ADDRESSING GLOBAL ENVIRONMENTAL SECURITY CHALLENGES THROUGH CIRCULAR ECONOMY INITIATIVES

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Implementing principles of a circular economy can improve environmental security, with key opportunities across the Departments of Defense, Commerce, and Health and Human Services, as well as other departments and agencies. In November 2021, world leaders met in Glasgow at the Conference of Parties to acknowledge and discuss the global actions needed to minimize the impacts of climate change on health, prosperity, and security of nations. In his remarks, President Biden issued a call to the United States to lead climate change adaptation, mitigation, and resilience. This proclamation followed several executive orders from 2021, including the Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, the Executive Order on Tackling the Climate Crisis at Home and Abroad, and the Executive Order on America's Supply Chains. Taken together, these executive orders mandate a government-wide approach to climate change, including identifying and mitigating risks to U.S. supply chains. Circular economy principles could be instrumental in succeeding.

Circular Economy Principles Address Both Supply Chain and Climate Change Challenges

The global supply chain is a complex system-ofsystems and is increasingly vulnerable to climate impacts such as coastal flooding, extreme weather, wildfires, and droughts. Building a resilient supply chain is at the heart of circular economy principles. A circular economy retools supply chains and economic drivers to utilize existing materials and products, minimizing waste and new resource extractions.¹ Specifically, circular economy principles call for the adoption of systems and processes through which waste and byproducts are reused, recycled, repurposed, or remanufactured to maintain embodied energy, water, and/or materials. Circularity is a functional component of sustainability by helping separate economic growth from increased resource extraction from the environment.²

Circular systems increase the resilience of supply chains (and the economy) to shocks and decrease pressure on global bio-geophysical systems by considering the way goods and people inputs flow through systems, involving transportation, labor, critical infrastructure, and how the environment is used.³ Through re-engineering of product cycles and recycling of resources such as rare earth materials, the resource life cycle is extended and/or available to other uses (see Figure 1 for an illustration of circular economy systems). In both public and private sectors, the demand for circular supply chains is increasing for two interrelated reasons:

- 1) Increased calls for action to mitigate climate change risks through sustainable economics
- Projected resource insecurity for essential supply chains across many sectors, including health, energy, and defense⁴

The Opportunity for a Federal Circularity Standard in Recycling and Energy Efficiency

Traditional product life cycles can have varying degrees of circularity based on the extent to which they reuse components and resources; however, there is no standardized way to identify, plan, and discuss circularity opportunities across governments or economic sectors. The various federal procurement requirements and guidance provide only a loose framework to consider recycling and energy efficiency in federal government purchasing.⁵ An opportunity exists for the federal government to collectively articulate data needs and enable the measuring of progress toward closed-loop (or circular) systems. Data architectures, frameworks, tools, and policies could be developed to support these standards and address both sustainability and security challenges.



Figure 1. Circular Economy Systems Diagram. Source: Ellen MacArthur Foundation.



A whole-of-government approach is necessary because supply chain shortages can propagate due to several factors, including changes in technological innovation (e.g., lithium batterypowered electronics), climate-related impacts (e.g., wildfire disruptions to transportation grids), or pandemics; this makes it difficult to fully understand the extent and scale of impacts from a single degraded supply chain element. The impacts are not linear and have various cascading components that can perturb a supply chain well beyond the initial event or node failure (including outside regions of local, state, and even federal government control). Circular economy approaches position supply stocks closer to the demand, decreasing the number and diversity of the network of vulnerabilities.

Accelerating the Adoption of Circular Economy Principles in Government

An important first step in resource security and waste reduction in the supply chain is understanding the potential for high-impact circularity within large-scale government and commercial consumptive patterns. MITRE's experience in analyzing supply chains across multiple industries, including microelectronics, batteries, and healthcare products, has highlighted important lessons that can together help the federal government with this important step.

At-Risk and Critical Materials for Critical Energy and Power Technologies for Military Applications

A MITRE study on the domestic marketplace of materials and components employed in current and future critical energy and power technologies for military applications showed that more volatile international trade relationships can impact critical material affordability and availability. The study considered the usage plus their cost, availability, and performance in comparison to alternatives to critical materials when evaluating the risk they represent to Department of Defense (DoD) capabilities (current and future). In addition to reiterating the risks to electric motors and generators plus advanced batteries, the next generation of power distribution technologies adds new critical material vulnerabilities to the picture. Tackling these challenges is beyond the purview of only DoD and beyond the current authority of the Committee on Foreign Investment in the United States.

Identifying Impacts across Diverse Supply Chains

MITRE is currently simulating changes in local production due to supply and demand shocks across an extended area to investigate the potential for highimpact circular economies. This type of simulation framework would better enable decision makers to identify critical nodes in their supply chains and provide insight into where incentives and support should be allocated for sustained and resilient production. This could be particularly useful for identifying strategic opportunities for securing supply chains and understanding disproportionate impacts on vulnerable communities and economies.

A Way Forward

A U.S. commitment to a more resilient supply chain will require significant resource, performance, and quality tracking across the product life cycle. This commitment requires the nation to:

- 1) Understand the feasibility and cost to identify, track, and validate circularity opportunities.
- 2) Map how circularity indexes could be integrated into various business processes across U.S. Government agencies, programs, and acquisition processes.
- 3) Implement and manage circularity technologies, processes, and policies across various U.S. Government programs.

The National Institute of Standards and Technology (NIST), Department of Commerce (Commerce), General Services Administration (GSA), Office of Management and Budget (OMB), DoD, and Department of Veterans Affairs (VA) can take the lead in the adoption of circular principles that are essential for more resilient and secure federal government supply chains by instituting the following recommendations.



Recommendation 1 Define and adopt a material and product

circularity index to enable measurable benchmarks and to help address the data gap.

Defining a material and product circularity index allows for the measurement of linear or circular elements of a product and supply chain. The index, whose development could be led by NIST and supported by Commerce and GSA, would enable the U.S. Government to reduce supply chain risk through critical component control and investment strategies with measurable benchmarks. These indexes would also guide the development and maintenance of circular data repositories and best practices for measurement, helping address a major existing challenge surrounding the lack of data. A standardized, federal approach would also reduce uncertainty among manufacturers by providing a baseline against which requirements can be understood.



Recommendation 2 Develop and pilot a supply chain tracking system to enable near-realtime analysis and management of risks and performance.

DoD, VA, and NIST should research how to build and pilot an integrated supply chain tracking system to monitor the flow of supply chain materials. The research should simultaneously target a whole-of-government solution to also optimize resource use in collaboration with how OMB and GSA could use and integrate the capability across agencies while conducting pilots on critical national security supply chains for DoD and healthcare supply chains with VA. A transparent and independent tracking system that sits at the intersection of government and industry would improve national efforts to understand and improve U.S. supply chain resilience and recovery capabilities across multiple industries.



Recommendation 3 Support an ISO standards-based approach to circularity across global supply chains.

The United States has an opportunity through NIST to lead the adoption of the emergent International Organization for Standardization (ISO) standards to its own benefit. These standards would create the global framework for a circularity score and enable consistent authenticity verification (e.g., through specific product blockchain analysis). As huge consumers of goods across global supply chains, DoD and VA could mandate a standards-based approach to circularity for their large-scale acquisition programs, helping promote ISO/CD 59020.2, "Circular economy – measuring circularity framework."⁶ This would simplify U.S. efforts to understand global aspects of its supply chains an intractable problem if countries collect and manage data differently.

Conclusion

Applying circular principles to the sectors of the U.S. supply chain driven by the purchasing power of the federal government will help accelerate a more sustainable and resilient economy while improving U.S. environmental security. The U.S. Government can invest now in technologies, capabilities, and standards to position it to realize these goals within the complex global economy.

About the Authors

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