural Gas: Increase	\$2.5	\$0.52***
Renewable: Increase	\$7.34**	\$0.02
Nuclear: Increase	\$-7.93	\$-0.72**
Nuclear: Decrease	\$-1.59	\$-0.49***
Coal: Decrease & improve efficiency	\$4.24	\$-0.57**
Coal: No change & improve efficiency	\$4.23	\$0.61**
Jobs: Decrease by 2000	\$-23.94***	\$0.06

+voteTrump represents the percentage of voters in the respondent's county that voted for President Trump over the state average

CE: Attributes & Levels

Attribute	Levels
Carbon emissions reduction (Carbon)	reduce <u>to</u> required standard* reduce by <u>more</u> than required
Electricity generation from coal (Coal)	Decrease coal & no change in efficiency* decrease coal & increased efficiency no change in coal & increased efficiency
Electricity generation from natural gas (Natural Gas)	no change* increase
Electricity generation from wind and solar (Renewable)	no change* increase
Electricity generation from nuclear energy (Nuclear)	decrease no change* increase
Change in number of New Mexico jobs (Jobs)	gain 2000 jobs no change* lose 2000 jobs
Change in monthly electricity bill (Cost)	no change \$5 \$10 \$20 \$30 \$40

Results: Model 1 & Model 2

		Model 1: MNL	Model 2: RPL
Cost: (continuous)		-0.0484*** (0.00367)	-2.851*** (0.219)
Carbon: Decrease beyond CPP		-0.239* (0.143)	-0.444* (0.243)
Natural Gas: Increase		-0.0734 (0.125)	-0.248 (0.214)
Renewables: Increase		0.362*** (0.138)	0.892*** (0.339)
Nuclear: Increase		-0.115 (0.237)	-0.422 (0.461)
Nuclear: Decrease		0.114 (0.137)	-0.134 (0.248)
Coal: Decrease & improve efficiency		0.504*** (0.169)	0.999*** (0.357)
Coal: No change & improve efficiency		-0.0136 (0.173)	0.122 (0.360)
Jobs: Increase 2,000 jobs		0.538*** (0.137)	0.850*** (0.286)
Jobs: Decrease 2,000 jobs		-1.229*** (0.142)	-2.294*** (0.578)
Cost: (continuous)			1.086*** (0.289)
Carbon: Decrease beyond CPP			0.118 (1.295)
Natural Gas: Increase			-0.823 (0.708)
Renewable: Increase			-0.0401 (1.061)
Nuclear: Increase			2.067** (0.886)
Nuclear: Decrease			0.910 (0.595)
Coal: Decrease & improve efficiency			-0.174 (0.861)
Coal: No change & improve efficiency			-2.957*** (0.996)
Model	N	2566	2566
Statistics	LL	-666.0	-655.6
	Chi2	289.3	20.84
	AIC	1351.9	1347.1
	BIC	1410.4	1452.4
SE in parenthesis. Significance Levels: * p<0.10, ** p<0.05, *** p<0.01 Omitted Levels: Carbon—no standard; Coal—Dec w/ no change in efficiency; Natural Gas, Renewables, Nuclear—no change. Jobs—no change Cost is lognormal distribution; other variables are normally distributed.			

Results: Model 3 & Model 4

Selected Interactions →	Model 3: MNL: FF & CC			Model 4: RPL: FF & CC		
	none	Fossil Fuel County [†]	Disagreed with Climate Statement ^{††}	none	Fossil Fuel County [†]	Disagreed with Climate Statement ^{††}
Cost: (continuous)	-0.0517*** (0.00391)			-2.735*** (0.229)		
Carbon: Decrease beyond CPP	-0.101 (0.161)		-0.715*** (0.241)	-0.202 (0.263)		-1.058** (0.420)
Natural Gas: Increase	-0.326* (0.167)	0.687*** (0.202)	0.687*** (0.202)	-0.724** (0.324)	1.176*** (0.422)	0.267 (0.351)
Renewables: Increase	0.647*** (0.175)	-0.111 (0.200)	-0.976*** (0.211)	1.333*** (0.442)	-0.216 (0.430)	-1.521*** (0.495)
Nuclear: Increase	-0.133 (0.251)			-0.586 (0.495)		
Nuclear: Decrease	0.157 (0.146)			-0.0900 (0.257)		
Coal: Decrease & improve efficiency	0.638*** (0.226)	-0.134 (0.332)	-0.595* (0.341)	1.037** (0.409)	0.116 (0.544)	-0.696 (0.570)
Coal: No change & improve efficiency	-0.285 (0.212)	0.239 (0.270)	0.765*** (0.278)	-0.405 (0.438)	0.416 (0.644)	1.520** (0.764)
Jobs: Increase 2,000 jobs	0.430** (0.171)	0.399* (0.239)		0.556* (0.318)	0.808* (0.480)	
Jobs: Decrease 2,000 jobs	-1.240*** (0.178)	-0.143 (0.260)		-2.250*** (0.618)	-0.351 (0.512)	
Cost: (continuous)				1.049*** (0.242)		
Carbon: Decrease beyond CPP				-0.0482 (0.859)		
Natural Gas: Increase				-0.774 (0.851)		
Nuclear: Increase				0.104 (0.714)		
Nuclear: Decrease				-2.364** (0.936)		
Coal: Decrease & improve efficiency				0.996* (0.555)		
Coal: No change & improve efficiency				-0.474 (0.875)		
Model Statistics	N	2490		2490		
	LL	-621.1		-610.0		
	Chi2	314.4		22.23		
	AIC	1284.3		1278.1		
	BIC	1406.5		1446.8		

SE in parenthesis.

Significance Levels * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[†] Respondent lives in a county with ~~xxx~~ \$1M in fossil fuel extraction in 2013.

^{††} "Climate change is occurring and is made worse by humans."

Omitted Levels: Carbon—no standard;
 Coal—Dec w/ no change in efficiency;
 Natural Gas, Renewables,
 Nuclear—no change.
 Jobs—no change

Table 8: Estimation Results for Models with vote Trump Heterogeneity

Selected Interactions →	Model 5: MNL: VoteTrump		Model 6: RPL: VoteTrump	
	none	Vote Trump	none	Vote Trump
Cost: (continuous)	-0.0520*** (0.00390)		-2.553*** (0.371)	
Carbon: Decrease beyond standard	-0.121 (0.172)	0.0149 (0.0101)	-0.305 (0.347)	0.0235 (0.0207)
Natural Gas: Increase	0.130 (0.134)	0.0273*** (0.00848)	0.0531 (0.272)	0.0482** (0.0229)
Renewables: Increase	0.382** (0.160)	0.00115 (0.00977)	1.058* (0.588)	-0.000725 (0.0216)
Nuclear: Increase	-0.412 (0.256)	-0.0372** (0.0163)	-0.912 (0.667)	-0.0432 (0.0352)
Nuclear: Decrease	-0.0826 (0.153)	-0.0253*** (0.00945)	-0.551 (0.426)	-0.0451* (0.0234)
Coal: Decrease & improve efficiency	0.221 (0.194)	-0.0298** (0.0124)	0.946 (0.617)	-0.0266 (0.0218)
Coal: No change & improve efficiency	0.220 (0.187)	0.0317** (0.0125)	0.755 (0.561)	0.0758* (0.0433)
Jobs: Gain 2,000 jobs	0.794*** (0.155)	0.0314*** (0.00950)	1.403** (0.611)	0.0575** (0.0287)
Jobs: Lose 2,000 jobs	-1.245*** (0.157)	0.00333 (0.00888)	-2.857** (1.257)	-0.00655 (0.0215)
Cost: (continuous)			1.013*** (0.277)	
Carbon:			-0.220 (0.975)	
Natural Gas: Increase			1.332 (0.941)	
Renewable			-0.699 (1.013)	
Nuclear: Increase			2.723* (1.524)	
Nuclear: Decrease			1.170 (0.924)	
Coal: Decrease & improve efficiency			0.869 (0.857)	
Coal: No change & improve efficiency			3.559** 1.013***	
Model Statistics	N	2532		2532
	LL	-633.2		-623.1
	Chi2	305.8		20.12
	AIC	1304.3		1300.2
	BIC	1415.2		1457.8

SE in parenthesis.

Significance Levels * p<0.10, ** p<0.05, *** p<0.01

+voteTrump represents the percentage of voters in the respondent's county that voted for President Trump over the state average

Omitted Levels: Carbon—to standard;
Coal—Dec w/ no change in efficiency;
Natural Gas, Renewables,
Nuclear—no change.
Jobs—no change

Results:
Model 5
&
Model 6

Return: Last
Return: Results

MWTP Table

Table 6: MWTP from MNL Models

Selected Interactions →	Model 1: MNL	Model 3: MNL: FF & CC			Model 5: MNL: VoteTrump	
			Fossil Fuel County	Disagreed w/ Climate Statement		Vote Trump
<i>Carbon: Dec beyond standard</i>	\$-4.94* (\$-11.21, 0.94)	\$-1.96 (\$-8.40, 4.26)		\$-13.82*** (\$-4.18, -24.25)	\$-2.32 (\$-9.2, 4.25)	\$0.29 (\$-0.09, 0.68)
<i>Natural Gas: Increase</i>	\$-1.52 (\$-6.92, 3.08)	\$-6.31* (\$-12.91, -0.76)	\$13.28*** (\$5.97, 21.44)	\$1.34 (\$-6.28, 9)	\$2.5 (\$-2.75, 7.23)	\$0.52*** (\$0.2, 0.84)
<i>Renewable: Increase</i>	\$7.48*** (\$1.40, 13.58)	\$12.52*** (\$5.37, 19.84)	\$-2.15 (\$-9.29, 5.61)	\$-18.87*** (\$-28.33, -10.87)	\$7.34** (\$0.83, 13.84)	\$0.02 (\$-1.28, -0.1)
<i>Nuclear: Increase</i>	\$-2.37 (\$-11.48, 6.90)	\$-2.57 (\$-11.6, 6.57)			\$-7.93 (\$-17.27, 1.62)	\$-0.72** (\$-1.28, -0.1)
<i>Nuclear: Decrease</i>	\$2.36 (\$-2.85, 7.94)	\$3.04 (\$-2.22, 8.54)			\$-1.59 (\$-7.28, 4.04)	\$-0.49*** (\$-0.85, -0.13)
<i>Coal: Decrease & improve efficiency</i>	\$10.43*** (\$4.12, 17.94)	\$12.33*** (\$4.08, 21.47)	\$-2.58 (\$-15.26, 10.51)	\$-11.50* (\$-25.14, 1.67)	\$4.24 (\$-2.64, 12.12)	\$-0.57** (\$-1.03, -0.1)
<i>Coal: No change & improve efficiency</i>	\$-0.28 (\$-7.29, 6.90)	\$-5.5 (\$-13.29, 2.99)	\$4.62 (\$-5.55, 14.97)	\$14.8*** (\$4.12, 25.1)	\$4.23 (\$-2.87, 11.63)	\$0.61** (\$0.1, 1.06)
<i>Jobs: Increase by 2000</i>	\$11.13*** (\$5.47, 16.88)	\$8.30** (\$1.90, 14.71)	\$7.72* (\$-1.22, 16.63)		\$15.27*** (\$9.22, 21.37)	\$0.6*** (\$0.26, 0.99)
<i>Jobs: Decrease by 2000</i>	\$-25.42*** (\$-31.19, -20.01)	\$-23.97*** (\$-30.66, -17.63)	\$-2.76 (\$-12.77, 6.62)		\$-23.94*** (\$-29.8, -18.57)	\$0.06 (\$-0.29, 0.42)
Model Statistics	N	2566	2490			2532
	LL	-666.0	-621.1			-633.2
	Chi2	289.3	314.4			305.8
	AIC	1351.9	1284.3			1304.3
	BIC	1410.4	1406.5			1415.2

Krinsky-Robb 95% confidence interval in parentheses.

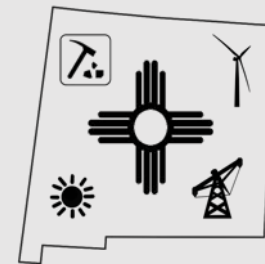
Significance Level (based on coefficient significance) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Omitted Levels: Carbon—no standard;
Coal—Dec w/ no change in efficiency;
Natural Gas, Renewables,
Nuclear—no change.
Jobs—no change

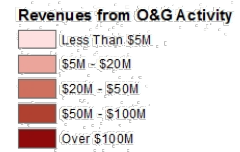
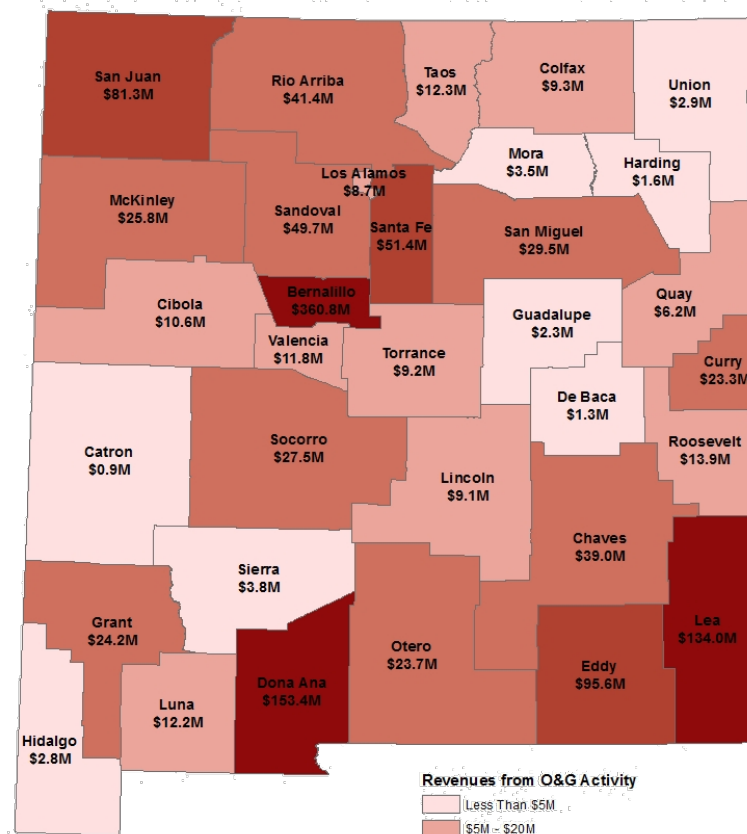
Appendix 2

Slides that may be useful in the future. Alternative organizations, etc

Study Area: New Mexico



County Revenues from Oil & Gas Activity (Fiscal Year 2013)



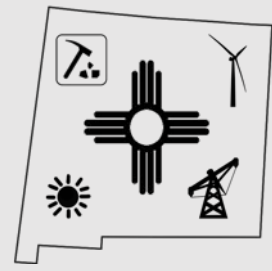
Note: Data from NM Tax Research Institute, 2014. Fiscal Impacts of Oil and Natural Gas Production in New Mexico. Revenue derived from state general fund education appropriations attributable to oil and gas (K-12 and higher education), capital allocations and severance tax bonds attributable to oil and gas, gross receipts tax attributable to oil and gas that are returned to the county, and ad valorem production and ad valorem production equipment taxes in producing counties.



Date: 6/16/2014

•<Cite: ABQ Journal Flynn>

Carbon: go beyond CPP reductions



Base: meet CPP reductions

Model 1: Average Respondent

\$-4.94*

Model 2: FF & CC Heterogeneity

\$-1.96

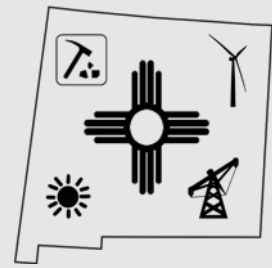
+ \$-13.82*** if disagreed with climate statement

Model 3: voteTrump Heterogeneity

\$-2.32

+ \$0.29 per percentage over 40% of county that voted for Trump

Natural Gas: Increase Reliance



Base: No Change

Model 1: Average Respondent
\$-1.52

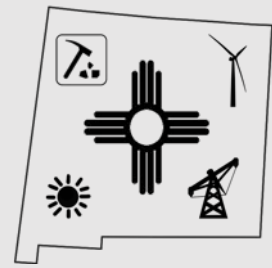
Model 2: FF & CC Heterogeneity
\$-6.31*

- + \$13.28*** if lives in county with fossil fuel production
- + \$1.34 if disagreed with climate statement

Model 3: voteTrump Heterogeneity
\$2.50

- + \$0.52*** per percentage over 40% of county that voted for Trump

Renewables: Increase Reliance



Base: No Change

Model 1: Average Respondent

\$7.48***

Model 2: FF & CC Heterogeneity

\$12.52***

+ \$2.15 if lives in county with fossil fuel production

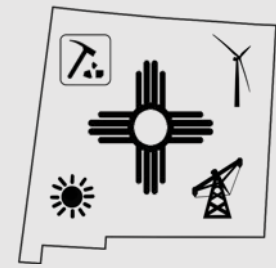
+ \$-18.87*** if disagreed with climate statement

Model 3: voteTrump Heterogeneity

\$7.34**

+ \$0.02 per percentage over 40% of county that voted for Trump

Nuclear: Increase Reliance



Base: No Change

Model 1: Average Respondent

\$-2.37

Model 2: FF & CC Heterogeneity

\$-2.57

Model 3: voteTrump Heterogeneity

\$-7.93

+ \$-72 per percentage over 40% of county that voted for Trump

Nuclear: Decrease Reliance



Base: No Change

Model 1: Average Respondent

\$2.36

Model 2: FF & CC Heterogeneity

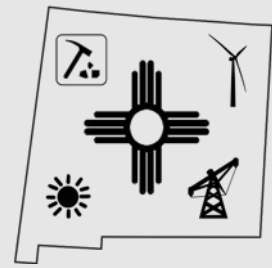
\$3.04

Model 3: voteTrump Heterogeneity

\$-1.59

+ \$-0.49*** per percentage over 40% of county that voted for Trump

Coal: Decrease Reliance and improve efficiency



Base: decrease reliance
and no change in efficiency

Model 1: Average Respondent

\$10.43***

Model 2: FF & CC Heterogeneity

\$12.33***

+ \$-2.58 if lives in county with fossil fuel production

+ \$-11.50* if disagreed with climate statement

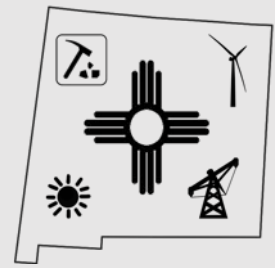
Model 3: voteTrump Heterogeneity

\$4.24

+ \$-0.57** per percentage over 40% of county that voted for Trump

Coal:

No change in reliance and improve efficiency



Base: decrease reliance
and no change in efficiency

Model 1: Average Respondent

\$0.28

Model 2: FF & CC Heterogeneity

\$-5.50

+ \$4.62 if lives in county with fossil fuel production

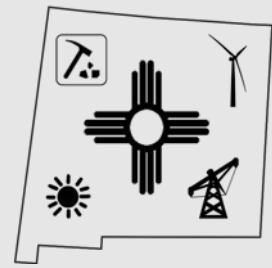
+ \$14.8 if disagreed with climate statement

Model 3: voteTrump Heterogeneity

\$4.23

+ \$0.61** per percentage over 40% of county that voted for Trump

Jobs:
Gain 2,000



Base: No Change

Model 1: Average Respondent

\$11.13***

Model 2: FF & CC Heterogeneity

\$8.30**

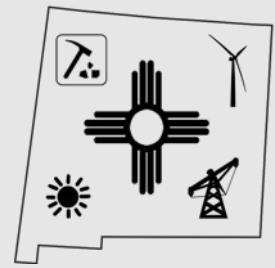
+ \$7.72* if lives in county with fossil fuel production

Model 3: voteTrump Heterogeneity

\$15.27***

+ \$0.60*** per percentage over 40% of county that voted for Trump

Jobs:
Lose 2,000



Base: No Change

Model 1: Average Respondent
\$-25.42

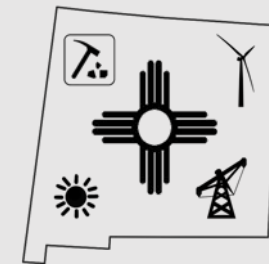
Model 2: FF & CC Heterogeneity
\$-23.97

+ \$-2.76 if lives in county with fossil fuel production

Model 3: voteTrump Heterogeneity
\$-23.94***

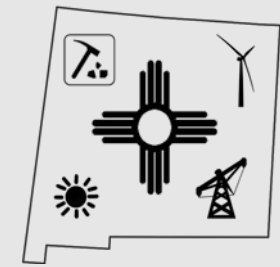
+ \$0.06 per percentage over 40% of county that voted for Trump

Model 1: No heterogeneity



Attribute and Level:	Monthly MWTP
Carbon: Dec beyond standard	\$-4.94*
Natural Gas: Increase	\$-1.52
Renewable: Increase	\$7.48***
Nuclear: Increase	\$-2.37
Nuclear: Decrease	\$2.36
Coal: Decrease & improve efficiency	\$10.43***
Coal: No change & improve efficiency	\$-0.28
Jobs: Increase by 2000	\$11.13***
Jobs: Decrease by 2000	\$-25.42***

Model 2: Unobservable heterogeneity

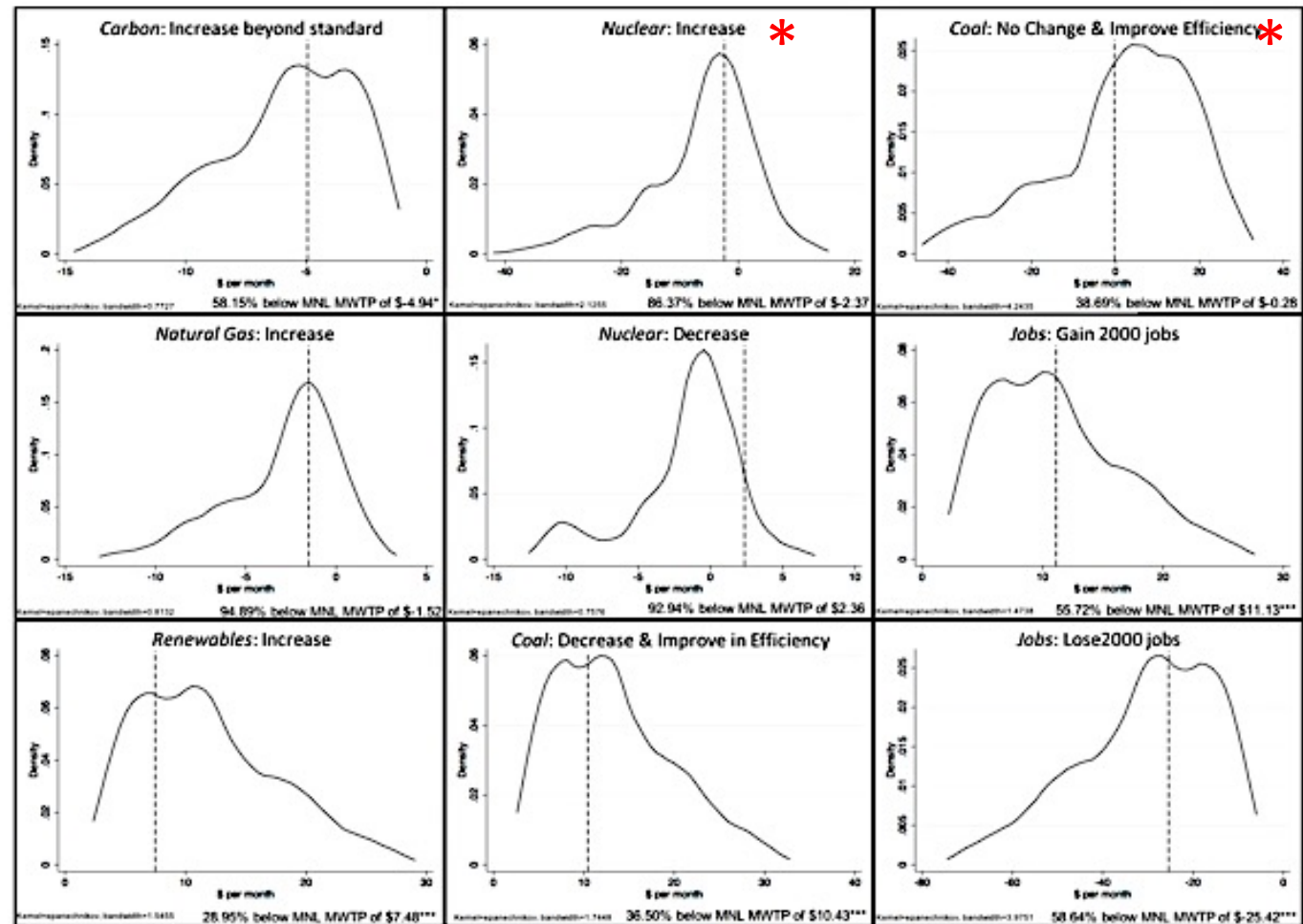


(Note: Density values on y-axis varies by attribute and level)

Means Significant

- Cost (-)
- Carbon (-)
- Renewable increase (+)
- Coal decrease and improve efficiency (+)
- Jobs gain 2000 (+)
- Jobs lose 2000 (-)

* Denotes SD was significant

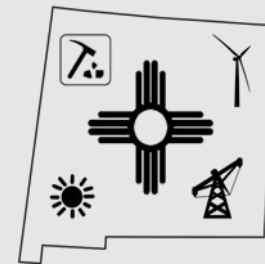


----- Estimated MWTP from Model 1: MNL

————— Distribution of Individual MWTP from Model 2: RPL

Note: Top and bottom 5% were dropped.

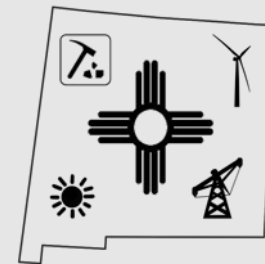
Model 3: MNL with FF & CC Heterogeneity



Selected Interactions→ none FF County Yes Climate No

Selected Interactions→	none	FF County Yes	Climate No
Carbon: Dec beyond std	\$-1.96		\$-13.82***
Natural Gas: Increase	\$-6.31*	\$13.28***	\$1.34
Renewable: Increase	\$12.52***	\$-2.15	\$-18.87***
Nuclear: Increase	\$-2.57		
Nuclear: Decrease	\$3.04		
Coal: Dec & imp eff	\$12.33***	\$-2.58	\$-11.50*
Coal: No chg & imp eff	\$-5.5	\$4.62	\$14.8***
Jobs: Increase by 2000	\$8.30**	\$7.72*	
Jobs: Decrease by 2000	\$-23.97***	\$-2.76	

Model 5: MNL with voteTrump heterogeneity



Selected Interactions→	none	voteTrump ⁺
Carbon: Dec beyond standard	\$-2.32	\$0.29
Natural Gas: Increase	\$2.5	\$0.52***
Renewable: Increase	\$7.34**	\$0.02
Nuclear: Increase	\$-7.93	\$-0.72**
Nuclear: Decrease	\$-1.59	\$-0.49***
Coal: Decrease & improve efficiency	\$4.24	\$-0.57**
Coal: No change & improve efficiency	\$4.23	\$0.61**
Jobs: Decrease by 2000	\$-23.94***	\$0.06

+voteTrump represents the percentage of voters in the respondent's county that voted for President Trump over the state average