

# The Perverse Impact of Calling for Energy Conservation

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# Calls for Conservation

At times of high load utilities ask for help

## Pepco Urges Customers to Conserve Energy

Pepco today urged customers to conserve energy wherever possible as high temperatures are forecasted to affect the entire mid-Atlantic region. While power supply in the region is expected to be sufficient to meet anticipated high demand, extreme heat also can stress electric system equipment. -July, 18 2011

# Research Question

What are the supply-side impacts of calls for conservation?

- How do consumers respond to calls for conservation?
  - Evaluate relative to a command-control conservation program
  - Evaluate response to media intensity
  - How does consumer behavior translate to production side
  - Do consumers conserve in the optimal way

# PEPCO/BGE Cycling Programs

- Focus on Baltimore-DC area utilities PEPCO and BGE
- BGE has a cycling program called “Peak Rewards” in place throughout sample
- Consumers commit to 50%, 75% or 100% cycling during events
- Around 330,000 households enrolled

	50% cycling	75% cycling	100% cycling
Year 1 total bill credits & bonus	\$100	\$150	\$200
Year 2 total bill credits	\$50	\$75	\$100
Year 3 total bill credits	\$50	\$75	\$100
Year 4 total bill credits	\$50	\$75	\$100
Year 5 total bill credits	\$50	\$75	\$100
Sub Total	\$300	\$450	\$600
Thermostat & Install No out-of-pocket expense	\$290	\$290	\$290
Thermostat Energy Savings*	\$900	\$900	\$900
<b>Total Savings</b>	<b>\$1490</b>	<b>\$1640</b>	<b>\$1790</b>

*Bill credits are paid June-July-August-September. The value of the thermostat and installation varies according to market pricing. \*Savings vary and \$900 is based on an average of \$180 per year over five years.*

# PEPCO/BGE Cycling Programs

Emergency events called by RTO when predicted load approaches available supply

- All consumers AC units will cycle off at the pre-selected frequency
- These events occur approximately once per year

Economic events called by utility when RT price surges

- Consumers can opt out of up to 2 events per year
- Economic events occur approximately 10 times per year

# Data Set Description

- Assemble a panel of power plant, energy market and weather data
- Collect dates of utility requests for conservation
- Requested dates/times of cycling events from PEPCO and BGE

Built a data set of hourly data for May-September for power plants in Maryland between 2000-2010

# EPA CEMS Data

EPA is charged with implementing and monitoring SO<sub>2</sub> markets

EPA Constant Emissions Monitoring Systems measure:

- Operating status of the plant

- Power output

- Efficiency

- Pollution emissions

Sampled every minute and aggregated to the hourly level

Audited and published by EPA to compare to permit holdings

Available hourly for most fossil fuel burning power plant from late 90's till today

Merged with hourly load data from PJM from 2005 onwards

# Descriptive Statistics

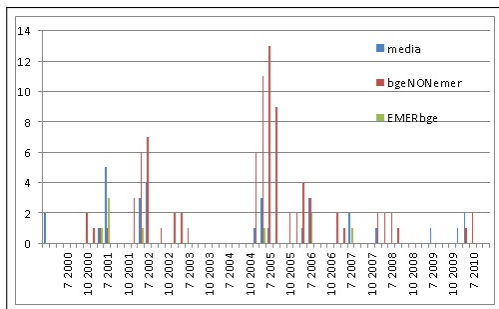
	Sample	Emergency	Media
High Temp	26.2	36.5	35.5
Dew Point	16.9	23.8	22.5
Load	72,623	90,869	95,521
DA Load	72,623	83,745	93,146
Average Price	82.0	343.4	252.4

Descriptive stats consistent with our understanding:

- Emergency and media days are atypical
- Emergencies associated with DA load far below actual
- Media days tend to have highest DA load



# Cycling and Media Frequency



Descriptive stats consistent with our understanding:

- There are an average of 2.5 media events per year
- Slightly more than 10 economic cycling events per year
- Just over 1 emergency even per year
- Average cycling event lasts just over 3 hours

# Empirical Strategy

Three identification strategies that are progressively more restrictive

- Start with a fixed effects regression
  - Month-Year
  - Day of week
  - Facility
- Diff-in-Diff estimator with control *power plants*
- Matching routine to select ideal control *days*

## Cycling and the Media

Observe 123 days with cycling or media events (out of approximately 1200)

	Media	
	N	Y
No Cycling	.	0.13
Economic	0.70	0.09
Emergency	0.05	0.05

There is significant variation in media and cycling behavior  
Identify the impact of media releases holding cycling level constant

## Estimation

Estimate fixed effects regression to isolate the differences in hourly demand on voluntary vs. optimal calls

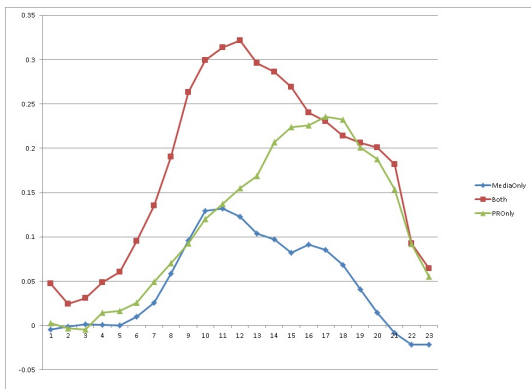
$$\text{Gen}_{i,h} = \alpha_h(\text{Media}_{i,h}) * \text{Hour}_i + W_{it} + M_{it-1} + \lambda_i + \delta_h + \psi + \eta + \epsilon_{i,h}$$

$$\text{Gen}_{i,h} = \beta_h(\text{Cycling}_{i,h}) * \text{Hour}_i + W_{it} + M_{it-1} + \lambda_i + \delta_h + \psi + \eta + \epsilon_{i,h}$$

- Gen measures the fraction of power plant capacity operating in a given hour
- i indexes power plants and h denotes hours
- $W_{it}$  is a set of hourly weather observations
- $M_{it}$  is a vector of energy market variables
- Includes plant ( $\lambda$ ), hour of day ( $\delta$ ), day of week ( $\psi$ ), year-month fixed effects ( $\eta$ )

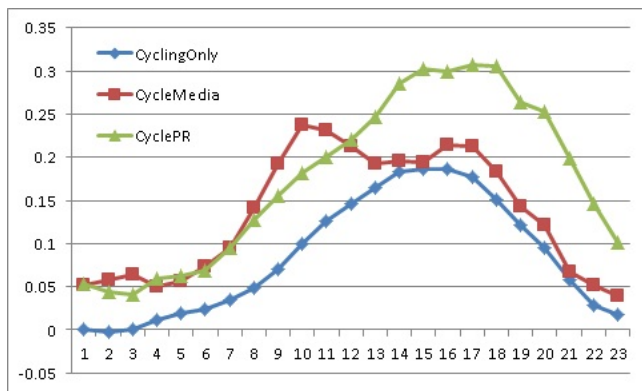
Estimate 24 hourly coefficients for  $\alpha$  &  $\beta$

# Press Release versus Media Coverage



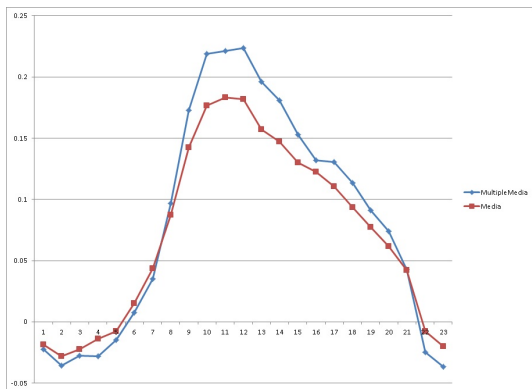
- Not all press releases are picked up in media and not all media coverage is based on press release
- 28 press releases, 21 media events, 10 days of overlap
- Media coverage seems to shift generation to morning hours

# Press Release versus Media Coverage



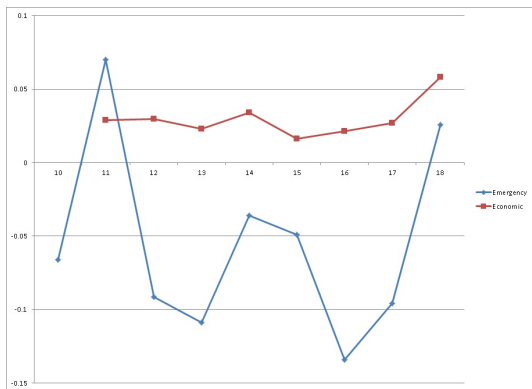
- The impact of media/press release on cycling days
- Media shifts consumption in a predictable way
- PR changes level, but not pattern

# Multiple Media Outlets



- Not all press releases are picked up in media and not all media coverage is based on press release
- 28 press releases, 21 media events, 10 days of overlap
- Media coverage seems to shift generation to morning hours

# Economic vs. Emergency Cycling



- Compare economic and emergency cycling across effective hours
- Weak evidence that emergency cycling is effective
- Suggests that lots of consumers exercise opt out



## Day Matching Procedure

- First stage logit to estimate the probability of a press release calling for conservation
- Use day ahead load and pricing estimates
- Ideally use weather forecast, but that is not available for the full time series

$$\text{PressRelease}_t = W_t + W_{t-1} + W_{t-2} + \text{DA Load}_i t + \text{DA Price}_i t + \psi + \eta,$$

where DA Load is a vector of regional load forecasts and DA Price is a vector of 17 prices for production at MD generators

Use predicted values from this regression to match most similar media/non-media days

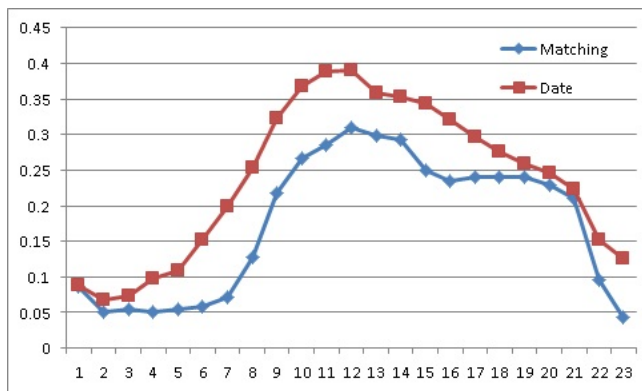
Introduction day-pair fixed effects to previous regression

## Probit Results

Dep Var	Press Release	Cycling
Temp	-1.886* (-1.84)	-0.189 (-1.19)
Humid	1.849** (1.99)	0.030 (0.40)
Liquid Precip	-0.589** (0.48)	
Max DA Load	7.399*** (3.25)	
Max RT Load		14.387 (1.29)
N	1,986	1,986
Pseudo-R2	0.80	0.57

- Selected results from probit specification
- Produce fitted values from this specification

# Press Release versus Media Coverage



- The effect of press releases across identification strategies
- Magnitude of effect drops around 6% in matching estimates
- Pattern of shifts are fairly similar

# Environmental Implications

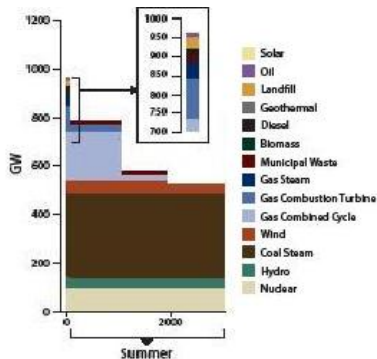
Fuels are heterogenous in pollution intensity

Dynamic pricing (and other load shifting) may have a negative impact on emissions

Table: Pounds of CO<sub>2</sub> per kWh

Fuel	Output Rate
Coal	2.1
Oil	1.9
Gas	1.3
Other	1.4

Figure: Gen Stack



# Conclusion: Perverse Impacts

## Perverse Impact

- Voluntary calls for conservation lead to no net reduction in demand
- Calls shift demand through day in potentially damaging ways

Command and control regulations are effective in reducing peak demand by 10%

- Result is robust to different identification strategies
- Calls for conservation swamp effect of cycling

Utilities conserve at higher rate than customers would prefer:

- Public good benefits of conservation not included in private decisions
- Real time (wholesale) pricing is not sufficient to address the problem

# Maryland Transmission System

