Title of the Presentation:

Is biomass co-firing a means to end or extend coal-based electricity production in the US? Evidence from a choice experiment

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Is biomass co-firing a means to end or extend coal-based electricity production in the US? Evidence from a choice experiment

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Introduction

- In 2021 the key goal set by COP26 was to secure global net zero emissions by 2050 and keep 1.5 degrees within reach
- To deliver on the target, countries will need to accelerate the phase-out of coal
- CO_2 emissions by US electric power sector amounts to 32% of total U.S. energy related CO_2 emissions in 2021 (EIA)
- The need to reduce CO_2 while meeting energy security needs has brought a renewed focus on increasing renewable energy sources in the energy mix
- Co-firing biomass with coal is a near term, low-cost option for efficiently and cleanly generating electricity
- Not only reduces the environmental footprint but also offers multiple benefits - reduction of NO_x SO_2, and generation of new markets for agriculture (Hite et al. 2008)
- Significant driver of widespread adoption is cost of implementation, co-firing ratio and biomass storage (Agbor et al., 2014; Rentizelas et al. 2009)
- Al-Mansour and Zuwala (2010) outline three mature technological approaches: direct co-firing (lowest cost), indirect co-firing and parallel co-firing
- Also, high operational and maintenance cost of co-firing equipment, cost of biomass feedstock, adequate year-round supply and cost of transport are major drivers (Goerndt et al. 2013)
- This paper uses a Choice Experiment framework to gauge consumers' willingness-to-pay (WTP) for electricity derived from co-firing biomass with coal

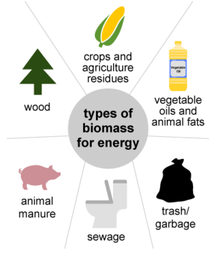

Fig1: Biomass Sources
Source: EIA

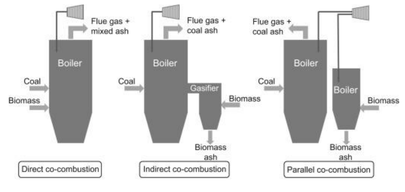

Fig2: Types of co-firing
Source: María V. Gil, Fernando Rubiera (2019). Coal and biomass cofiring: fundamentals and future trends

Objective

- No studies have focused on consumers' preferences for biomass and coal co-fired electricity
- A concern with the promotion of co-firing is how it will impact the phasing out of coal - Do consumers view it as a means to prolong the use of coal? What would be the ideal fuel-mix for co-firing?

Survey Design

The choice experiment was designed with the following attributes and levels:

1) Change in your monthly electricity bill
- No Change, Decrease 10%, Decrease 5%, Increase 5%, Increase 10%

2) Fuel used to produce your baseload electricity
- (100% coal, 90% coal 10% biomass co-fired, 70% coal 30% biomass co-fired, 50% coal 50% biomass co-fired)

3) Type of Biomass co-fired
- None, Wood processing waste, Dedicated energy crops, Agricultural waste

4) Planned phaseout date of Coal for electricity production in the U.S.
- 2035, 2050, 2065

5) Change in your household annual carbon footprint
- Decrease 5%, No Change, Increase 5%

Sample Choice Scenario:

	Option A	Option B	Standard Option
Change in your monthly electricity bill	Decrease 5%	Increase 5%	No change
Fuel used to produce your baseload electricity	90% coal 10% biomass co-fired	50% coal 50% biomass co-fired	100% coal
Type of Biomass co-fired	Wood processing waste	Agricultural waste	None
Planned phaseout date of coal for electricity production in your region	2035	2065	2050
Change in your household annual carbon footprint	Decrease 5%	Increase 5%	No change

Summary Statistics

Variables		Mean	Std. Dev.
Age		43.87	(17.30)
Gender			
	% Male	47.36	(0.49)
	% Female	51.48	(0.49)
Education			
	Less than HS	2.46	(0.37)
	HS	29.2	(0.45)
	Some College	16.94	(0.37)
	College/Undergraduate	12.17	(0.32)
	Advanced/Graduate	39.14	(0.48)
Income Level			
	$0-25k	18.25	(0.38)
	$25k-50k	20.72	(0.40)
	$50k-75k	19.57	(0.39)
	$75k-100k	13.48	(0.34)
	$100k-150k	17.59	(0.38)
	$150k+	10.36	(0.30)
	Urban	33.72	(0.47)
	Rural	21.05	(0.41)
	Suburban	45.23	(0.49)
N		**608**	

Results

- We use a mixed logit model to calculate the coefficients and the willingness-to-pay. The results from the model are shown below:

Variable	Coefficient
Cost of electricity	-0.031***
	(0.002)
Fuel mix	-0.007***
	(0.001)
Phase-out date	-0.003**
	(0.002)
Energy crop	0.066
	(0.15)
Agricultural waste	0.097**
	(0.045)
Carbon footprint	-0.036***
	(0.005)
Status Quo	-1.925***
	(0.185)
Log likelihood	-5177.843
No. of choices	18240
No. of respondents	608

Table: Standard errors in parenthesis. *p <0.1, **p <0.05, ***p <0.01

Willingness to pay estimates:

- Fuel %

Consumers are willing to increase their monthly electricity bill by 0.25% for each 1% increase in the percentage of biomass in the co-fired fuel mix

- Phase-out date of Coal

Consumers are willing to increase their monthly electricity bill by 0.29% for each 1 year reduced in the phase-out date of coal from 2065

- Carbon Footprint

Consumers are willing to increase their monthly electricity bill by 1.17% for each 1% reduction in their household's carbon footprint

- Status Quo

Consumers are willing to accept a reduction of 61.87% of their monthly electricity bill to maintain the status quo of using only coal

WTP	
Fuel mix	-0.251
Phase-out date	-0.095
Energy crop	2.123
Agricultural waste	3.130
Carbon footprint	-1.174
Status Quo	-61.874

Conclusion

- The results show that consumers prefer an increase in the percentage of biomass in the fuel mix but also prefer an earlier date for the planned phase-out of coal

References

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