A major challenge of the 21st century is exponentially increasing consumption of materials and the related energy and waste burden. Product complexity and rapid technology trajectory are driving the use of an expanded diversity of materials. Sourcing this wide array of metals and minerals in a global economy presents challenges. Sustainability strategies for such challenges include urban mining and recycling, industrial symbiosis, and circular economy approaches. Urban mining is when wastes that typically end up in landfills are instead processed for recovery of contained materials. Industrial symbiosis is when wastes from one industry can be used as inputs to another industry; often co-location makes this an efficient exchange. Circular economy is when resource recovery can disrupt the currently linear economic system of take (mine), make (manufacture), and dispose of materials. Such strategies can ensure additional environmental incentives in pursuing the extraction of metals and minerals from waste and industrial byproduct materials. This talk will highlight research results for two specific material systems: rare earth elements and materials necessary for the production of lithium ion batteries.