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How can biotechnology be harnessed for economic development?

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Written by Amitabh Sinha Follow

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Government officials are calling it the first step towards the industrialisation of biology, which can have profound impacts on the economy. (Image source: @DrJitendraSingh/X)

The Centre unveiled its BioE3 (Biotechnology for Economy, Environment and Employment) policy last week. On the face of it, the policy appears to be a routine attempt to create incentives and opportunities to energise growth in the biotech sector. But it is, in fact, about transforming existing industrial and manufacturing processes across various sectors to make them more sustainable and environment-friendly, and less wasteful.

The policy seeks to achieve this by harnessing the power of biotechnology, and developing new manufacturing methods that replicate, or mimic, processes found in natural biological systems. Government officials are calling it the first step towards the industrialisation of biology, which can have profound impacts on the economy.

### What are the potential benefits of biotechnology?

Biotechnology, the science of manipulating biological organisms and processes to develop desired products or applications, is a vast and diverse field. It includes areas such as genomics, genetic engineering, synthetic biology, bioinformatics, gene therapy, etc.

develop new varieties of plants that, for example, have special desirable traits. So far, biotechnology-based solutions have been applied largely in the fields of medical science and agriculture.

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However, recent breakthroughs in gene editing technologies, protein synthesis, or the ability to grow specific enzymes using genetically modified microorganisms, coupled with increased data processing capabilities and the use of artificial intelligence, have opened up new possibilities for biotechnology.

Traditional products such as synthetic clothes, plastics, meat or milk, and fuel can have more environment-friendly alternatives, produced using modern biology. Similarly, several chemical processes in the industry can be replaced by organic and less polluting biological processes.

For example, animal-free milk, which is the same in taste, texture, and nutritional benefits as natural milk, can be produced using a process called precision fermentation. There are benefits in terms of lower carbon footprint, greater access, higher nutritional value, and increased supply.

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can be substituted by a range of bioplastics such as polylactic acid that are biodegradable. These bioplastics are made from renewable and recyclable biological materials like corn starch or sugarcane, and not from hydrocarbons that are the source for traditional plastics.

Micro-organisms such as some kinds of bacteria and algae can also be used for capturing carbon dioxide from the atmosphere, a critical bioprocess in times of climate change. Different versions of existing carbon capture and storage technologies, based on chemical processes, have remained unviable for many reasons, including high costs and the fact that they involve burying the captured CO<sub>2</sub> in geological formations below the Earth for an indefinite period. Biological processes involving micro-organisms break down CO<sub>2</sub> into other useful compounds, including biofuels, thus negating the need for storage.

In the field of synthetic biology, novel organisms with specific characteristics or biochemicals like proteins and enzymes can be designed from scratch to perform desired functions. Using a process called organogenesis or organ engineering, organs can be grown in laboratories. This can eliminate the dependence on donors for organ transplants.

The potential of biotechnology is just beginning to unfold. While some alternatives like animal-free milk are already commercially available in a few markets, most of the technologies are still under development. They may be facing scalability, financial or regulatory hurdles as of now.

### **How can BioE3 policy benefit India?**

In a few years, these technologies are expected to transform the economy and existing processes.

Bio-manufacturing — the use of biological organisms or processes in industrial production of goods and materials — alone is expected to have an economic impact worth \$2-4 trillion over the next decade, according to government estimates.

Bio-manufacturing is just one part of the greater integration and reliance on biology in economic processes.

unlikely to yield any economic dividend in the near term. But the idea is to build competencies, promote research, educate and train young talent, and get involved in the process of technology development so that India can be well-placed to derive benefits when the technologies become mature.

In this regard, the BioE3 policy is similar to several other recent government initiatives in the science and technology sector. The Artificial Intelligence Mission, the Quantum Mission, and the Green Hydrogen Mission are attempts to enable India to develop and harness futuristic technologies that are expected to soon become the backbone of the global economy, and help solve critical issues like climate change and energy security.

The BioE3 policy envisages the setting up of several biomanufacturing hubs across India. At these hubs, industry partners and start-ups can establish facilities for producing specialised chemicals, smart proteins, enzymes, functional foods, and other bio-products and services.

The hubs will focus on six areas — bio-based chemicals and enzymes, functional foods and smart proteins, precision biotherapeutics, climate resilient agriculture, carbon capture and utilisation, and futuristic marine and space research.

The last is aimed at developing products such as life support systems for astronauts that recycle waste in space and produce oxygen and food. This is done by growing special plants or micro-organisms like algae in space habitats.

Research on marine ecosystems could result in the biomanufacturing of novel compounds and enzymes produced by marine organisms. They can have useful applications in areas such as pharmaceuticals or cosmetics.



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The BioE3 policy is being piloted by the Department of Biotechnology but its impact is so widespread that at least 15 different government departments, or more, need to collaborate for successful implementation.

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**Trending** September 4, 2024 11:20 IST

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