

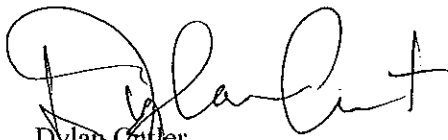
MEMO

**Date:** February 24<sup>th</sup>, 2016  
**To:** Yvette Kline  
**From:** Dylan Cutler, Brett Oakleaf  
**Subject:** Social Cost of Carbon in Optimization of Master Planning

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This memo is to detail the innovative work done by of Miami University of Ohio in collaboration with the National Renewable Energy Laboratory on optimization of master plan development. This effort evaluated a suite of options (formulated as a mathematical optimization) including: solar photovoltaics, ground-source heat pumps, combined heat/power, thermal energy storage, and improved district heating/cooling configurations, and recommended master plan alternatives based on lowest life cycle cost for the university.

One the most innovative aspects of this project was the incorporation of the social cost of carbon<sup>1</sup> into the optimization framework. Emissions were calculated for all of the fuel options (including upstream and fugitive emissions) and the cost of these impacts was incorporated into the optimization framework. The analysis was able to evaluate the life-cycle impact of the carbon emissions, and determine the optimal master plan for Miami University of Ohio based on both cost savings and avoided carbon costs.



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<sup>1</sup> <http://www3.epa.gov/climatechange/EPAactivities/economics/scr.html>. Accessed 2/23/16