

All aboard for the BioRevolution

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The Coming decades may be defined by advancements in biotech

The historical arc of human progress has tended to advance on a parallel path to critical developments in technology. Many readers understand the importance of the following historical periods or events:

- Industrial Revolution
- The Advent of the Mass-produced Automobile
- The Advent of Electricity/Lightbulbs
- The Advent of computers
- The Advent of the Internet—and later high-speed internet
- The near ubiquity of the smartphone
- The explosion of Data Production and tools like AI to help process the data

It's possible that future generations will look back at the 2020s and 2030s and will add something akin to 'Advancements in Biotechnology' to the above list, as the world could be ripe for a 'biorevolution.'

The BioRevolution could cover a vast landscape of different venues

The challenge, as well as the opportunity, within the BioRevolution regards the different areas where it could have important impacts.

Human Health

This is a very broad area of possible progress, which could touch diagnostics, gene therapies, regenerative medicine and vaccines, to name a few. For example:

There have been recent, favourable developments in the treatment of Sickle Cell Anemia. The ultimate goal is to find a simple, inexpensive way to treat this disease with a gene therapy that could be injected, similar to a vaccine. It would be important to be able to bring it to the developing world—not solely advanced countries. Until the present, the only cure was found in bone marrow transplantation. Researchers have been able to identify the gene responsible for the production of red blood cells in adults, and are seeking to reactivate a different gene—the one that would direct red blood cell production in a fetus—thereby bypassing the mutation that causes Sickle Cell Anemia¹. This is far from the only disease that could benefit from precise, targeted gene therapies.

Agriculture & Food

‘No soil. No Growing Seasons. Just add water and technology’².

The company AppHarvest, in Morehead, Kentucky, has a greenhouse that covers the same area as 50 football fields. 3 million pounds of beefsteak tomatoes are growing inside. Indoor farms like this one, or those run by Bowery—the largest vertical farming company in the USA—are using machine learning, data analytics, and proprietary software to coax customised flavours from fruits and vegetables. Kalera, in March 2021, had a 77,000 square foot facility that could produce more than 10 million heads of lettuce annually. Today, there are more than 2,300 hydroponic farms in the USA, but they only supply a small sliver of the \$5.2 billion fruit and vegetable market. In 2020, \$929 million flowed into US indoor farming facilities as investments, more than double what was invested in 2019³.

Materials, Chemicals & Energy

Renewable fuel demand has shown up in strong price performance of soyoil.

The US Agriculture Department estimates that the biofuels sector will consume 12 billion pounds of soybean oil in the 2021-22 marketing year, up from 9.5 billion pounds in 2020-21. Production capacity of soyoil in the US is expected to grow to 935 million gallons in 2021, nearly double 2020 levels. It is expected that 2023 production will be more than 2 billion gallons. Archer Daniels Midland indicated in May 2021 that it would invest \$350 million into building a new soybean crushing plant in North Dakota which would open before the 2023 harvest and could process up to 150,000 bushels of soybeans a day. Cargill indicated in March 2021 that it would spend \$475 million improving its soy crush facilities across seven states. Cargill also announced in April 2021 that it would partner in a joint venture with Love's Family of companies to construct a new renewable diesel plant in Nebraska that could supply the market with 80 million gallons of renewable diesel a year. Phillips 66 confirmed in April 2021 that it was buying 4,000 barrels a day of soybean oil produced at a plant in Iowa.

About 40% of all beef tallow and 80% of all reclaimed yellow cooking grease are already being sold for biofuel purposes. Coronavirus-related labour shortages have impacted the production of palm oil in Southeast Asia, bringing the global supply of this oil to the lowest levels seen in four years⁴.

Biological Machines

DNA can be used to store information.

Encoding a single gigabyte in DNA could be prohibitively expensive relative to using a standard computer hard disk. However, for really large storage requirements the ratio of gigabytes stored per cubic metre. The ratio for a hard drive could be something akin to 30 million gigabytes per cubic metre. DNA could offer 600 billion gigabytes per cubic metre. Organisations with the largest data storage requirements could see a benefit to using DNA over standard hard drives⁵.

DNA can cram up to 215 petabytes of data into a single gram. This is 10 million times what the best modern hard drives can manage. Additionally, the typical hard drive warranty rarely exceeds five years, but DNA

is routinely recovered from bones that are thousands of years old. The record stands at roughly 700,000 years⁶.

The BioRevolution will be a noteworthy megatrend

While each of the aforementioned areas is filled with potential in its own right, it is impossible to know for sure exactly when or how specific value will be added as we sit here in 2021. Some developments could occur more immediately whereas others may currently be more theoretical and take years if they are ever successful. Investments are defined by how they address inherent uncertainties, so we believe in a diversified approach to the BioRevolution, recognising that different areas may become hotter or cooler at different times, thereby creating a better chance at exposure to some of the large winners in the coming decades.

1 Kolata, Gina. "Pioneering Gene Therapy Freed Her of Sick Cell. Is a Cure at Hand?" The New York Times. 14 September 2021.

2 Source: Severson, Kim. "No Soil. No Growing Seasons. Just Add Water and Technology." The New York Times. 6 July 2021.

3 Source: Severson, Kim. "No Soil. No Growing Seasons. Just Add Water and Technology." The New York Times. 6 July 2021.

4 Source: Maltais, Kirk. "Renewable-Fuel Push Drives Soyoil Prices to Record High." Wall Street Journal. 6 June 2021.

5 Source: "DNA may soon be used to store computer data." Economist. 20 October 2018.

6 Source: "DNA could be used to embed useful information into everyday objects." Economist. 12 December 2019.

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