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 CO₂

- 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

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>NOₓ</th>
<th>PM₂.₅</th>
<th>SO₂</th>
<th>CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>0.0003</td>
<td>0.00000</td>
<td>0.0000</td>
<td>0.52</td>
</tr>
<tr>
<td>Oil</td>
<td>0.0031</td>
<td>0.00003</td>
<td>0.0027</td>
<td>1.10</td>
</tr>
</tbody>
</table>

- 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 SO₂, CO₂, and NOₓ based on the primary and secondary fuels for each generator using eGrid data
  - PM₂.₅ 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 CO₂:

\[ V_{cit} = MER_{it}^{CO₂} \times (SCC - RGGI) \]

For other pollutants:

\[ V_{pit} = \begin{cases} 
\frac{MER_{it}^{CO₂}}{0.52} V_{gas}^{pit} & \text{if } MER_{it}^{CO₂} \leq 0.52 \\
\left(\frac{1.1 - MER_{it}^{CO₂}}{1.1 - 0.52}\right) V_{gas}^{pit} + \left(\frac{MER_{it}^{CO₂} - 0.52}{1.1 - 0.52}\right) V_{oil}^{pit} & \text{if } MER_{it}^{CO₂} > 0.52 
\end{cases} \]

Where

- \( MER_{it}^{CO₂} \): Marginal emission rate of CO₂ in zone \( i \) in hour \( t \)
- \( V_{pit} \): Value of avoided damages from emissions of pollutant \( p \) in zone \( i \) in hour \( t \) (\( p = PM_{2.5}, SO₂, NOₓ \))
- \( V_{gas}^{pit} \): Generation-weighted average value of avoided damages from natural gas power plants emitting pollutant \( p \) in zone \( i \) in hour \( t \)
- \( V_{oil}^{pit} \): 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

\[
V_{pit} = \begin{cases} 
\frac{MER_{it}^{CO2}}{0.52} V_{pit}^{gas} & \text{if } MER_{it}^{CO2} \leq 0.52 \\
\left(\frac{1.1 - MER_{it}^{CO2}}{1.1 - 0.52}\right) V_{pit}^{gas} + \left(\frac{MER_{it}^{CO2} - 0.52}{1.1 - 0.52}\right) V_{pit}^{oil} & \text{if } MER_{it}^{CO2} > 0.52
\end{cases}
\]

- If \( MER_{it}^{CO2} = 0 \), then \( V_{pit} = 0 \)
- If \( MER_{it}^{CO2} = 0.52 \), then \( V_{pit} = V_{pit}^{gas} \)
- If \( MER_{it}^{CO2} = 0.75 \), then \( V_{pit} = 0.6 V_{pit}^{gas} + 0.4 V_{pit}^{oil} \)
- If \( MER_{it}^{CO2} = 1.1 \), then \( V_{pit} = V_{pit}^{oil} \)
Figure 4: E Value Stack Using EASIIUR 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, 95\textsuperscript{th} 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 CO₂ as well as local pollutants with some granularity

• This value changes with respect to time and location
  • Peak/off-peak/critical-peak
  • Zonal
  • Seasonal