

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

June 15, 2018



**e-Smart Energy Leading to a Cleaner,  
More Sustainable Business & Planet**



# Big Picture

- **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***



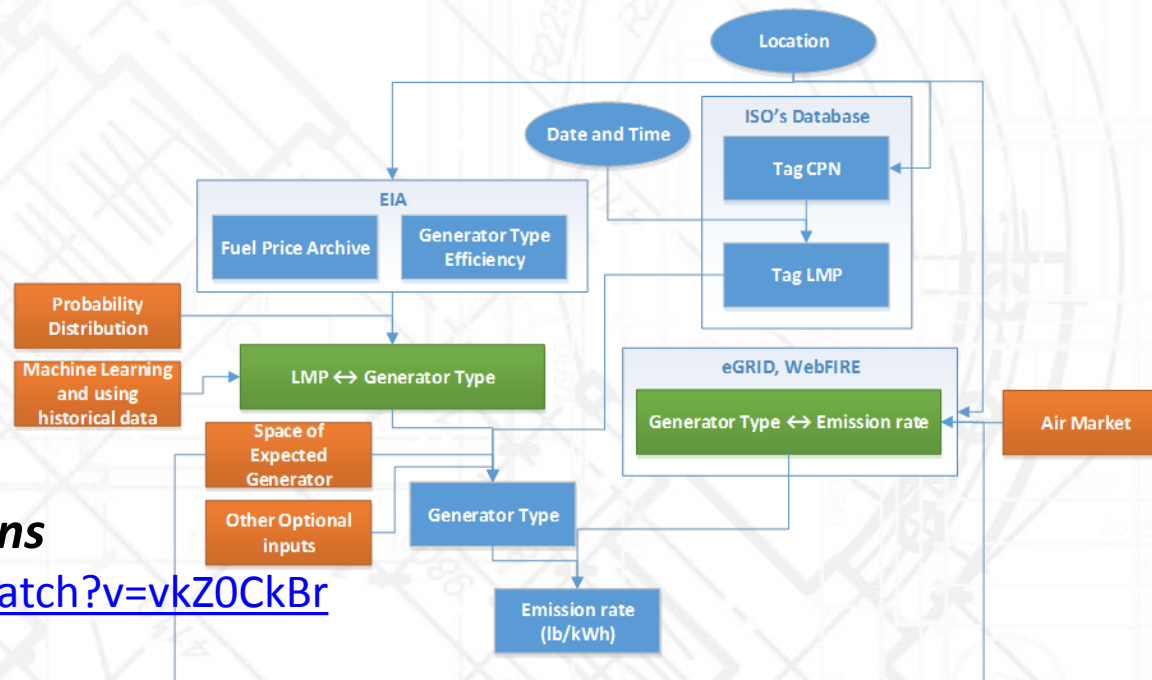
# Be E-Smart? Who Cares?

- **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?

- Local 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***

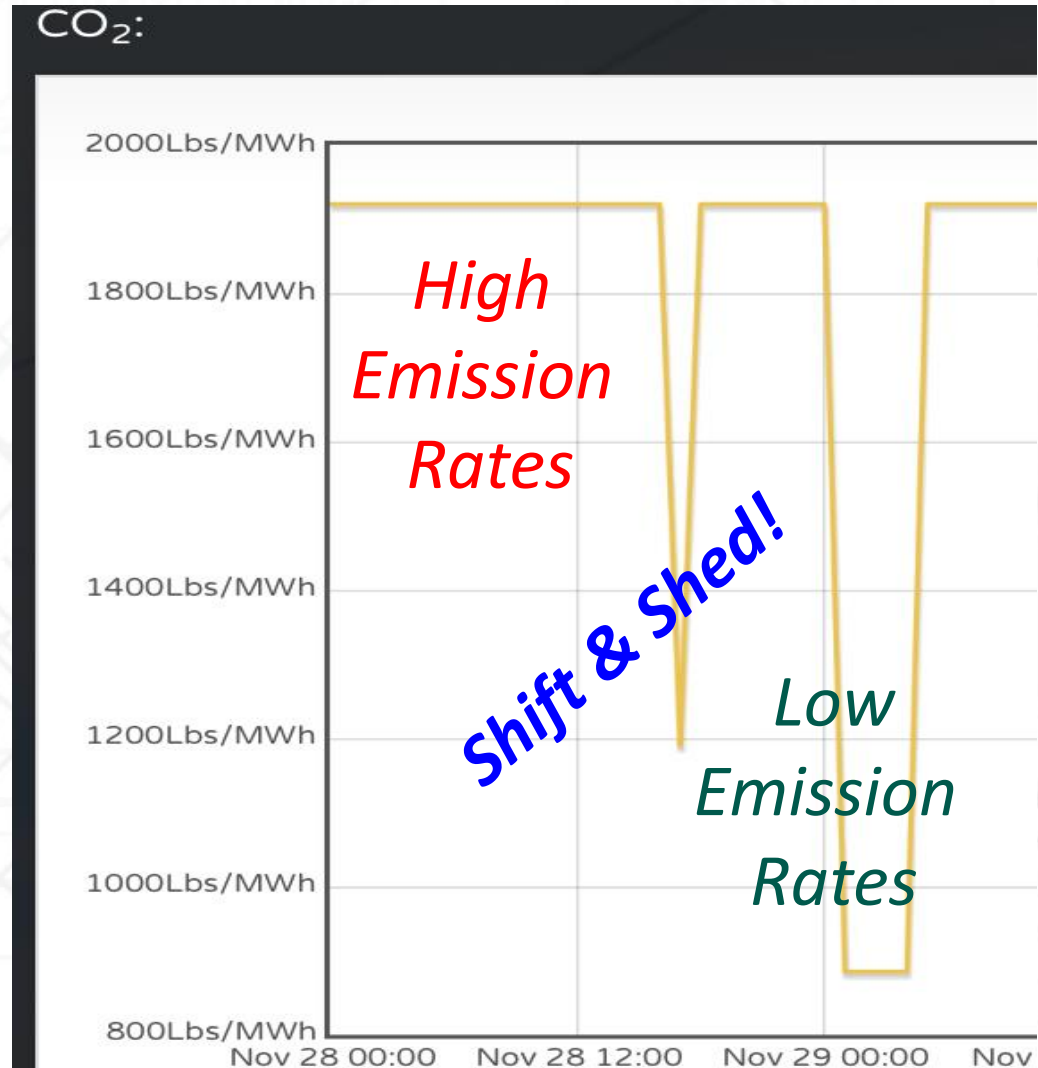
<https://www.youtube.com/watch?v=vkZ0CkBrqWk>



# How LEEM Works

E2i

- Local 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





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# How LEEM Works

E2i

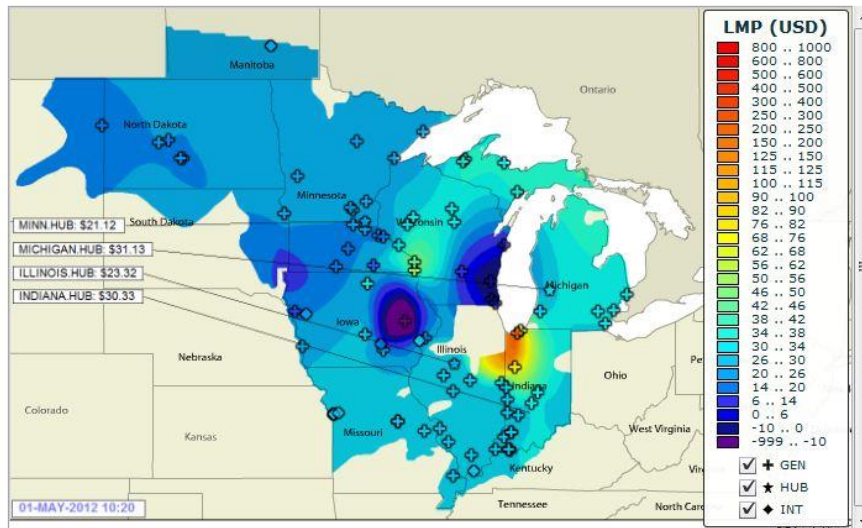
Local Marginal  
Prices (LMPs)



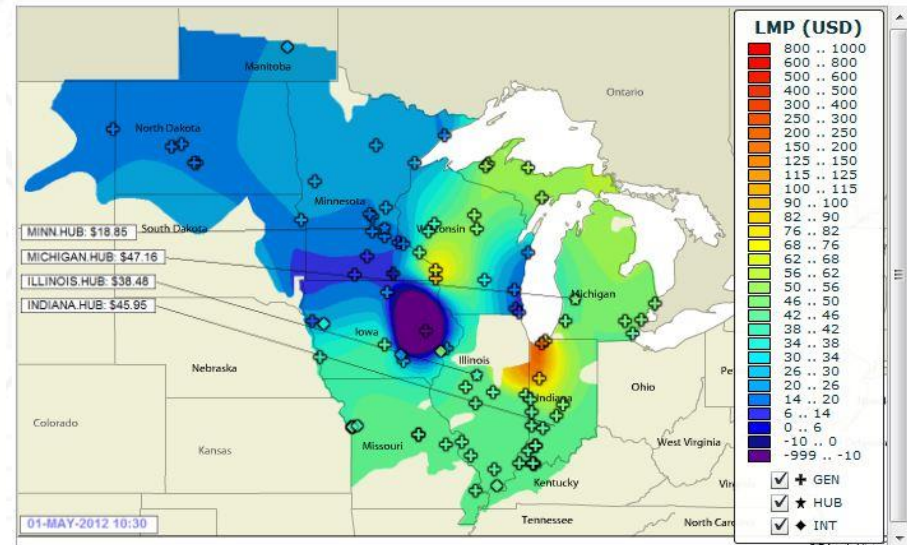
Marginal  
Generating  
Unit Type



Marginal  
Emissions  
(LMEs)



10:20 AM



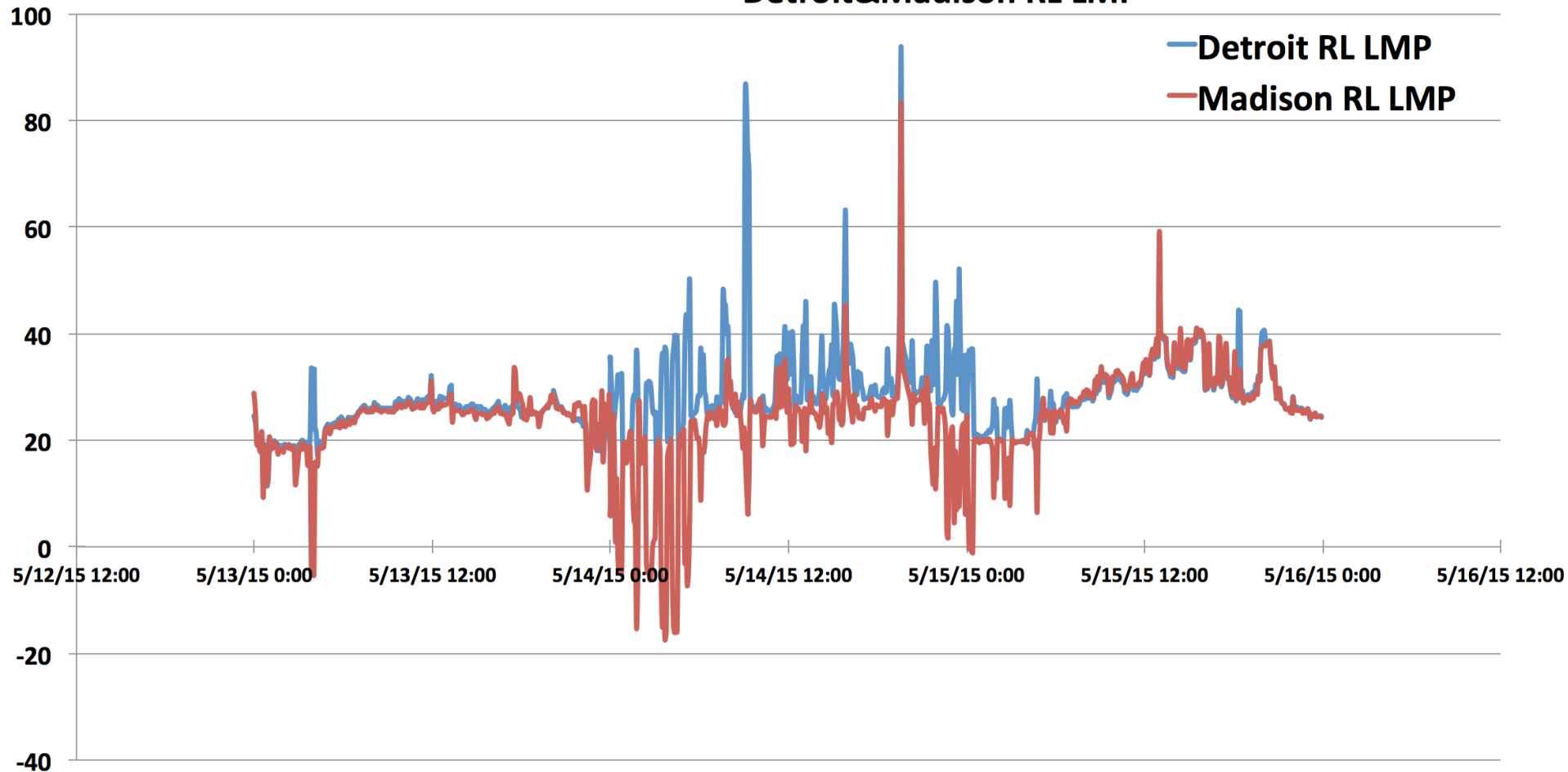
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# LMPs = f(space, time) E2i

Detroit&Madison RL LMP

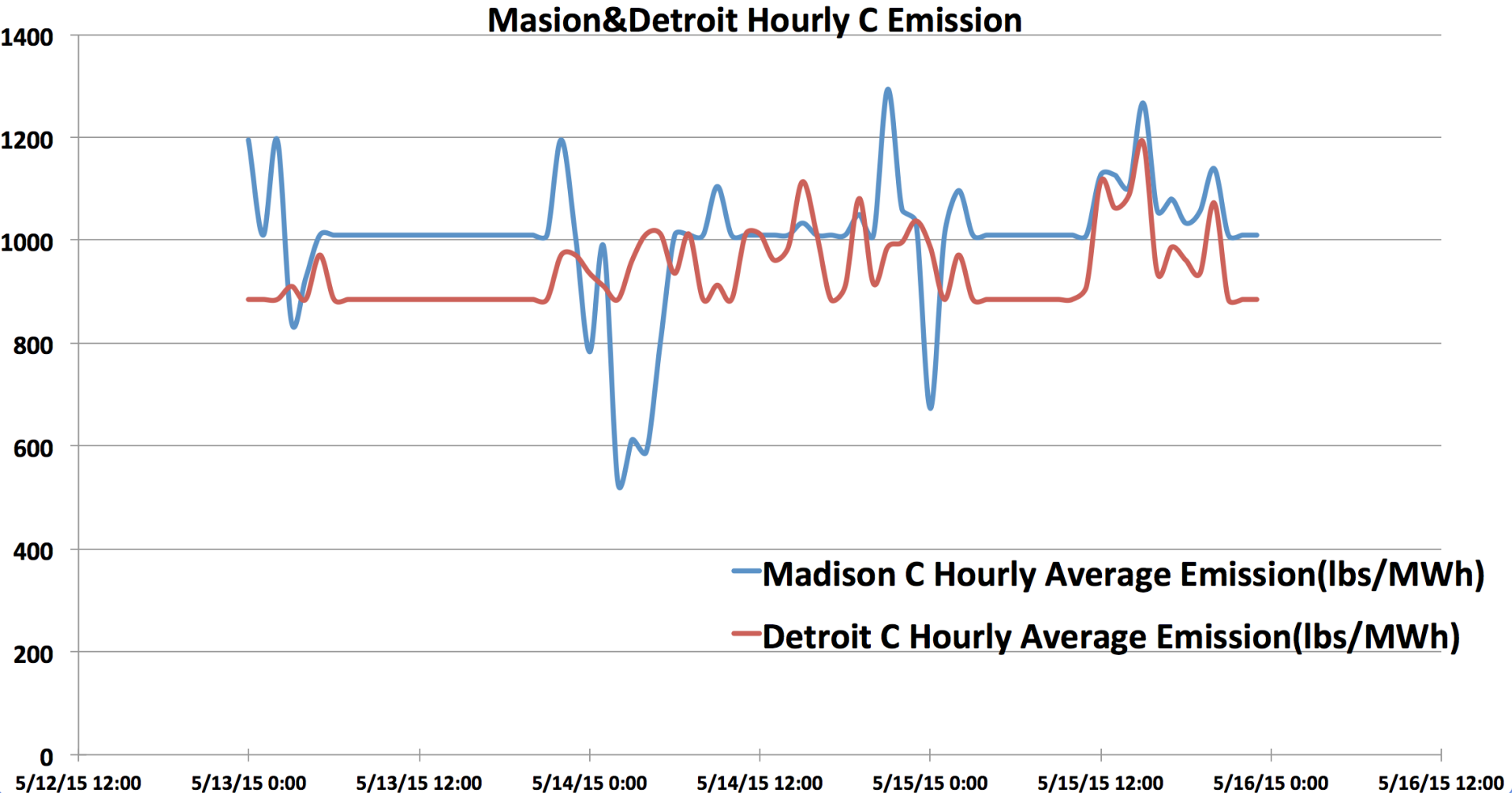




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# Marginal Emissions = f(space, time)

E2i





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# AWWA's Water Utility Energy Challenge

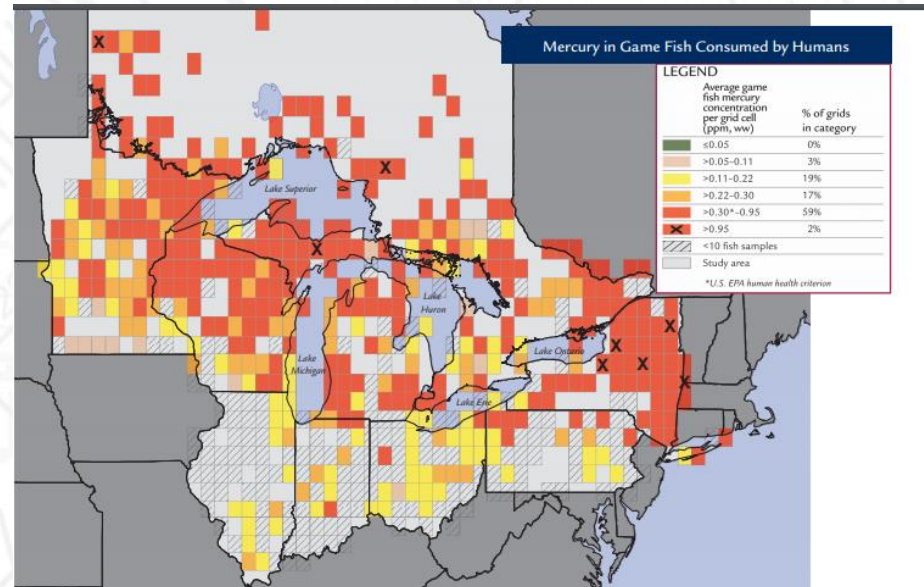
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American Water Works Association



Great Lakes  
Protection Fund





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# AWWA's Water Utility Energy Challenge

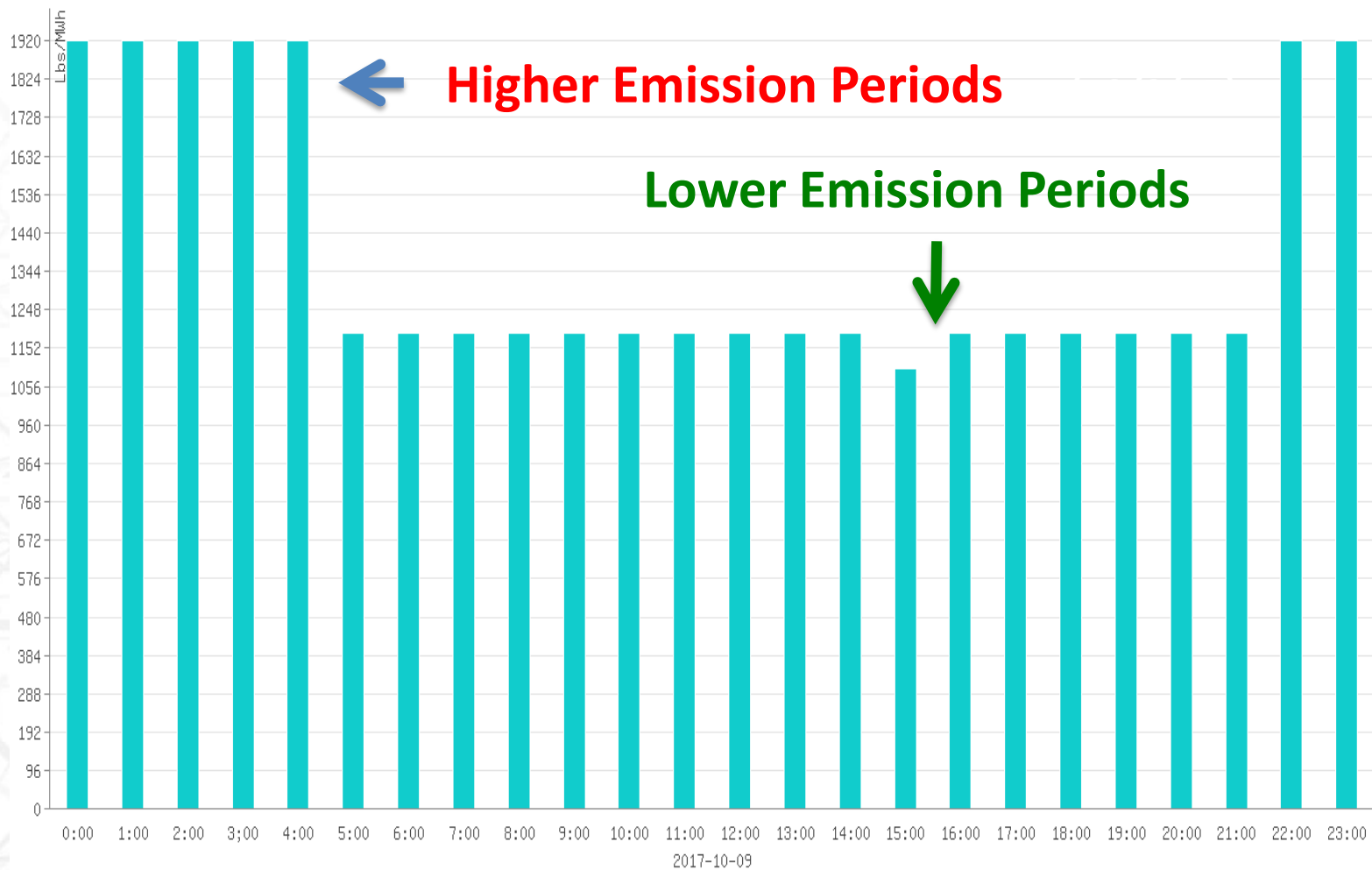
E2i

## Five Water Utility Competitors

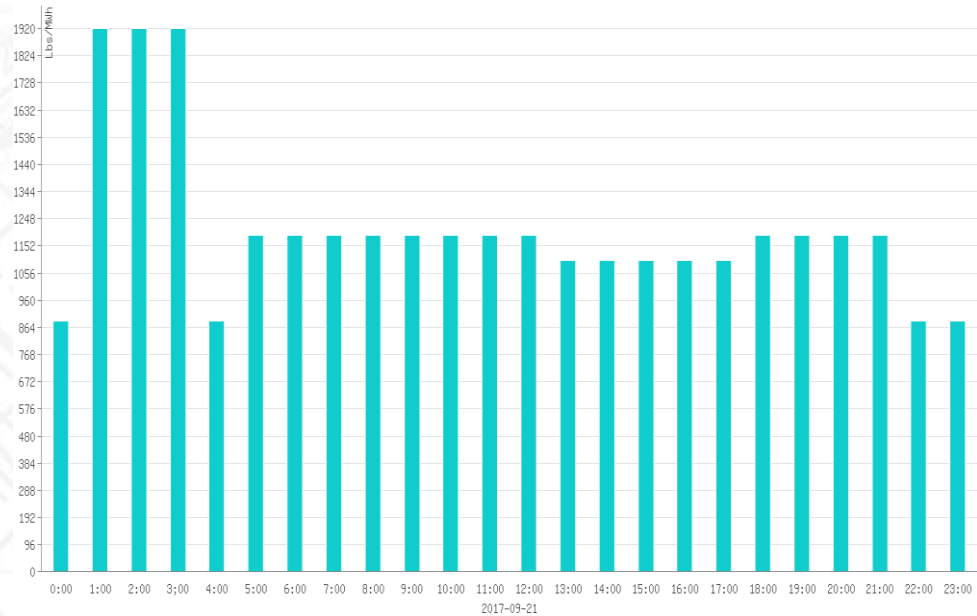
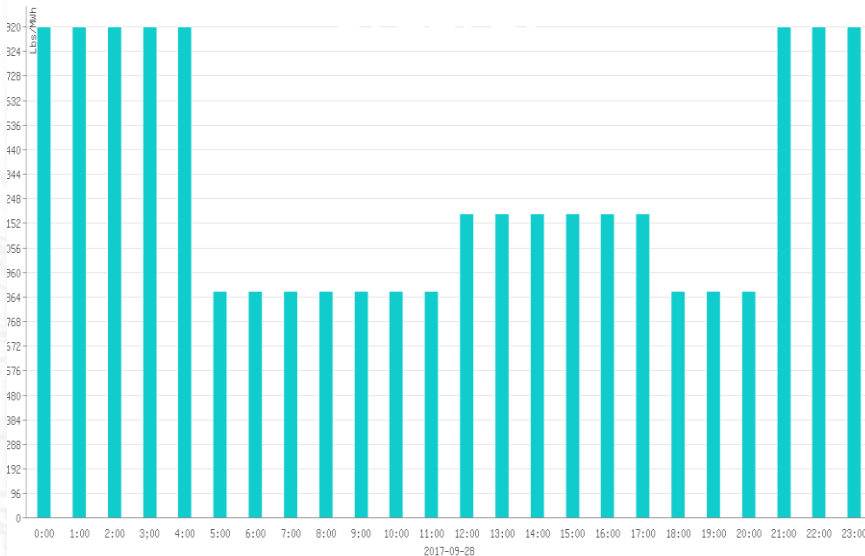




## LEEM Day-Ahead CO2 Emission LEEM



Day-Ahead  
emissions vary from  
day to day ...



# AWWA's Water Utility Energy Challenge

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## Sample WTP Emission Reductions Per Filter Washes

July 2017 Estimates of Normalized Electricity-Generated Emissions for Filter Washing Operations at the  Water Plant (Draft)

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

*Note: These estimates are preliminary, and may be adjusted upon further analysis.*

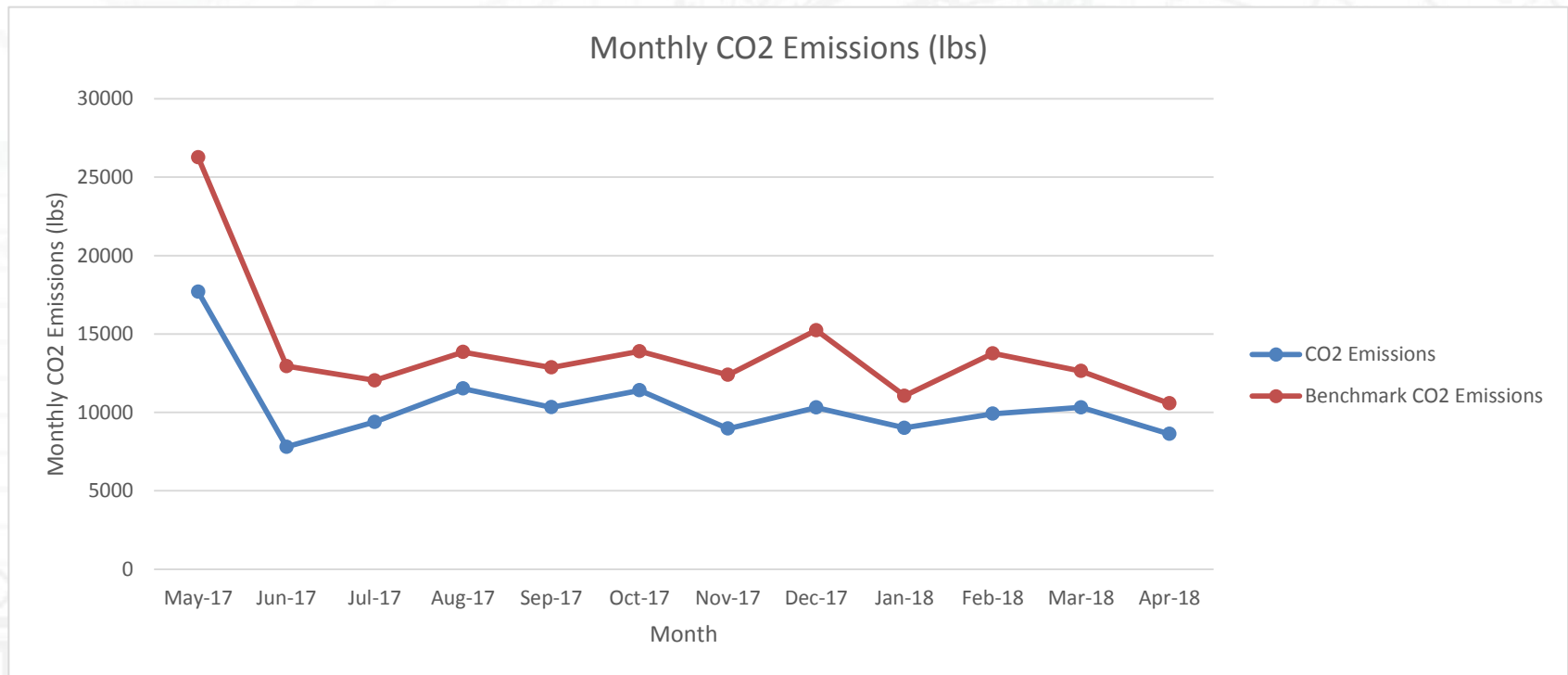


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# AWWA's Water Utility Energy Challenge

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## Sample WTP CO2 Emissions From Filter Washing



# AWWA's Water Utility Energy Challenge

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## "WINNERS"

**Water Utility Champion**

Ann Arbor

**Water Utility Green Leader**

Bayfield

**Best Technology Leader**

Highland Park

**Champion Carbon Reducer**

Onandoga County Water Authority

**Best Pilot Demonstration**

Great Lakes Water Authority

	Total Amount Reduced	House-Month Equivalents* Reduced
CO <sub>2</sub> (lbs.)	1,504,069	1,692
NO <sub>x</sub> (lbs.)	535	2,745
SO <sub>2</sub> (lbs.)	729	4,059
Hg (lbs.x10 <sup>-6</sup> )	10,019	2,896
Pb (lbs.x10 <sup>-6</sup> )	32,527	3,051
Energy Usage (MWh)	1,874	2,082

\*One "House-Month Equivalent" is the average pollution emission or energy usage in a household during a single month in the competition area.

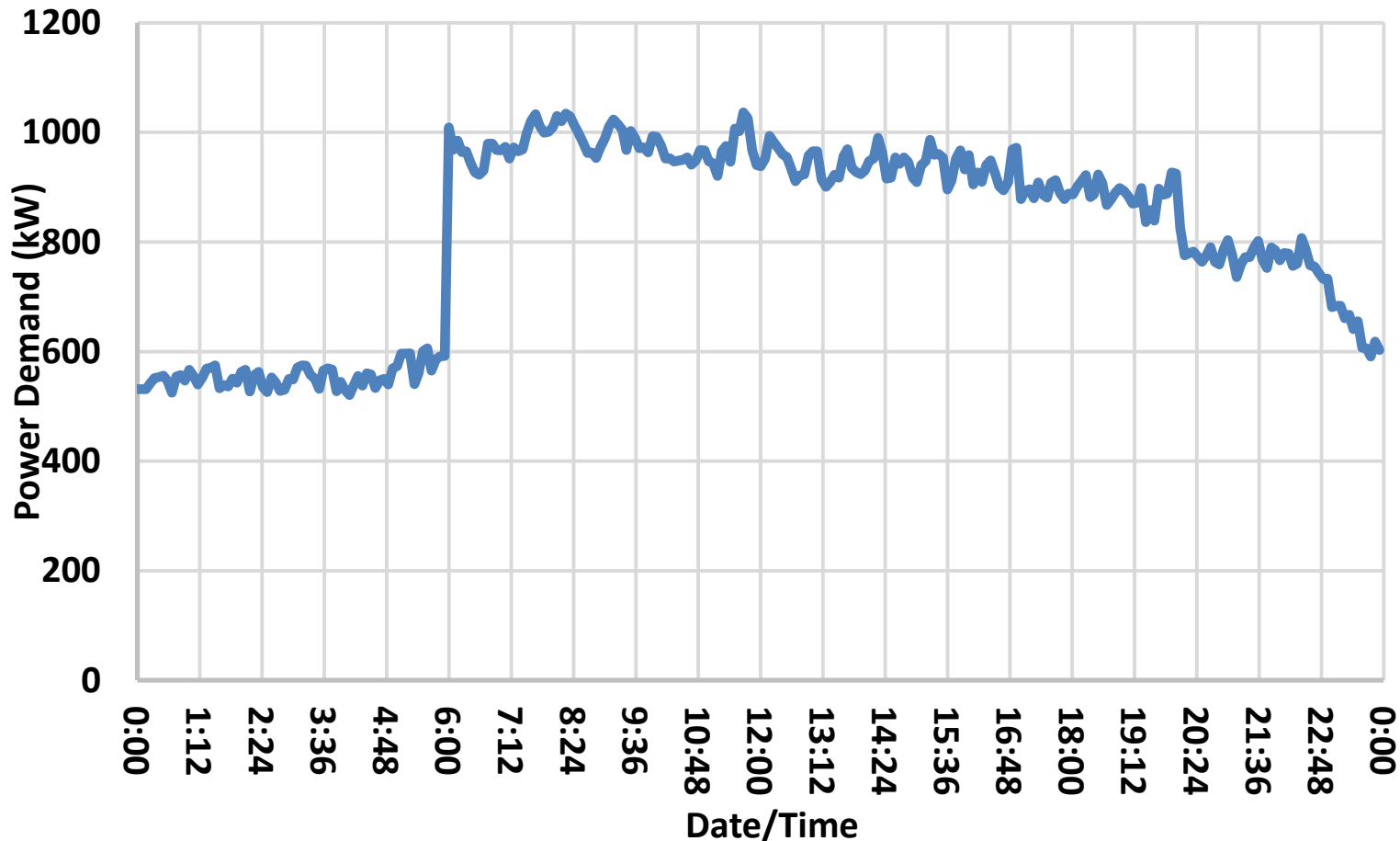


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# Other Applications: Buildings

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## Building Electricity Demand (kW)

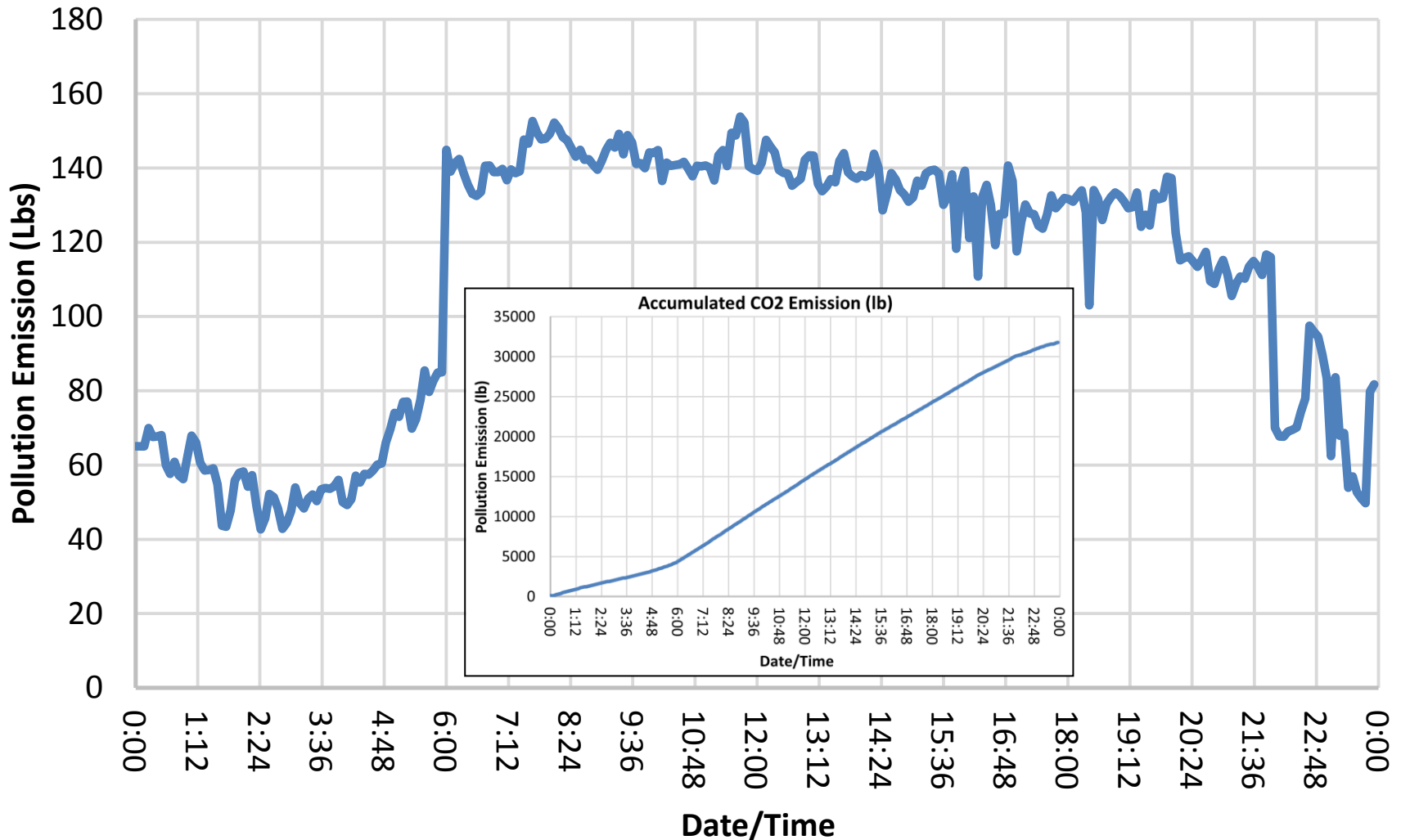




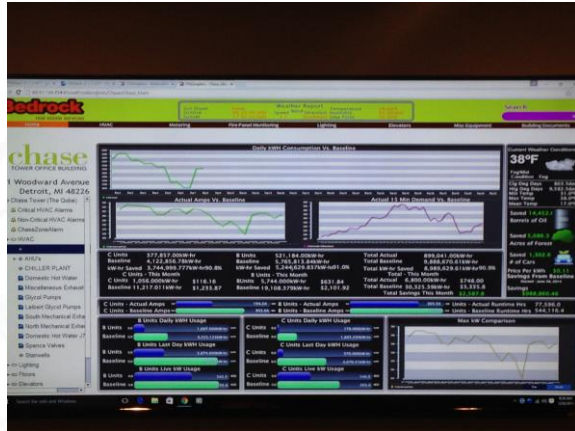
# Other Applications: Buildings

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CO2 Emission Rate (Lbs)



# Illinois Science & Energy Innovation Foundation Pilot **E2i**



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***Building Energy  
Management  
System Integration***

**UIC**  
UNIVERSITY  
OF ILLINOIS  
AT CHICAGO

***Incentivized Actions  
for  
Building Tenants***





Great Lakes  
Protection Fund



**DTE Energy®**



# Help Your Community Reduce Emissions?

E2i

- Questions & Discussion
- Thank You!

**Pilot LEEM In Your Community?**

***Please Contact***

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