Predictive and Historical Analysis of an Energy Optimization Tool for Emissions Control

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About Me

Brianna Harte is a dual environmental engineering and chemical engineering major at Rensselaer Polytechnic Institute in Troy, NY.

Introduction

In 2014, power plants emitted 2.167 billion metric tons of CO2 and millions of metric tons of other pollutants.

35% of all strokes are attributed to air pollution.

Outdoor air pollution killed 3.0 million people worldwide in 2012.

State energy taxes and credits decrease both emissions and electricity prices by encouraging production and use of cleaner energy.

Approach

-Regression was used to analyze trends of electricity production
- Selected the largest cities of the highest emitting states that LEEM covers
- Plotted and analyzed day-ahead predictions against real-time estimations

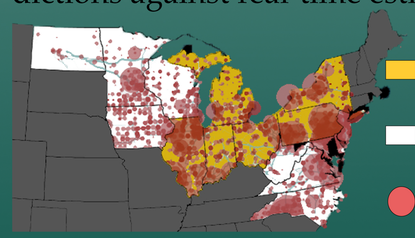


Figure 2. Selection process of high emitting states within ISOs that LEEM covers.

Background

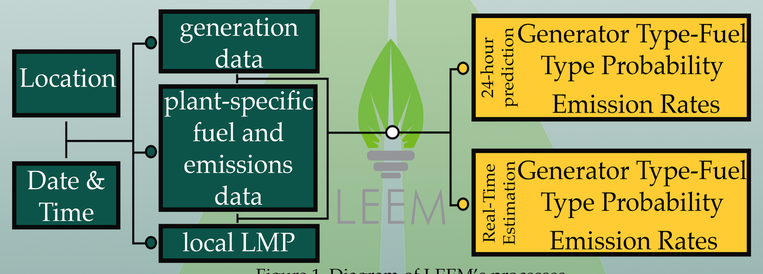


Figure 1. Diagram of LEEM's processes

Previous Evaluation: Compare LEEM's Real-Time estimations with eGRID reports
-Method: Simulations with stochastic analysis
-Result: 70-80% accuracy for primary fuel types in use
10-150% error in emission rates estimates, the lowest error being for CO2 (<25%).

Current Evaluation: Compare LEEM's day-ahead predictions with Real-Time estimations

Results

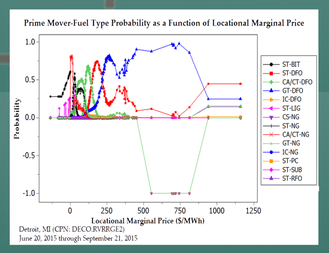


Figure 3. Generator type and fuel type probability VS LMP.

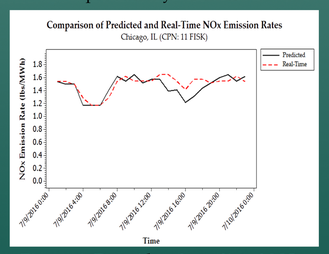


Figure 4. Day-Ahead predicted NOx plotted against Real-Time predictions.

Prediction Analysis

-Most accurate predictions:
CO2 Emission Rate
-Least accurate predictions:
Lead Emission Rate

Historical Analysis

-Emission rates and LMP varied through time
-For lower LMPs, most PM-FT probabilities have cubic regression
-LMP <$15/MWh correlates with incomplete probability

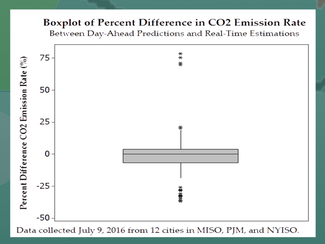


Figure 5. Boxplot of percent differences between day-ahead predicted CO2 emission rate and real-time estimations.

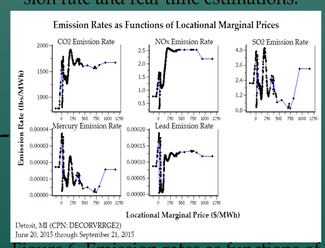
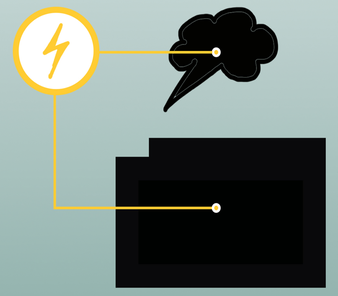


Figure 6. Emission rates as functions of locational marginal prices.

Relation to Sustainable Manufacturing



- Manufacturing requires energy, creating emissions
- LEEM predicts when cleaner energy sources will be generating electricity
- Energy management of manufacturing companies can decrease environmental footprints using LEEM.

Acknowledgements

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Conclusion

-CO2, the pollutant of greatest concern to the public, has emission rates predicted accurately against real-time estimations, which are fairly accurate against public emissions data
-LEEM has great potential to be used to reduce emissions footprints of industries such as manufacturing

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