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Data-Driven sustainability for energy and materials recovery

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Data-driven sustainability, a field that attempts to optimize environmental resources and reduce environmental impacts using methodologies from data science and environmental engineering, has been applied for analyzing energy and materials recovery (recycling) processes. These processes mainly involve materials collection, physical separation, volume reduction (compaction), and size reduction in Materials Recovery Facilities (MRFs), which are also necessary for Energy Recovery Facilities (ERFs or waste-to-energy facilities) as pretreatment processing prior to combustion and/or other chemical conversion processes. a decision-making algorithm has been developed for this study and allocates resources based on real-time data collected from sensors in various locations such as garbage containers, trucks as well as, the equipment in MRFs and ERFs. The result of this numerical analysis shows the optimized operation can reduce maximum 43% of time used in a separation process including eddy diffusion, cyclone (air), magnetic and electrostatic system, and scrubbers, 21% of cost in a compression (volume reduction) process used in compactors that applies forces or pressure to the solid waste materials to achieve volume reduction and density increase to aid in storage and carriage, and 32% of energy use for size reduction processes in the form of crushing, shredding, grinding, and milling.

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