

Trace Element Sampling and Partitioning Modeling to Estimate Wastewater Composition and Treatment Performance at Coal Generators



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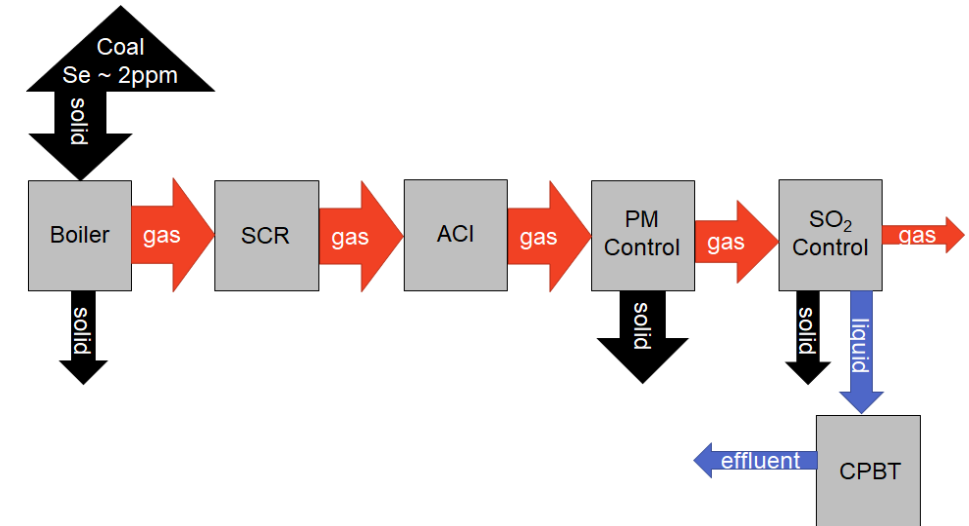
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Purpose and Alignment to FE Objectives

- Trace elements have variable concentration in coal, and behave predictably in air pollution controls
- This model improves on existing predictions for trace element partitioning at coal-fired power plants (CFPPs) by (1) accounting for plant-level variability and (2) providing validation

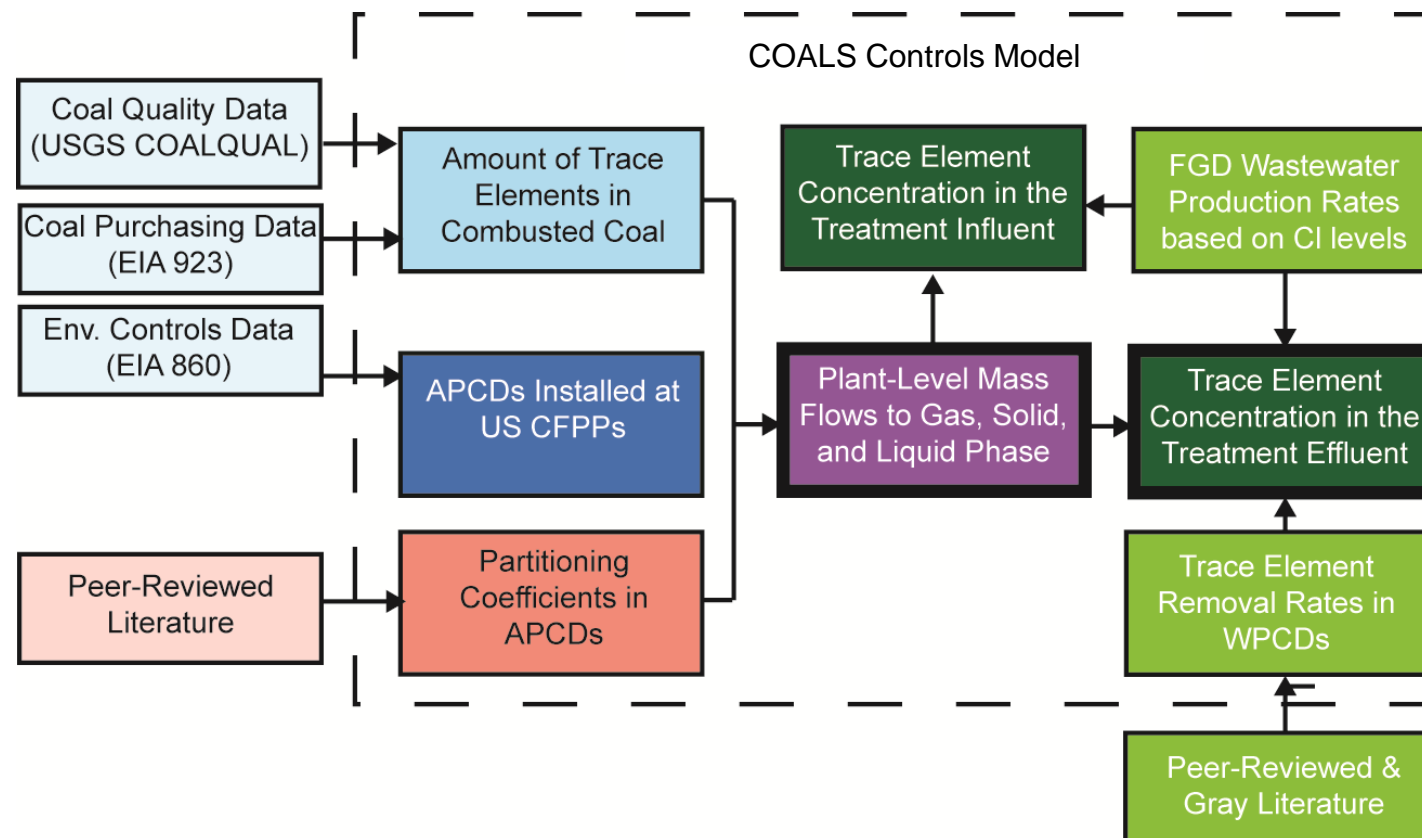


DOE FE Objective 1.1 – Develop cost-effective, environmentally responsible transformational technologies that will underpin coal-based facilities of the future

DOE Water Security Grand Challenges - Reduce water impacts in the power sector

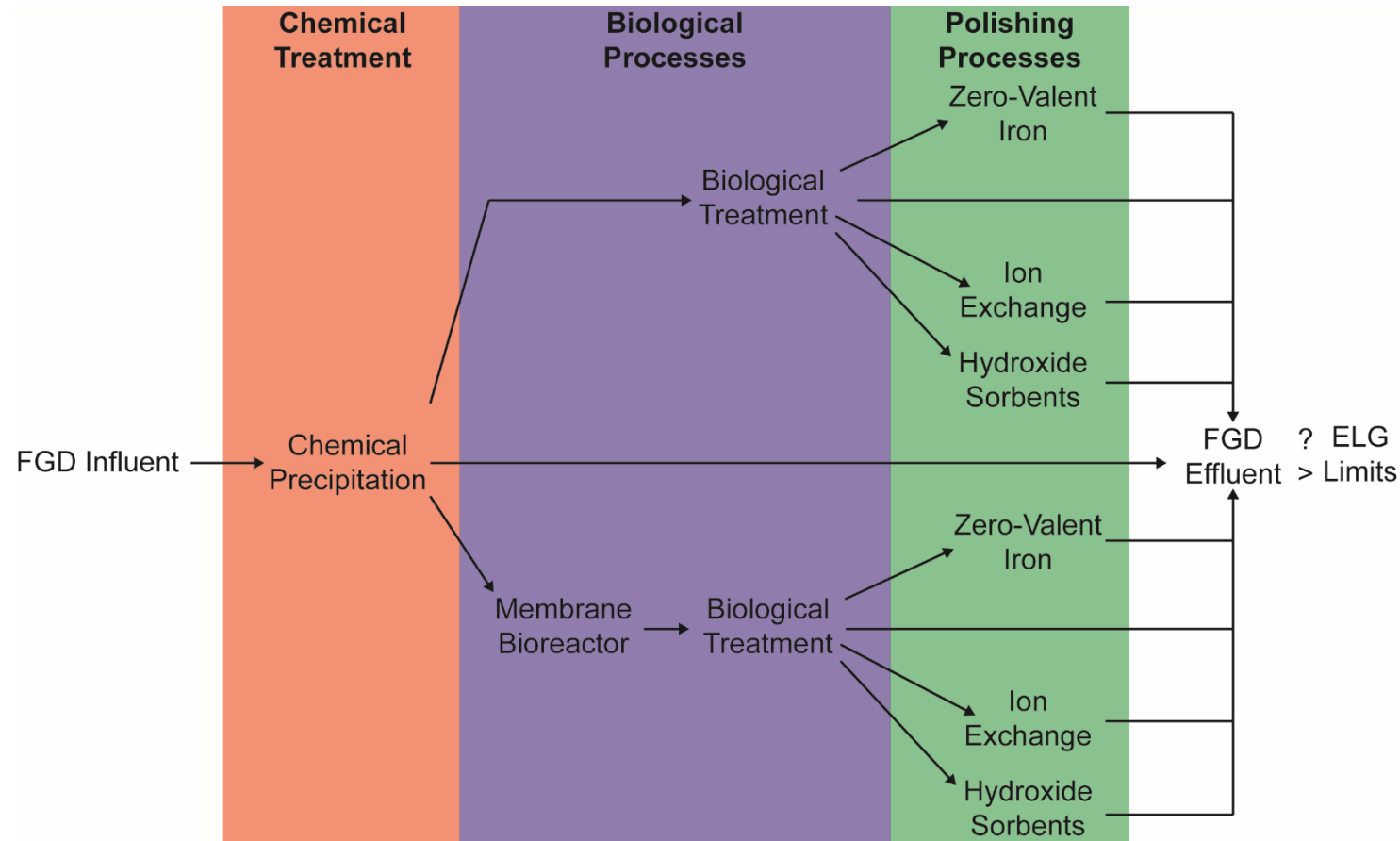
Project Objectives

1. Develop a generalizable, open-source COn-taminant behavior in Air, Liquid, and Solids (COALS) Controls Model to describe the quantity and partitioning behavior of trace elements **B, As, Se, Pb, Hg, Cl and Br** at US CFPPs



Project Objectives

2. Characterize removal performance for trace elements of concern within the best available technologies (BATs) under the ELGs for FGD wastewater treatment



Industry Collaboration

- The project uses data collected at LGE-KU partner facilities and includes non-steady state plant operation
- Partner facilities include Trimble County, Ghent, and Mill Creek Generating Stations

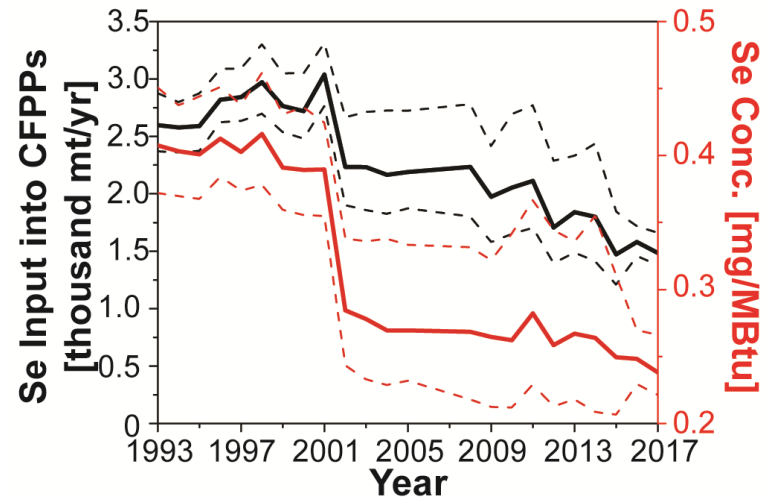


Trimble County Generating Station

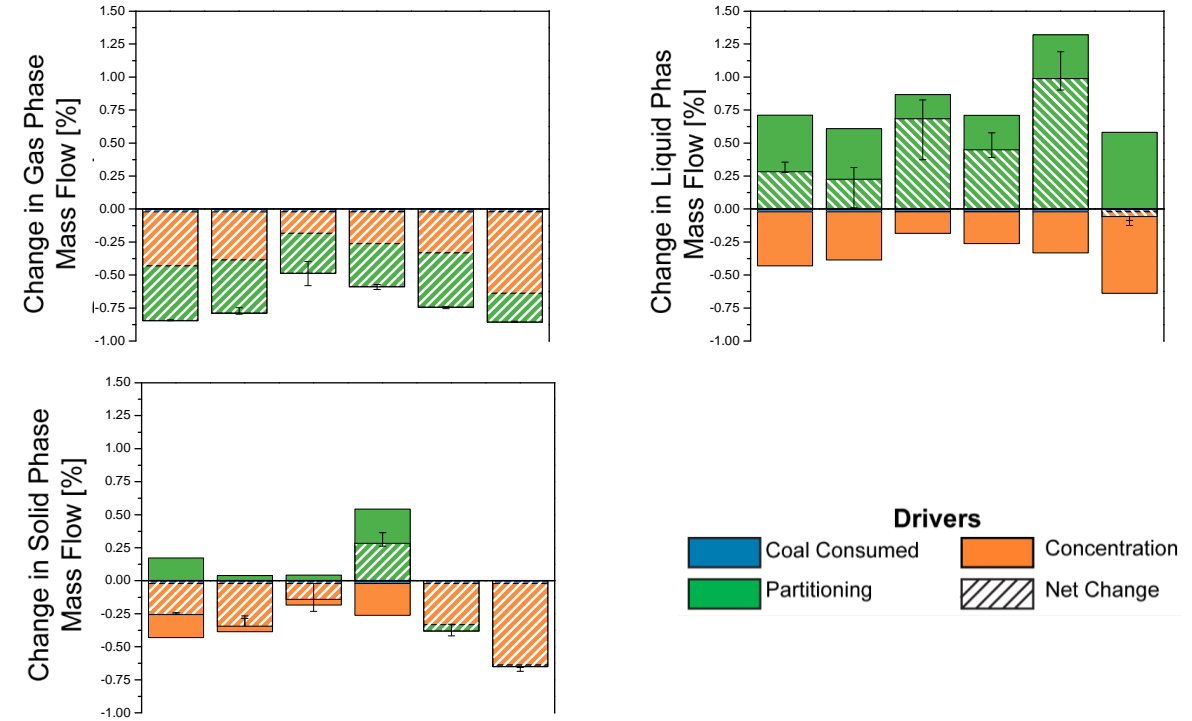


Sample collection at
Ghent generating station

Develop Trace Element Partitioning Model in APCDs

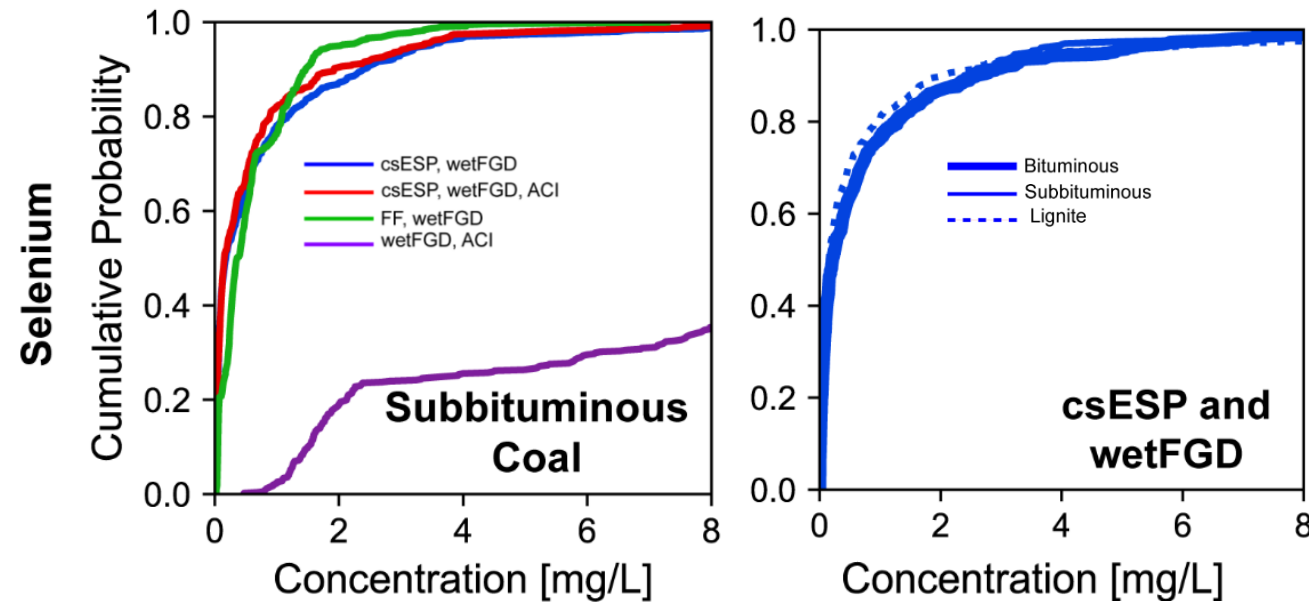


Percent change in the mass of Selenium entering U.S. CFPPs between 1993 and 2017

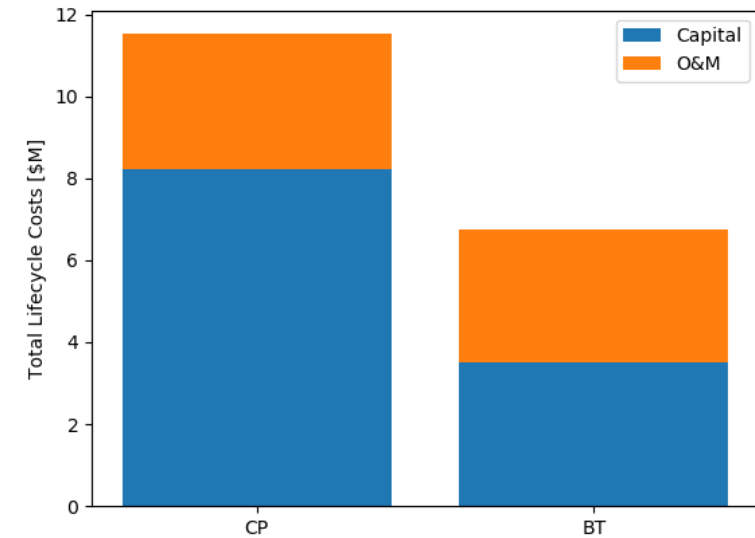


Attributional analysis of changes in the phase of trace elements exiting U.S. CFPPs

Modeled Trace Element Removal in Best Available Technologies for FGD Wastewater Treatment

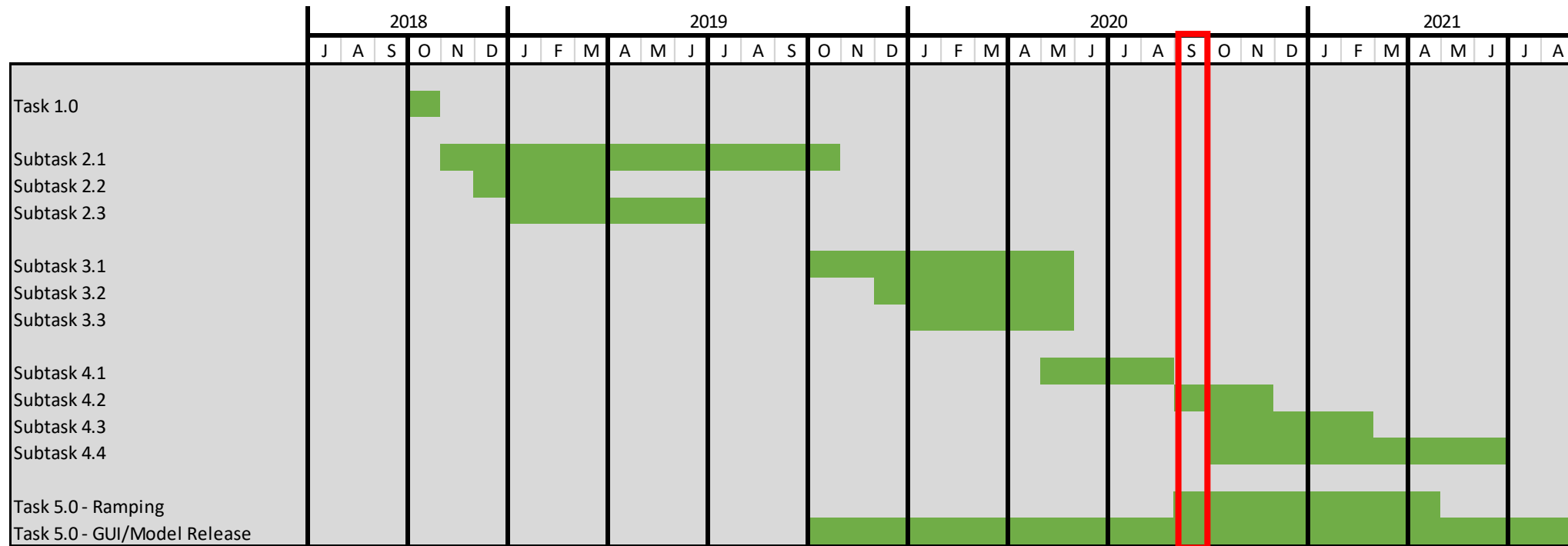


Simulated FGD wastewater
concentrations for the year 2017



Cost of chemical precipitation (CP)
and biological treatment (BT) at the
550 MW NETL CFPP
[$i = 10\%$, and $n = 25$ years]

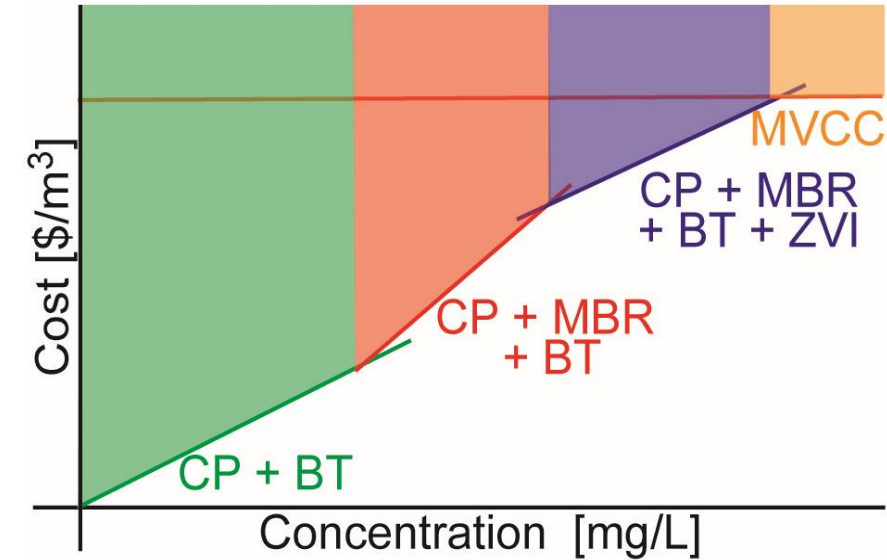
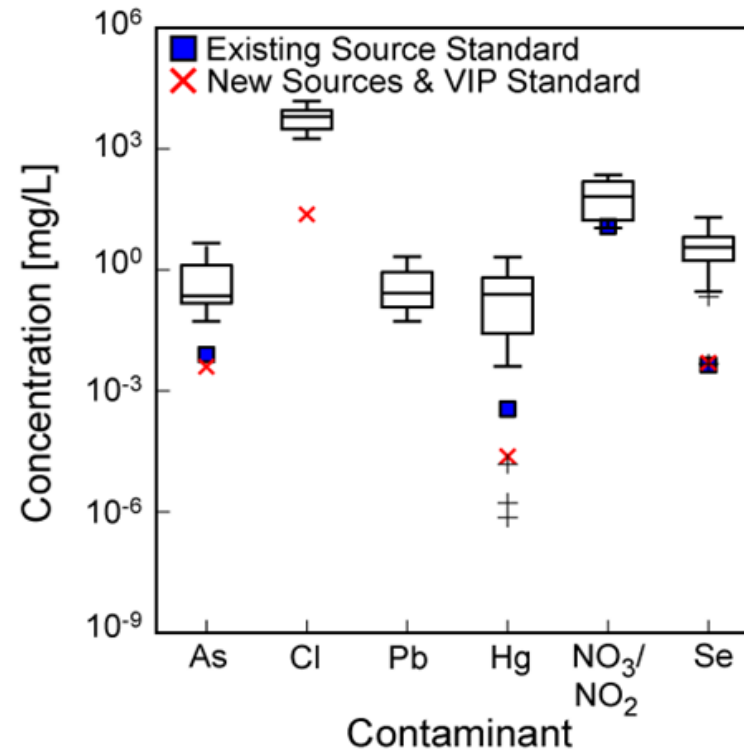
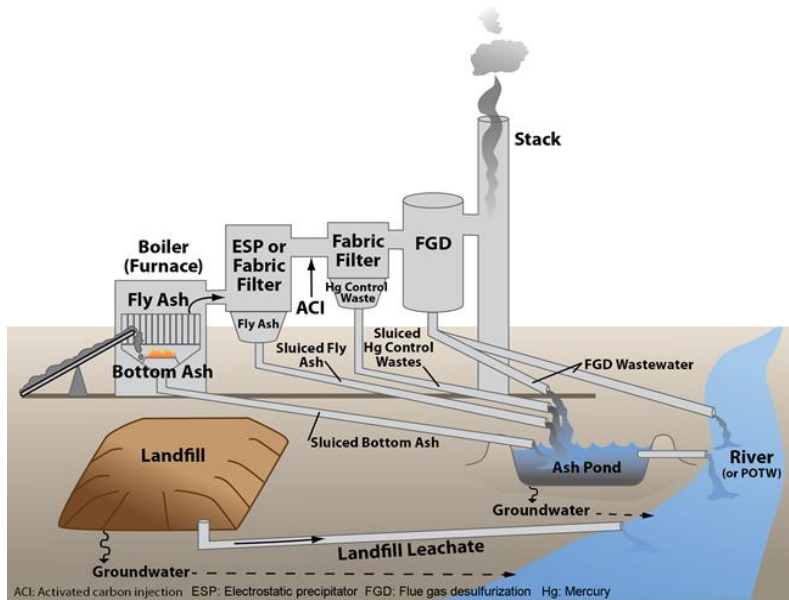
Next steps for model development



Task 4 - Complete prediction of typical FGD wastewater composition (as a Function of Coal Rank, APCDs) for 2018-2019 and validate results. Model costs for trace elements (e.g. Br and Pb) in remaining FGD Wastewater Treatment systems

Task 5 - Continue modeling relationship between ramping and APCD/WPCD performance using the data that has been collected at Partner Facilities

Benefits for discharge management at CFPP



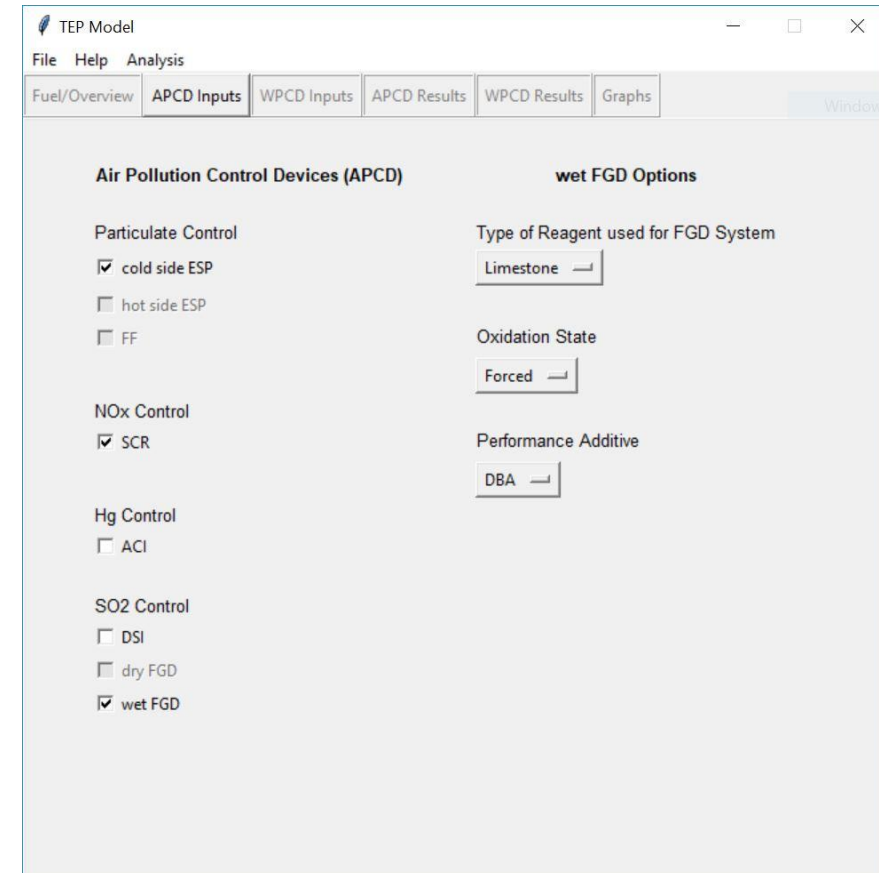
Enable solid, liquid, and gas discharge management by modeling trace element behavior

Develop typical FGD wastewater compositions for treatment technology development

Identify cost-effective FGD wastewater treatment technology options

Dissemination of results to industry

- 3 manuscripts published in Energy Policy and Environmental Science & Technology
- Public GitHub project and Open Science Foundation project were created for the COALS Controls Graphical User Interface
- Future research will connect the partitioning fractions calculated in this project to assessment of environmental tradeoffs of trace element emissions control technology at CFPP including bromine



Concluding Remarks

- This project has successfully met objectives to predict trace element partitioning at coal-fired power plants (CFPPs)
- Future work will identify FGD wastewater treatment costs given the wastewater composition determined using the model
- The objectives contribute towards DOE FE strategic objectives to improve environmental stewardship of and reduce environmental impacts from coal-based facilities of the future
- The objectives address water impacts in the power sector highlighted in DOE Water Security Grand Challenges