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The 2035 Initiative | Research Policy Brief

Reducing water consumption enhances the economic viability of industrial energy efficiency strategies

We find that water savings from improvements to industrial steam systems can improve the economic case for industrial energy conservation measures.

Based on E. Niemeyer et al. Impact of water consumption on the economic viability of energy efficiency improvements for industrial steam systems. *Energy Efficiency* https://doi.org/10.1007/s12053-023-10167-9 (2023).

The Policy Problem

Energy efficiency initiatives are pivotal for reducing global energy consumption and carbon pollution. Industrial energy conservation measures (ECMs) are specific improvements which lower energy consumption, and in turn save money for stakeholders in the industrial sector. Examples focused on steam systems can include adding or repairing insulation, improving the functioning of steam traps, and upgrading to energy efficient burners. In addition to lowering energy consumption, many of these strategies also lower the amount of water consumed in industrial steam systems, resulting in significant additional monetary savings. Current evaluation metrics often overlook water considerations, which hinders comprehensive analysis and policy formation for these energy conservation measures. Therefore, assessing water conservation co-benefits and integrating water savings into energy conservation measure assessments is critical for understanding their full economic and environmental potential and guiding effective policy interventions.

Key Findings and Proposed Solutions:

- Several common steam system energy efficiency improvements result in combined energy-water savings, and these steam system improvements are shown to be more viable when water consumption costs are considered
- Combined energy-water conservation (CCEW) provides a more complete picture of the economic viability of steam system ECMs than conventional cost of conserved energy (CCE), as it incorporates the important influence of water savings costs that accompany steam systems ECMs
- Broader consideration of water savings can improve the economic case for industrial energy conservation measures

What We Found

Our results show that a combined energy-water conservation (CCEW) metric, which accounts for both energy and water savings, would assess the co-benefits of steam system improvements for water savings in industrial facilities. Adding water savings into these calculations increases the economic viability of ECMs as the total amount of money saved increases. The average price of water for industrial consumers has also been increasing. We find that increasing industrial water prices results in a stronger economic case for ECMs that also reduce water consumption. Specific ECM improvements targeting energy reductions that correlate with a reduction in steam generation requirements exhibit a CCEW that is $0.22-$0.83/GJ lower than a conventional CCE. As competition for water increases, it is likely that prices will continue to increase for industrial customers, which would continue to strengthen the economic viability of such ECMs.

What We Did

Our research highlights the relationship between water consumed by individual steam systems and the fuels consumed in them, which we developed using a fundamentals-mass and energy balance model of an industrial steam system. Our methodology involved integrating a steam system model with industrial energy audit data to estimate potential water savings for 21 common ECMs. By considering both energy and water conservation aspects, we evaluated the economic viability of these ECMs and demonstrated the importance of incorporating water savings into industrial energy efficiency strategies.

ECM#	ECM name	CCE ($/GJ)	CCEW* ($/GJ)	CCEW reduction ($/GJ)
1	Steam distribution	0.44	0.22	0.22
4	Steam vents	0.76	0.55	0.22
9	De-aerator	1.10	0.88	0.22
13	Blowdown	1.31	0.48	0.83
15	Traps	1.50	1.28	0.22
18	Leak repair	1.75	1.54	0.22

Fig. 1 Cost of conserved energy (CCE) vs. combined energy-water conservation (CCEW) results