Environmental Value of Distributed Energy Resources in New York State

July 11th, 2018

Value of Distributed Energy Resources Value Stack Working Group

Outline

- E/EJ Value Subworking Group Background
- Principles
- Overview of “E” Value Methodology
- Subgroup Work on “E” Value
- Results
- Summary

Principles

- E value should compensate DERs for uninternalized damages from air pollution emissions they avoid
- E value should depend on:
  - **Location**: DERs are worth more when avoiding air pollution in areas with high population density and more vulnerable population
  - **Time:** DERs are worth more when higher emitting generators are on the margin
  - **Pollutant:** Different generators emit different pollutants, which cause different levels of public health and climate damage
- For emitting DERs, E value should be reduced based on their emissions and could potentially be negative
- Payment should balance accuracy and administrability

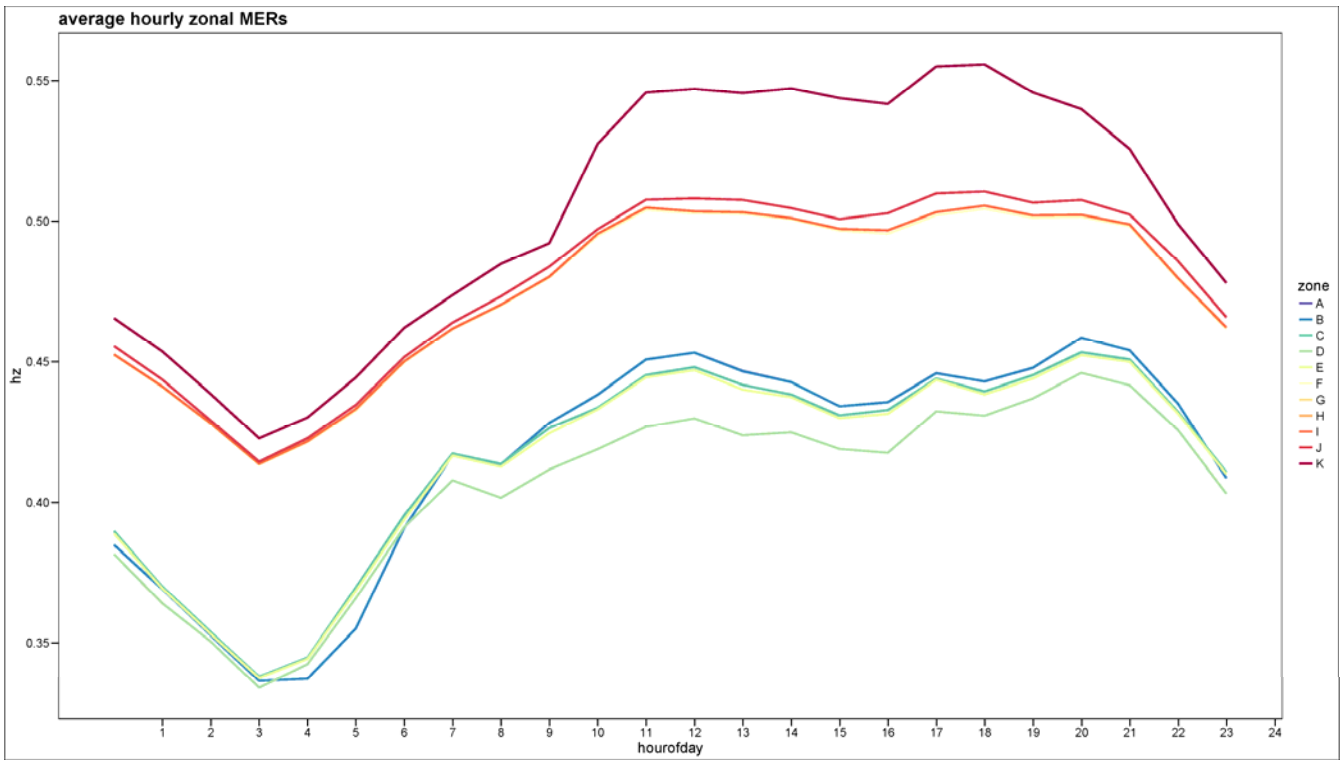
E Value Methodology

- **Step 1** determines what generation will be displaced by DERs.
- **Step 2** quantifies the emissions rates for displaced generators.
- **Step 3** calculates the monetary value of the damages from emissions identified in Step 2.
- **Step 4** uses the emissions rates from Step 2 and damage estimate per unit of emissions from Step 3 to monetize the value of avoided emissions from displaced generation.
  - Adjustments are needed if existing policies already put a price on emissions of some or all of the pollutants covered in Steps 1-3.
- **Step 5** takes into account emissions produced by the DER itself, if any.
  - Only needed if emitting DERs—such as diesel generators or combined heat and power generators—qualify for E value.

Step 1: Identifying Displaced Generator

- Options we tried but abandoned:
  - NYISO data on marginal generator, but data not publicly available
  - NYISO data on generators getting paid in a given interval, but data was insufficient
  - NYISO Gold Book data on marginal fuel, but data was not temporally granular
- Best available short-run approach:
  - Inferring marginal generator and fuel type from NYISO data on marginal emissions rates ("MER") for CO_2
- Longer term options:
  - Work with NYISO to calculate zonal marginal emissions rates for all pollutants
  - Work with NYISO to calculate granular damage value using confidential marginal generator data
  - Use econometric techniques to estimate marginal emissions rates

Figure 1: Average Hourly Zonal CO_2 MERs



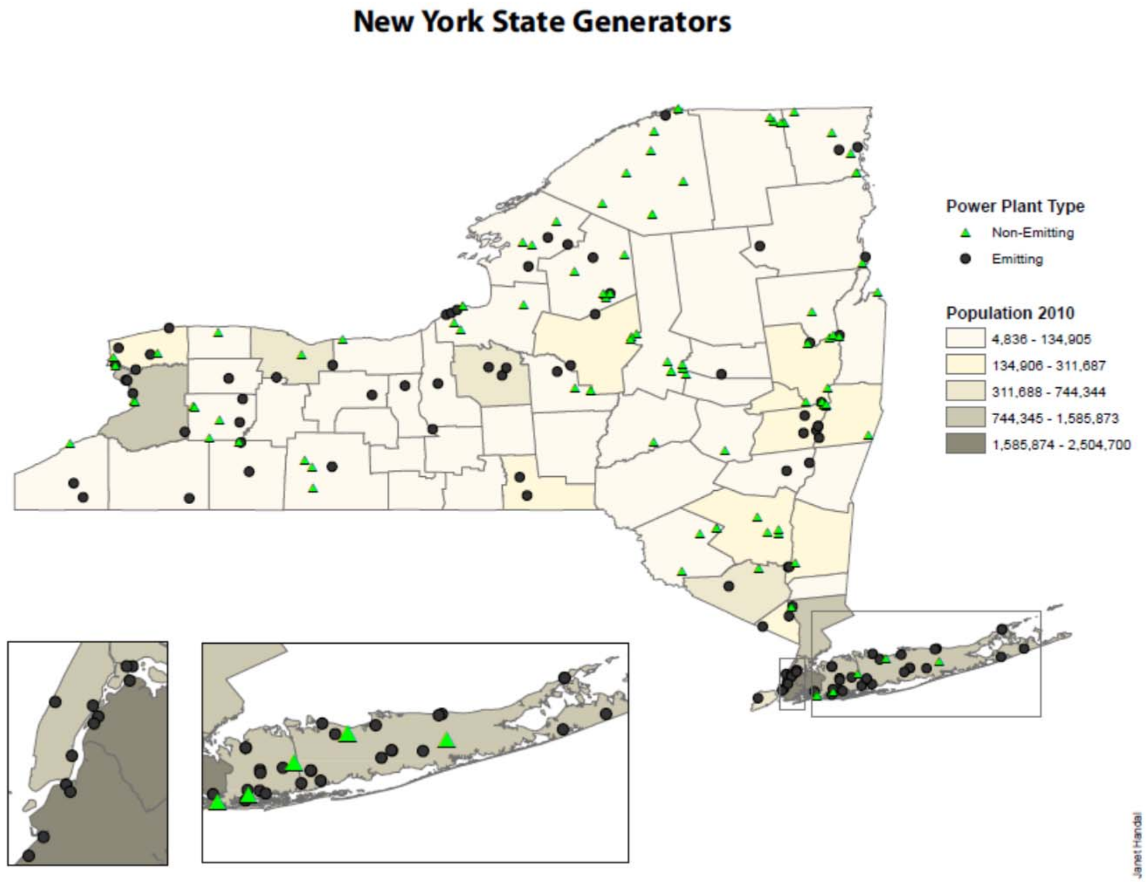
Step 2 – Identifying Emission Rates of Displaced Generation

Generation-weighted State-average Emission Rates (kg/kWh) For Gas and Oil Generators

Fuel Type	NO_X	$PM_{2.5}$	SO_2	CO_2
Natural Gas	0.0003	0.00000	0.0000	0.52
Oil	0.0031	0.00003	0.0027	1.10

- When possible we used EPA's eGrid and National Emissions Inventory databases to calculate emissions rates for generators in the NYCA
  - Matched 358 out of the 412 generators (87%) active in 2016 as reported in the 2016 NYISO Gold Book
- For the remaining generators:
  - Interpolated the emissions rates for SO_2, CO_2, and NO_X based on the primary and secondary fuels for each generator using eGrid data
  - $PM_{2.5}$ emissions rates based on data from the NEI

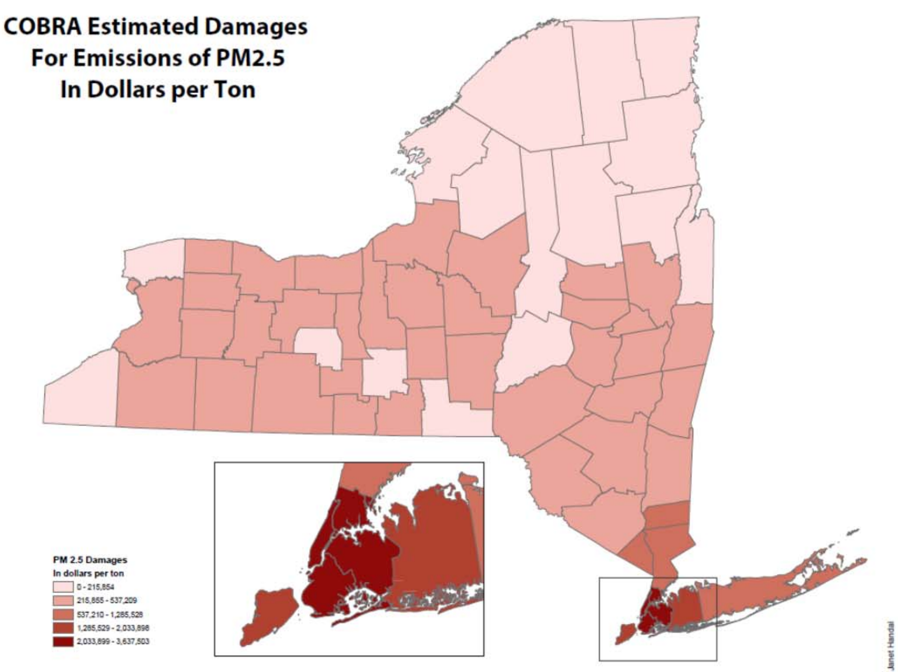
Figure 2: Emitting Generators in New York

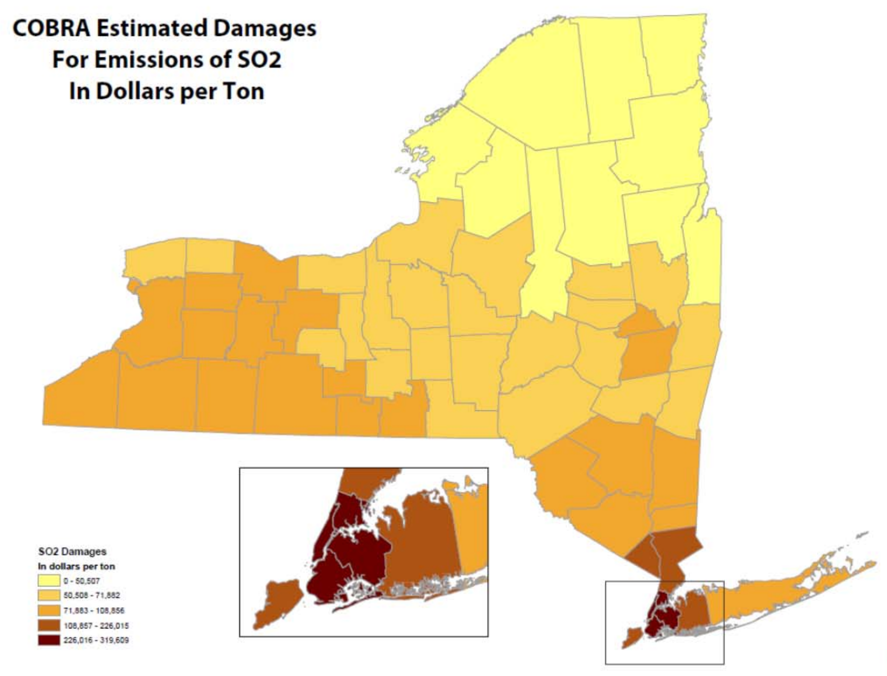


Step 3 – Calculate Damage Estimates

- For CO_2: IWG's Social Cost of Carbon ("SCC") – RGGI
- For local pollutants: Damage estimates from available models
  - EASIUR
    - Advantages: Ease of use, detailed transport model, seasonal variation, different stack heights
    - Disadvantages: Only exposure to secondary $PM_{2.5}$, some assumptions cannot be changed
  - COBRA
    - Advantages: Ease of use
    - Disadvantages: County level granularity, simple transport model, only exposure to secondary $PM_{2.5}$
- Longer term options:
  - Custom Modeling
  - BenMAP
  - InMAP

Figure 3: COBRA Damage Estimates for $PM_{2.5}$ and SO_2





Step 4 – Monetize the Avoided Externality from Displaced Generation

For CO_2:

$$V_{cit} = MER_{it}^{CO_2} * (SCC - RGGI)$$

For other pollutants:

$$V_{pit} = \begin{cases} \dfrac{MER_{it}^{CO_2}}{0.52} V_{pit}^{gas} & \text{if } MER_{it}^{CO_2} \leq 0.52 \\ \left(\dfrac{1.1 - MER_{it}^{CO_2}}{1.1 - 0.52}\right) V_{pit}^{gas} + \left(\dfrac{MER_{it}^{CO_2} - 0.52}{1.1 - 0.52}\right) V_{pit}^{oil} & \text{if } MER_{it}^{CO_2} > 0.52 \end{cases}$$

Where

$MER_{it}^{CO_2}$: Marginal emission rate of CO_2 in zone *i* in hour *t*

V_{pit}: Value of avoided damages from emissions of pollutant *p* in zone *i* in hour *t* (p= $PM_{2.5}$, SO_2, NO_x)

V_{pit}^{gas}: Generation-weighted average value of avoided damages from natural gas power plants emitting pollutant *p* in zone *i* in hour *t*

V_{pit}^{oil} : Generation-weighted average value of avoided damages from oil power plants emitting pollutant *p* in zone *i* in hour *t*

Step 4 – Monetize the Avoided Externality from Displaced Generation

$$V_{pit} = \begin{cases} \dfrac{MER_{it}^{CO_2}}{0.52} V_{pit}^{gas} & \text{if } MER_{it}^{CO_2} \leq 0.52 \\ \left(\dfrac{1.1 - MER_{it}^{CO_2}}{1.1 - 0.52}\right) V_{pit}^{gas} + \left(\dfrac{MER_{it}^{CO_2} - 0.52}{1.1 - 0.52}\right) V_{pit}^{oil} & \text{if } MER_{it}^{CO_2} > 0.52 \end{cases}$$

- If $MER_{it}^{CO_2}$=0, then V_{pit}=0
- If $MER_{it}^{CO_2}$=0.52, then V_{pit}=V_{pit}^{gas}
- If $MER_{it}^{CO_2}$=0.75, then V_{pit}= 0.6 V_{pit}^{gas} + 0.4 V_{pit}^{oil}
- If $MER_{it}^{CO_2}$=1.1, then V_{pit}=V_{pit}^{oil}

Figure 4: E Value Stack Using EASIUR Damages

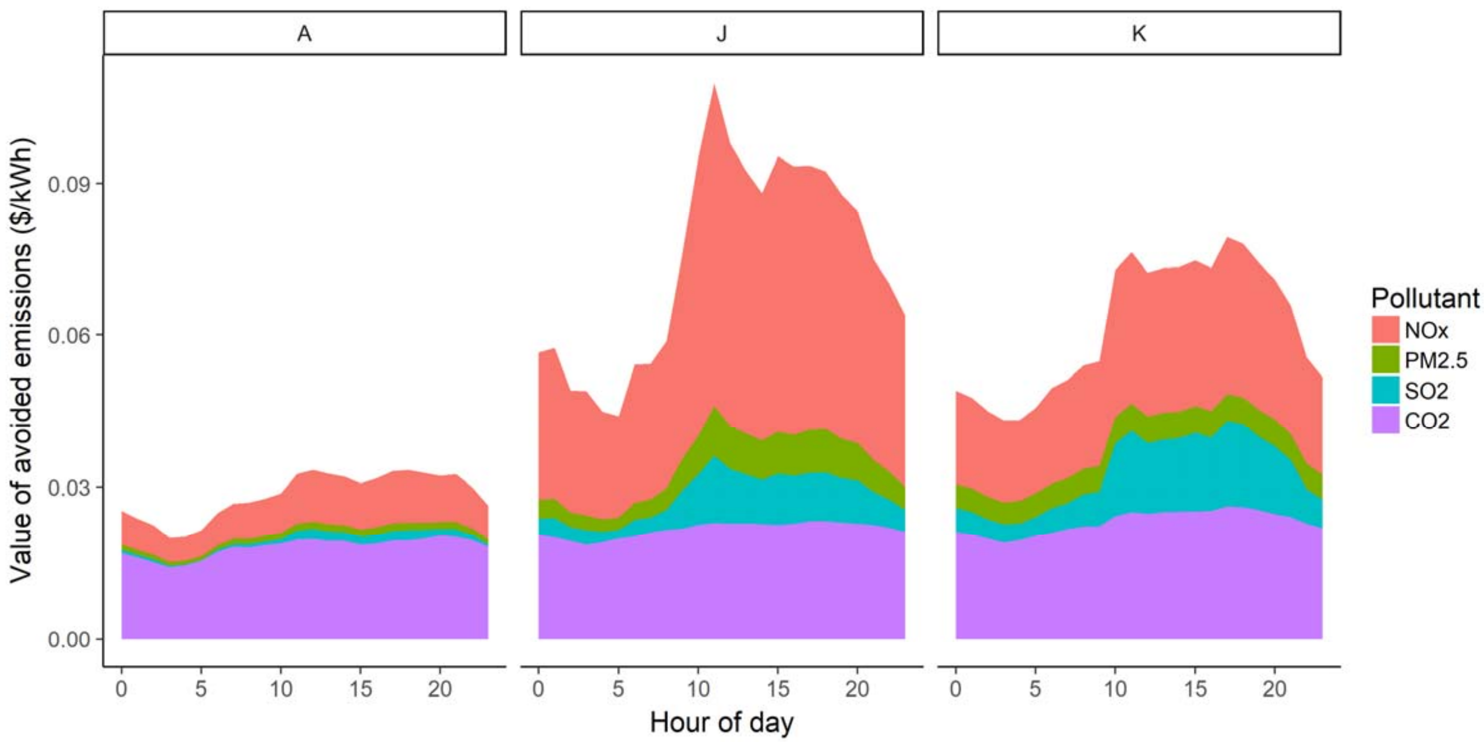


Figure 5: E Value Stack Using Low COBRA Damages

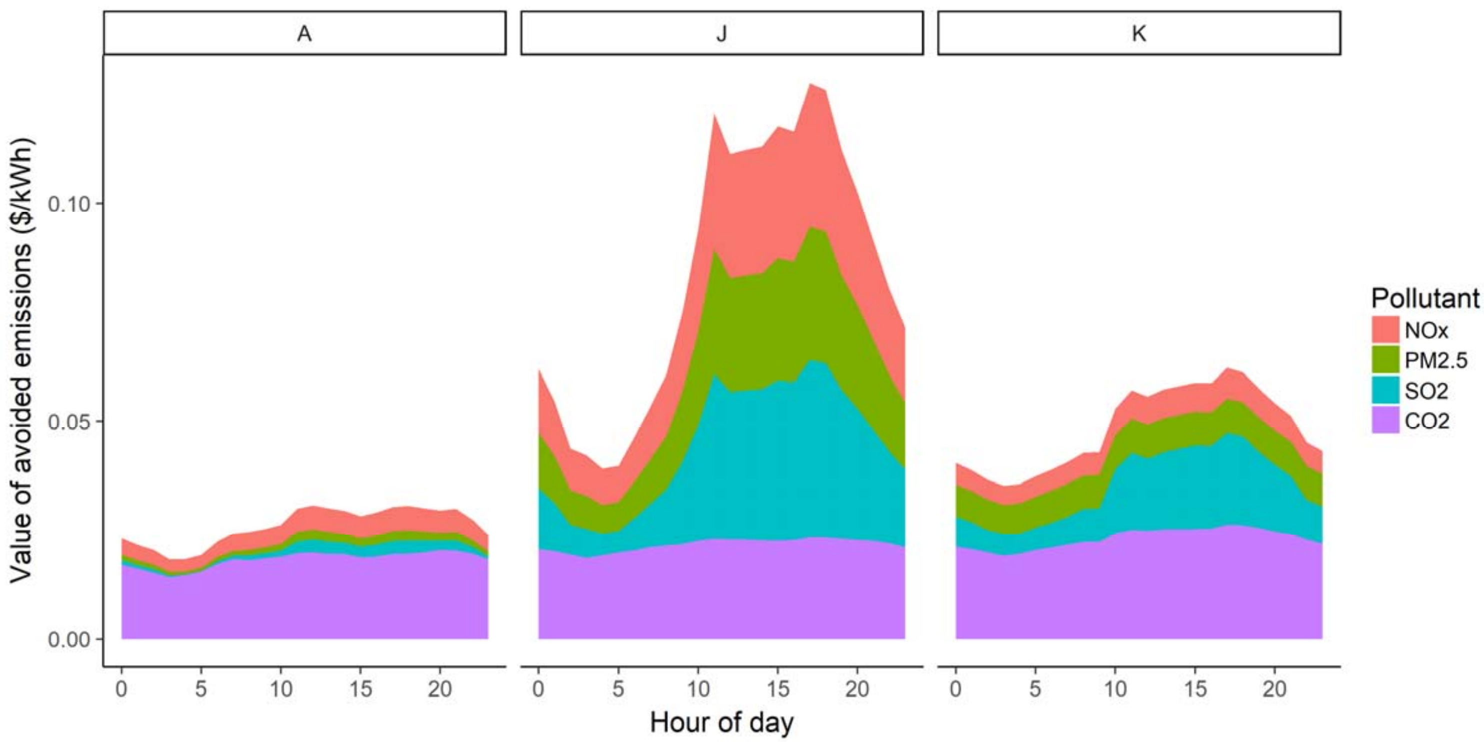


Figure 6: E Value Stack Using High COBRA Damages

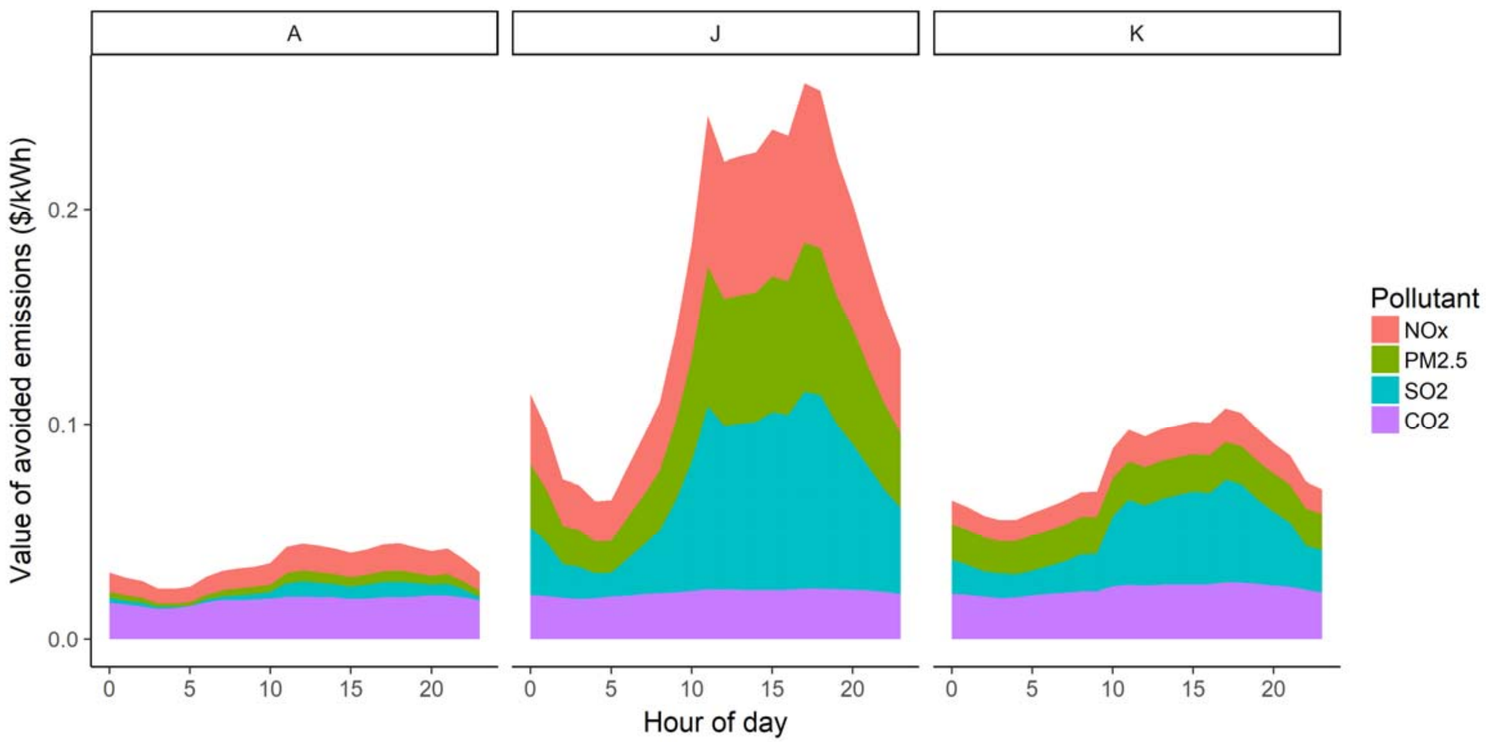


Figure 7: Zone-specific Hourly E Value Using High COBRA Damages

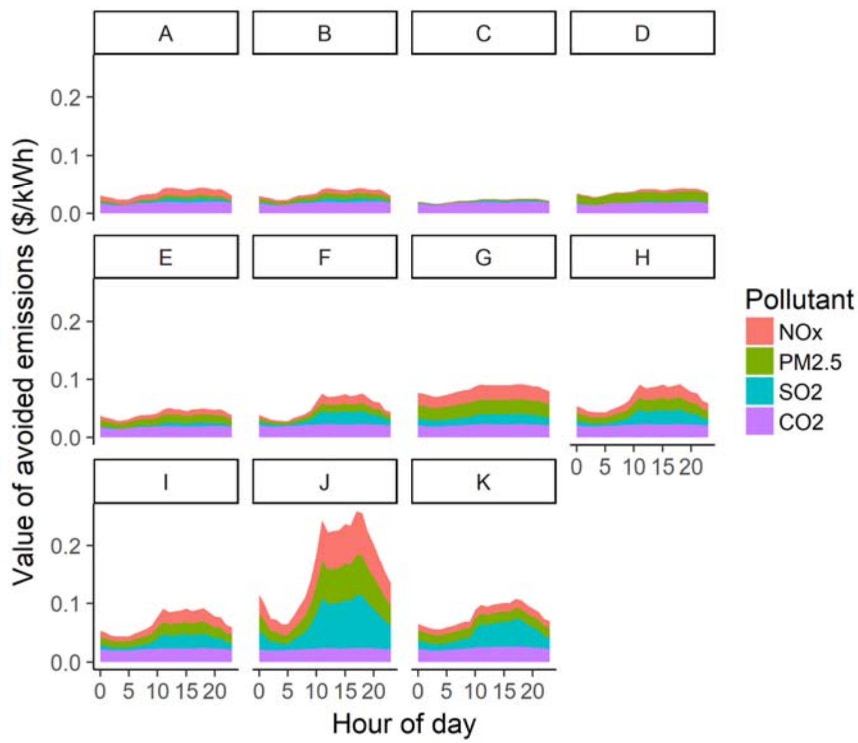
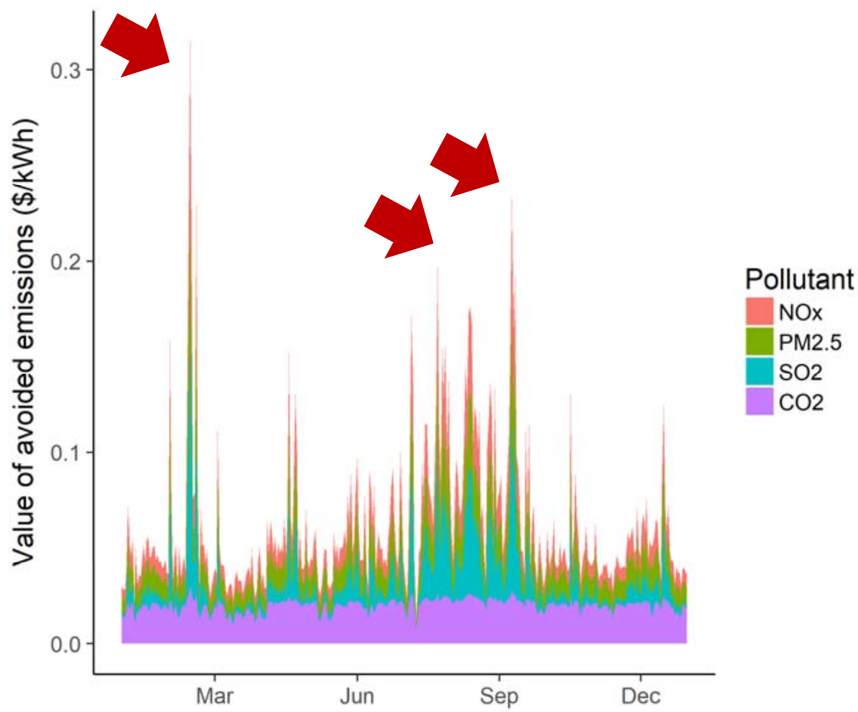


Figure 8: Daily E Value Stack Using High COBRA Damages



Other States

- California
  - Bay Area Air Quality Management District
    - Multi-Pollutant Evaluation Method
    - 2.5% SCC
  - California Public Utilities Commission
    - Uses COBRA as a “first step” until a more robust model can be developed
    - 3% SCC, 95th percentile to account for damages not included in current models
- Maryland – Value of Solar Study
    - COBRA for local pollutants
    - 3% SCC
- Maine – Value of Distributed Solar Study
    - EPA per-ton values used in the cost-benefit analysis for the proposed Clean Power Plan
    - 3% SCC
- Minnesota – Integrated Resource Planning
    - CAMx Air Quality Model
    - 3% SCC, 2300 time horizon; 5% SCC, 2100 time horizon

Summary

- The environmental and public health value of net avoided emissions is not zero
- We have good, existing tools to be able to put an “E” Value that covers CO_2 as well as local pollutants with some granularity
- This value changes with respect to time and location
  - Peak/off-peak/critical-peak
  - Zonal
  - Seasonal