

MISSION INNOVATION

Accelerating the Clean Energy Revolution

6. Clean Energy Materials Innovation Challenge

Our objective: To accelerate the exploration, discovery, and use of new high-performance, low-cost clean energy materials.

Materials discovery is a key element of the innovation cycle of energy conversion, transmission, and storage technologies, as well as energy use. Development of next-generation energy technologies faces the challenge of finding and integrating new materials at a faster rate.

This Innovation Challenge aims to accelerate the innovation process for high-performance, low-cost clean energy materials and automate the processes needed to integrate these materials into new technologies. Participants will work on automating and/or improving each step of the innovation chain of new materials, such as the discovery, synthesis, data and performance assessment, and process design and scale-up with the goal of leveraging these to enable an integrated, end-to-end materials innovation approach or “platform.” The proposed unified framework will benefit all stages of the materials innovation process and will merge international advances from individual activities.

This initiative will benefit a wide range of energy sectors and applications. Specific application areas for new materials include, for example, advanced batteries and solar cells, low energy semiconductors, thermal storage, coatings for various applications, structural materials, and catalysts for the conversion and capture of CO₂.

The Issue

Even with current state-of-the-art technologies, the innovation process for the translation of new materials from laboratory to market can take 10 to 20 years and is very expensive. Accelerating and improving this process through international collaborative research and development (R&D) could result in major breakthroughs for the energy sector.

The Opportunity

Materials design and discovery is a cross-cutting need for the entire energy technology portfolio. Accelerating the exploration, discovery, and integration of clean energy materials will expand the opportunities for speeding up the transition to a low carbon economy. This initiative can also transform other industries. Overall, this initiative has the potential to generate widespread economic benefits for countries around the world and for the global economy as a whole.

The Implementation

This Innovation Challenge will combine advanced theoretical and applied physical chemistry/materials science with next-generation computing, artificial intelligence (machine learning), and robotics tools, with the aim of creating a more fully integrated approach. Doing so could help model, simulate, predict, synthesize, characterize, and test the properties and performance of new clean energy materials up to 10 times faster (see Figure 1 and Figure 2).

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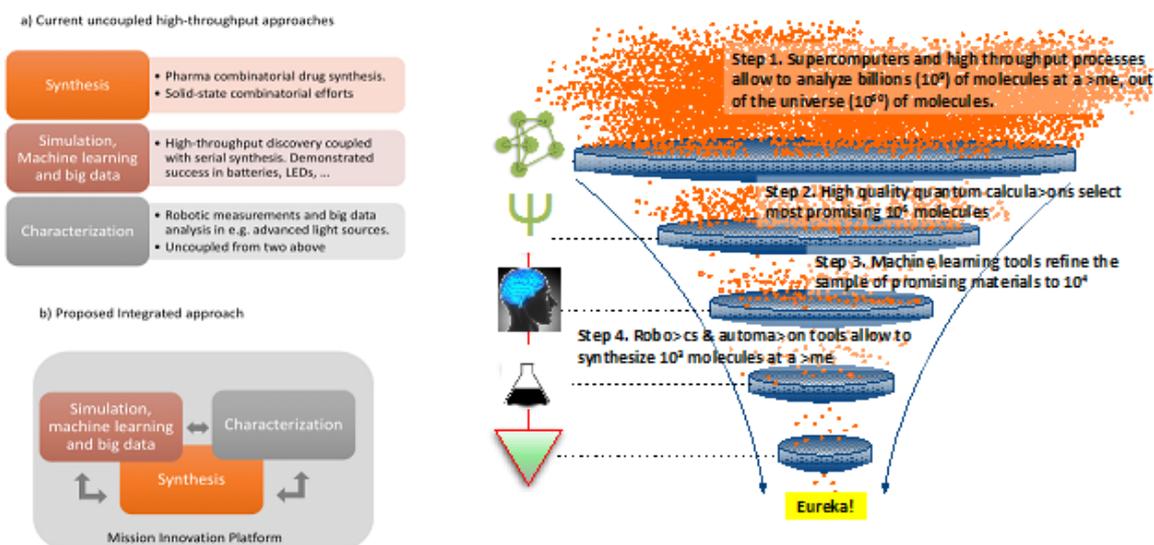


Figure 1 (left): The current uncoupled approach to materials discovery (a) could be integrated to accelerate materials discovery (b). Figure 2 (right): A disruptive technology for discovering high performance, low-cost energy materials. The integrated approach, or platform, for materials innovation could help model billions of molecules, simulate millions, predict hundreds of thousands, and synthesize and test thousands of molecules to accelerate the discovery, design, and use of new materials for high-impact energy technologies.

Many of the technologies for the implementation of this Innovation Challenge have been developed and are used in separate domains. Machine learning, for example, is heavily employed in the information technology (IT) sector and has recently been applied to materials discovery, while advanced computational tools are common in the pharmaceutical industry and other sectors. The novelty and challenge of this initiative is the integration of the advances for separate parts of the materials innovation process into a single framework, or platform, to result in materials that can be successfully used in clean energy applications.

This clean energy materials innovation initiative will build on and expand multidisciplinary and international research collaborations. Mission Innovation countries will bring together leaders in science, industry and government to work on this common goal. These experts will start by identifying the current state of R&D, including research gaps, explore mechanisms for deeper collaboration, and highlight investment opportunities with the common goal of accelerating the materials innovation process. These efforts will also promote capacity building, information sharing, and high-impact R&D and technology development.