Topics for FY 2020
Emerging Frontiers in Research and Innovation

The National Science Foundation has concluded its FY 2020 topic selection process for the Emerging Frontiers in Research and Innovation (EFRI) program and plans to release a solicitation in summer 2019 on the following new topic areas:

- **Distributed Chemical Manufacturing**
- **Engineering the Elimination of End-of-Life Plastics**

Read a brief introduction to the topics in the paragraphs below. For more information, please contact engefma@nsf.gov.

Projects funded through EFRI will provide an ideal platform for engineering education, outreach and workforce development activities.

Distributed Chemical Manufacturing

Investment in distributed chemical manufacturing research aims to revolutionize the chemical process industries by enabling the development of modular process plants that can take advantage of distributed resources and/or address distributed environmental remediation needs.

The potential for dramatic transformation of the chemical process industries stems from the recent, rapid development of process intensification, a concept that can potentially yield substantial economic and environmental benefits in combination with advanced manufacturing concepts that enable a significant reduction in the size of chemical process plants.

Advances in distributed chemical manufacturing research will lead to numerous new process technologies that can stimulate the nation’s economy and strengthen its global leadership.

These systems will be energy-efficient and environmentally-friendly, will reduce risks associated with high capital investments, and could be deployed in remote areas to take advantage of stranded resources, such as natural gas and waste biomass.

This EFRI topic will promote a **convergent research approach that combines fundamental research on chemical and physical transformations of matter** (e.g., related to catalysis, electrochemical engineering, molecular thermodynamics, reaction engineering, and separations) **with multiple other approaches required to engineer functional modular plants**:

- Modeling and simulation at multiple scales (from atomistic to enterprise levels), real-time optimization and control algorithms, heterogeneous data fusion.
- Successful outcomes of these EFRI-funded projects will also require integration of research addressing sensor networks and advanced manufacturing.
- Environmental risk assessment and socioeconomic analyses will be essential to determine optimal deployment of modular process plants

Engineering the Elimination of End-of-Life Plastics

Investment in Engineering for the Elimination of End-of-Life Plastics will create a scientific foundation for viable interdisciplinary solutions for the capture, management, and elimination of end-of-use plastics, which pose an urgent global environmental problem.

Plastics are an integral component of modern life, permeating the food and health industries and enhancing consumer safety, wellness, and convenience. However, they can also represent an environmental hazard. Their inherent durability leads to ever-increasing accumulation in landfills and the environment, where they eventually fragment into microplastics that contaminate waterways, wildlife, and human bodies.

The term "plastic" describes a wide array of polymeric materials with diverse compositions and properties. These polymers, or plastics, are sometimes combined with additives to obtain desirable physical, chemical, or mechanical properties. When plastic materials are dispersed into the environment, weathering can further alter the chemical and physical structure. The heterogeneity of end-of-life plastic materials, both in size and structure, presents significant challenges to lifecycle management and remediation efforts.

Effective management of such diverse end-of-life plastic waste will require **transformative strategies for capture and sorting, efficient chemical and/or biological degradation and valorization, and integration of new approaches within existing plastics manufacturing and recycling frameworks**.

To achieve this requires:

- robust physical systems and materials for plastic lifecycle management, including sensors for detection and characterization of composition, and mass separating agents for capture of microplastics;
- development of novel catalysts, biotechnology, and reaction pathways, either chemical or biological, enabling complete depolymerization and/or valorization of plastic waste; and
- systems-level integration of new plastic remediation and valorization technologies into manufacturing infrastructures, including improving the efficiency and economic viability of existing recycling, remediation, and valorization technologies.