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ACED: Accelerated Circular Economy Development

Big Idea. The world must more rapidly pursue the circular use of extracted minerals and manufactured products (aka “the circular economy”), and it must create new materials and innovative advanced processes from which replacement, non-petroleum-derived products can be produced. Rapid innovation-aimed at reducing waste and eliminating waste streams, reusing, repairing, remanufacturing, reprocessing, recycling, repurposing what is already available, and replacing systems, norms, products that are petroleum-reliant and/or petroleum-derived-is a necessary approach given finite global resources. Important aspects include novel lifecycle models (accounting, simulation), independently operated system optimizations, planning and investment processes linked by prices of shared inputs and outputs, research on shifting consumer behavior, strategic communications and engagement, and expedited shifts to a circular materials system, or a circular economy.

Reasoning and Justification. Economic policies and societal norms have enabled the dominance of fossil fuels and other resource extractions for energy and material needs. The linear economy based on these dominating industries has led to the massive accumulation of waste worldwide that threatens all forms of life. The overproduction of plastics and other petroleum-derived products is expected to increase and is not responding to environmental and public health threats. The current extraction of resources is not sustainable; fossil fuels and other extracted assets from the earth are non-renewable. A system-wide approach for materials recovery and reuse is required for global supplies of resources for safe and comfortable lifestyles and technological advances.

Requirements. To embark on a comprehensive, rapid-paced conversion to a circular economy, a cross-disciplinary approach is needed and broad engagement across multiple political and social scales, guided by social science methodologies is a prerequisite. This effort will require expertise from a variety of disciplines, including the quantitative sciences (computing, data, statistics, and mathematical modeling), various aspects of engineering (systems, industrial, mechanical, control), physical and life sciences, economics, behavioral/social sciences, political science, communications, education, industry and manufacturing, and business/management/accounting/finance. The resultant models, strategies, and tactics will reflect a new way to view and handle materials; their development guided by input from entities across industrial supply chains and consumer groups. Frequent and consistent communication with stakeholders, including industrial leaders, elected officials and politicians, and numerous other communities. It will be imperative to include nonprofit organizations (e.g., Ellen MacArthur Foundation), NGOs, national laboratories, global finance organizations (e.g., The World Bank), and U.S. government agencies and the local, state, and federal levels already engaged within the existing circular economy orbit.

Value and Impact. Numerous positive impacts are expected as a result of the comprehensive circular economy approach; for example: (1) increasing the sustainability of resources at the local, national and global levels, (2) improving economic equity for underserved and under resourced populations, (3) reducing waste and its related undesired social, economic and environmental problems, (4) emergence of new technologies and creative solutions in multiple parts and sectors of the economy, (5) reducing reliance and dependence on petroleum and its derivatives, and (5) tackling looming climate change disasters.