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Editorial

ACS Sustainable Chemistry & Engineering Welcomes Manuscripts on Advanced E-Waste Recycling

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Electronic and electrical products, such as mobile phones, personal computers, printers, and television sets, are ubiquitous in modern society. It has been estimated that more than 50 million tons[1] of end-of-life electronic waste (E-waste) is generated by these products annually and that these waste streams are growing rapidly. Recycling infrastructures are becoming available as product take-back programs and other means of collecting end-of-life electronic products emerge. However, fundamental challenges associated with the deconstruction of electronic products and establishment of complex systems required for sustainable resource recovery continue to exist. Typically, deconstruction and recycling of E-waste is conducted where the market price for manual labor is low, and in many scenarios, the level of environmental monitoring and control is minimal. E-waste is a critical material flow that must be managed to deliver circularity in terms of maximizing value and resource utilization; however, this must not compromise human health and other sustainable development goals. The opportunities associated with E-waste flow, together with the potential environmental and human impacts of unrecovered E-waste materials, have led many in the sustainable chemistry and engineering communities to develop environmentally friendly technologies to treat and recycle E-waste. This editorial is intended to identify chemistry and engineering challenges associated with advanced and sustainable recycling technologies and management of E-waste, focusing on areas where *ACS Sustainable Chemistry & Engineering* (*ACS SCE*) would welcome manuscripts.

Measurements of the output and distribution of electronic products are important steps in mapping and quantifying potential E-waste production. Data on the production, composition, and recycling of electronic products coupled with the application of big data and active materials tracking in E-waste management will play increasingly important roles in this objective. Effective data collection and modeling systems need to be developed to accurately predict production, stock, and flow of E-waste. Manuscripts describing innovations in the material flow analysis (MFA) and life cycle assessment (LCA) will be welcomed by *ACS SCE*.

Once E-waste is generated, and possibly mapped, resource recycling requires a complex system of technologies, in part due to the heterogeneous composition of the waste. Metals, recyclable plastics with brominated flame retardants (BFRs), liquid crystals, and other organic materials are commonly found in E-waste. Resource recovery technologies can involve principles of metallurgy, electrochemistry, and physics, as well as the use of innovative dissolution and reaction methods.[2,3] Identifying synergies that lead to the recovery of multiple materials is a major opportunity. *ACS SCE* welcomes contributions that advance novel and synergistic sustainable recycling technologies.

Pollution control in the recycling of E-waste is important. Data on the distribution of pollutants, release mechanisms, and ecosystem impacts associated with recycling processes including their consequences on health are important in order to make more objective evaluations of recycling technologies. For example, in recycling processes that employ mechanical/physical separation methods (dismantling, crushing, and physical separation), fine particles and organic pollutants (BFRs, polybrominated diphenyl ethers (PBDEs), polychlorinated dibenzo-*p*-dioxins, and dibenzofurans (PCDD/Fs)) can be released. Plasma and similar energy-intensive chemistries will have emissions associated with their energy use, and these types of emissions need to be accounted for in sustainability assessments of E-waste recycling processes. *ACS SCE* welcomes contributions that use innovative methods to identify and quantify pollutants and impacts associated with E-waste processing.

Finally, the sustainability of recycling processes of E-waste should be evaluated, including energy consumption, risk assessment of environment and human health, and economic feasibility. Separation of complex components in E-waste requires new cost-effective processes. In addition, secondary pollution and health risks to people during recycling must be minimized. Therefore, E-waste recovery strategies must use methods and tools to quantitatively measure overall sustainability. *ACS SCE* welcomes manuscripts on advances and uses of such systems approaches to ensure that a green circular economy of E-waste recycling does not result in unintended harm and is environmentally, economically, and socially desirable.

Broadly, (i) mapping electronic product and E-waste flows, (ii) innovations in recycling processes, (iii) synergistic recycling of multiple resources, and (iv) quantitative assessment of recycling technologies (energy consumption, risk assessment of health, environmental impact, and economic

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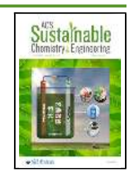

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feasibility), as well as (v) metrics and design for sustainable and resilient circularity, represent a sampling of the types of contributions that *ACS SCE* would welcome on the topic of E-waste. We welcome your feedback and look forward to your manuscript submissions in these areas.

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Notes

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