Introducing LEEM – A Novel Opportunity For Municipalities To Reduce Electricity-Related Emissions

June 15, 2018
• Grid electricity generated at fossil fuel plants contribute 30% of US carbon emissions

• For businesses, institutions and municipalities that want to reduce carbon emissions … options are limited to energy efficiency and renewable energy

• Imagine how much more you might do if knew when your grid electricity was coming from a high-carbon coal plant, natural gas, or a zero-carbon wind farm …
An Interesting Question

• What is the easiest, quickest and least expensive way to reduce carbon emissions?

Answer: Use less electricity when it is generated by a high-carbon generator plant!

But how do you know when this is happening?

You don’t - Until Now!
LEEM is a novel, easy, and quick tool to immediately reduce carbon emissions.
LEEM may be a game changer to manage electricity for performance, cost and lower emissions!

WE CALL IT BEING e-SMART
• **Companies, institutions and communities** that want to *proactively reduce air emissions* – automatically – at no/little cost.

• **Energy software & management firms** that want to add *new carbon reduction and footprint tools* to their offerings.

• **IoT devices (e.g. car chargers) owners** that want devices to *power down when emissions are high.*
What Is LEEM?

- **Locational Emissions Estimation Methodology**
- Big-data software tool
- Developed at Wayne State University
- Real time and day-ahead grid-based emissions
  - Specific to location and time

Dial Down Energy Emissions
https://www.youtube.com/watch?v=vkZ0CkBrqWk
How LEEM Works

- **Locational Emissions Estimation Methodology**

- Delivers a stream of emission intensity data specific to time and location

- Users can now *shed, shift & switch* electricity when emission intensities are high

![Graph showing high and low emission rates](image)
How LEEM Works

Local Marginal Prices (LMPs) → Marginal Generating Unit Type → Marginal Emissions (LMEs)

10:20 AM

10:30 AM
LMPs = f(space, time)
Marginal Emissions
= f(space, time)
AWWA’s Water Utility Energy Challenge

Five Water Utility Competitors

Bayfield, WI
Great Lakes Water Authority, MI
Highland Park, IL
Ann Arbor, MI
Onondaga County Water Authority NY
LEEM Day-Ahead CO2 Emission LEEM

What LEEM Shows

LEEM Data Provides...

(10/9/17)

Higher Emission Periods

Lower Emission Periods
Day-Ahead emissions vary from day to day …
## Sample WTP Emission Reductions Per Filter Washes


<table>
<thead>
<tr>
<th>Month</th>
<th>CO2 Emissions (Lbs./MWh)</th>
<th>Hg Emissions (10^-4 Lbs./MWh)</th>
<th>NOx Emissions (Lbs./MWh)</th>
<th>SO2 Emissions (Lbs./MWh)</th>
<th>Pb Emissions (10^-4 Lbs./MWh)</th>
<th>Total MWh Expended</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2017</td>
<td>1,131</td>
<td>0.11</td>
<td>0.7</td>
<td>1.4</td>
<td>0.52</td>
<td>27.61</td>
</tr>
<tr>
<td>July Control</td>
<td>1,574</td>
<td>0.28</td>
<td>1.4</td>
<td>3.7</td>
<td>1.37</td>
<td>32.14</td>
</tr>
<tr>
<td><strong>Change</strong></td>
<td><strong>-443</strong></td>
<td><strong>-0.16</strong></td>
<td><strong>-0.7</strong></td>
<td><strong>-2.3</strong></td>
<td><strong>-0.85</strong></td>
<td><strong>-4.52</strong></td>
</tr>
<tr>
<td><strong>% Change</strong></td>
<td><strong>-28.2%</strong></td>
<td><strong>-58.5%</strong></td>
<td><strong>-52.6%</strong></td>
<td><strong>-61.2%</strong></td>
<td><strong>-62.1%</strong></td>
<td><strong>-14.1%</strong></td>
</tr>
</tbody>
</table>

**Note:** These estimates are preliminary, and may be adjusted upon further analysis.
Sample WTP CO2 Emissions From Filter Washing

Monthly CO2 Emissions (lbs)

- CO2 Emissions
- Benchmark CO2 Emissions

Month

- May-17
- Jun-17
- Jul-17
- Aug-17
- Sep-17
- Oct-17
- Nov-17
- Dec-17
- Jan-18
- Feb-18
- Mar-18
- Apr-18
**“WINNERS”**

<table>
<thead>
<tr>
<th>Category</th>
<th>Winner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Utility Champion</td>
<td>Ann Arbor</td>
</tr>
<tr>
<td>Water Utility Green Leader</td>
<td>Bayfield</td>
</tr>
<tr>
<td>Best Technology Leader</td>
<td>Highland Park</td>
</tr>
<tr>
<td>Champion Carbon Reducer</td>
<td>Onandoga County Water Authority</td>
</tr>
<tr>
<td>Best Pilot Demonstration</td>
<td>Great Lakes Water Authority</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total Amount Reduced</th>
<th>House-Month Equivalents* Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2 (lbs.)</td>
<td>1,504,069</td>
<td>1,692</td>
</tr>
<tr>
<td>NOx (lbs.)</td>
<td>535</td>
<td>2,745</td>
</tr>
<tr>
<td>SO2 (lbs.)</td>
<td>729</td>
<td>4,059</td>
</tr>
<tr>
<td>Hg (lbs.x10^-6)</td>
<td>10,019</td>
<td>2,896</td>
</tr>
<tr>
<td>Pb (lbs.x10^-6)</td>
<td>32,527</td>
<td>3,051</td>
</tr>
<tr>
<td>Energy Usage (MWh)</td>
<td>1,874</td>
<td>2,082</td>
</tr>
</tbody>
</table>

*One “House-Month Equivalent” is the average pollution emission or energy usage in a household during a single month in the competition area.
Other Applications: Buildings

Building Electricity Demand (kW)
Other Applications: Buildings

CO₂ Emission Rate (Lbs)

Pollution Emission (Lbs)

Date/Time

E2i
Illinois Science & Energy Innovation Foundation Pilot

Building Energy Management System Integration

Incentivized Actions for Building Tenants
Help Your Community Reduce Emissions?

• Questions & Discussion
• Thank You!

Pilot LEEM In Your Community?

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