

ALL ABOARD FOR THE BIOREVOLUTION!

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Discussing the investing opportunity of one of the 21st century's defining megatrends

*WisdomTree has collaborated with Dr. Jamie Metzl to help create the [WisdomTree BioRevolution Index \(WTDNA\)](#), the underlying Index that the [WisdomTree BioRevolution Fund \(WDNA\)](#) seeks to track. Dr. Metzl is the author of *Hacking Darwin: Genetic Engineering and the Future of Humanity*, a member of the World Health Organization's advisory committee on human genome editing and a noted author and speaker. We sat down with Jamie and our own Jeremy Schwartz to unpack the BioRevolution, our unique new Fund and the blurring lines between science fiction and our new reality.*

Q: You've drawn a parallel between the greatest paradigm shifts of the last two centuries—the industrial revolution and the internet revolution—and a revolution already transforming our world. For investors new to the topic, what is the BioRevolution?

[Dr. Metzl]: All of life is made up of the same building blocks of DNA. At its core, the BioRevolution is a new and rapidly growing set of tools that are increasingly allowing us to read, write and hack that code of life with greater speed and precision and a rapidly decreasing cost. That has huge implications—not only in health care, but across a range of economic sectors throughout our lives and world.

Q: So how does that impact chain play out across sectors?

What we are seeing is a super-convergence of technological advances, which is continually accelerating the magnitude and speed of change. Over past decades, the sequencing of the human genome has helped unlock new approaches to understanding how our bodies work and delivering quality health care. Now we're seeing people literally bring the genetics revolution into their bodies through the miraculous messenger RNA, or mRNA, vaccines. Previous vaccines, like those for polio, mumps and smallpox, worked by injecting weakened or dead versions of the viruses. This new paradigm in vaccines works by giving our cells a set of instructions to achieve something they weren't designed to do on their own—to recreate the spike protein of the SARS-CoV-2 virus, which our bodies then recognize as foreign and mount an immune response.

From the moment Moderna got the information from the sequenced genome of the SARS2 virus, it took them just 48 hours to connect the dots and create the computer-generated formula that became their COVID-19 vaccine. It wasn't just people starting from scratch. It was 30 years of mRNA technology development converging with decades of computer and machine learning, all meshing to make the incredible advance of those 48 hours possible. That same super-convergence is driving paradigm changes across sectors, transforming other industries like agriculture, food, materials, energy and data storage. Much of the early energy in the BioRevolution has focused on health care applications, not least because we prioritize health care and spend 18% of GDP on it. But the same technologies driving this change in health care are already spurring massive transformations in the other sectors that are rapidly accelerating.

These revolutionary technologies are maturing rapidly. Generations of technological advances that may have taken decades or centuries in previous eras are now happening in months, right before our eyes. Now it's about world-class companies in a diverse range of sectors building world-changing applications.

Q: What are your favorite examples of breakthroughs that are disrupting other investing sectors?

I'll give you three categories where there are paradigm shifts, and in each one, a range of new industries are developing. The first is animal husbandry. Right now, we eat meat primarily from three animals—pigs, cows and chickens. We're providing protein to billions of people by growing these three at megascales. It's great that we are feeding people high-quality proteins, but industrial animal agriculture has devastating impacts on animal and human

health and on the environment. But what if we could grow the animal products we need without harming animals, spreading antibiotic resistance or contributing to global warming? A number of innovative companies are doing incredible work in cellular agriculture, or “clean meat,” which is beef, pork or chicken grown using cells extracted from living animals. They’re creating safe, healthy proteins while reducing animal cruelty, the widespread use of antibiotics that leads to resistance and major environmental problems. Even the world’s most aggressive environmentalists agree, if we want to stop climate change and preserve the environment, these technologies must be part of the solution.

A second example is the shift from digging up or cutting down raw materials to growing them. Humans have proliferated by getting the resources we need to thrive by extracting raw materials. Pretty soon, we’re going to need resources for 10 billion people, and cutting down more trees isn’t a sustainable answer. If everything is about extraction, we’ll hit the load limits of our planet and irreparably harm our species and home. But if we shift our mindset from extraction to production, the possibilities are unlimited. We’d no longer have to extract materials to produce everything from medicines to foods to cosmetics. In today’s BioRevolution, big problems are solvable at scale in new and far more sustainable ways.

A third example is data storage. Our data storage needs are accelerating exponentially, and we may be approaching the limit of silicon-based computer chips. DNA is by far the greatest information storage mechanism in history—and we’ve decoded it. When a million-year-old woolly mammoth was recently dug up, its DNA was readable. That’s what I call reliable data storage! Try digging up your cellphone a million years from now and see what you get. Advances in information storage are moving at light speed, and I’m quite confident we’ll be storing massive amounts of data through the medium of DNA over the coming decades.

Q: What would you say to the investor who is worried about the ethical implications? Is this playing God over our species?

That’s a critically important question. We’re talking about very powerful tools. Like all tools, they can be used wisely or misused, and the onus is on us to ensure they are used wisely. I’m a member of the World Health Organization’s advisory committee on human genome editing, for example, and our sole purpose is to make recommendations for how these technologies can be used wisely.

There is a strong ethical case for the wise application of these technologies. In human health care, we have the ability to prevent and cure previously deadly diseases and unlock human potential. For every person with a loved one stricken by a terrible cancer or debilitating disease like dementia, how wonderful would it be to have technologies that can save and improve lives? I can go sector by sector and make an overwhelming case for the ethical applications. But we need to be clear that there are always possibilities for any technology to be abused, which is why smart regulation is always important. That’s why we only want to work with companies that are highly ethical and working in well-regulated environments.

The underlying Index behind the [WisdomTree BioRevolution Fund \(WDNA\)](#), for example, is not working with any companies in China, where the regulatory environment is not as robust as in the U.S. and Europe. We’re talking about some of the most profound technologies that our species has ever developed. We will use them to do a lot of good. The question isn’t should we be using them but how best can we do so.

Q: Obviously, WisdomTree isn’t the first to recognize the economic implications and historic investment opportunities. What makes the [WisdomTree BioRevolution Index \(WTDNA\)](#) & the [WisdomTree BioRevolution Fund \(WDNA\)](#) unique?

[Jeremy Schwartz]: It may seem like there’s a lot of competition, but I believe there really is NO competition doing it like [WDNA](#). Other funds typically allocate 2% or less to non-health care sectors, and the other 98% is health care or genomics focused. We are uniquely and one of the first ETFs to bring it all together across all the elements of the biology revolution. We believe [WDNA](#) is at the sweet spot of innovation and [diversification](#)—with 20% of 115 stocks allocated in non-health care sectors. We also have more of an equally weighted process. So, our basket includes more of the younger companies, rather than just a list of mega-cap pharma players. Yes, they have innovation, so [WDNA](#) does include them. But our process allows growth in the earlier stage companies.

[Dr. Metz]: Health care is the most mature sector of those we are investing in, and even in health care, it’s still early. We’re just beginning the transition from generalized medicine (based on population averages), to precision health care (based on each person’s individual biology), to predictive health care and health (based on the predictive values of our own biology and our algorithms). So even in the most mature sector, it’s very early. But in other sectors—food, agriculture, materials, energy, data storage—it’s even earlier. Still, we’re seeing a tremendous pipeline of these disruptive non-health care companies reaching our size and quality thresholds, and that means they will be brought into the underlying Index portfolio. So, we have a dynamic Fund to match the dynamic growth potential of this revolution as it extends well beyond health care. That’s what sets [WDNA](#) apart.

Q: How do you select companies to include in the underlying [WDNA](#) Index basket?

[Jeremy Schwartz]: Jamie, of course, helped us identify the major themes, and he joins us at the quarterly committee meetings. We track “What are the latest companies coming to market? Do they fit the innovation standards we’re looking for? Are they positioned at the cutting edge of the technologies? Are they mature enough yet?” Using these analyses, we rebalance the Fund twice a year. Our goal with [WDNA](#) is to invest in a range of innovative companies across the size and impact spectrums, because diversification is key. Right now, the top 10 holdings account for less than 15% of the Fund’s total weight.

Dynamic companies are beginning to establish pole positions, and the pipelines are growing. Look at a Gingko Bioworks, the cell-programming company that’s coming public via [SPAC](#) in September¹. Or the plant-based Upside Foods and Mosa Meats, for example. You see them raising big amounts of capital as private companies. These are the types of names we may add.

Figure 1: The Potential BioRevolution Pipeline

Company	Pipeline Status	BioRevolution Sector	BioRevolution SubSector
Ginkgo Bioworks	5/11/2021 - expected to go public in 3Q 2021 via merger with special purpose acquisition company, valued at \$15bn	Materials, Chemicals, & Energy	Synthetic Manufacturing and Precision Fermentation
Zymergen	4/21/2021 - completed its initial public offering valued at approximately \$3bn	Materials, Chemicals, & Energy	Synthetic Manufacturing and Precision Fermentation
LIVEKINDLY	3/29/2021 - announced successful capital raise of \$335mn, bringing total funds raised in its first year to \$535mn	Agriculture & Food	Plant-Based Meats
OATLY	5/20/2021 - IPO at the top of valuation range and closed its first trading day above the IPO price, at a valuation of ~\$12bn	Agriculture & Food	Cellular Agriculture
BlueNalu	1/19/2021 - raised \$60mn in convertible note financing, following earlier \$20mn Series A and \$4.5mn Series Seed rounds	Agriculture & Food	Cellular Agriculture
JUST	3/23/2021 - secured \$200mn in funding and has raised more than \$650mn since founding in 2011	Agriculture & Food	Cellular Agriculture
UPSIDE Foods (formerly Memphis Meats)	1/22/2020 - completed Series B capital raise of \$161mn, bringing total funding to \$180mn	Agriculture & Food	Cellular Agriculture
Mosa Meat	2/23/2021 - raised \$85mn in Series B funding	Agriculture & Food	Cellular Agriculture
Perfect Day	7/8/2020 - raised \$340mn in Series C funding round, following \$34mn, \$24mn, and \$2mn in previous rounds	Agriculture & Food	Cellular Agriculture
Modern Meadow	4/26/2021 - completed \$130mn Series C Funding	Materials, Chemicals, & Energy	Synthetic Manufacturing and Precision Fermentation

Sources: WisdomTree, Ginkgo Bioworks, Zymergen, LIVEKINDLY, OATLY, BlueNalu, JUST, UPSIDE Foods (formerly Memphis Meats), Mosa Meat, Wildtype, Perfect Day, Modern Meadow. The companies detailed in this chart are private companies and not held by the WisdomTree BioRevolution Index (WDNA).

[View holdings of the WisdomTree BioRevolution Fund \(WDNA\).](#)

Q: What might investors be surprised to hear about the BioRevolution Fund?

Perhaps that it’s not just about innovative technologies. It also focuses on innovative business models. For example, imagine a company that has always produced perfumes by extracting its scents from flowers. Leaders in synthetic biology can now approach them and say “we can create scents that are indistinguishable from the best fragrances you get from flowers, and we can do it at scale for you, for less money. Just give us a percentage of all revenues made from selling this product.” Now extrapolate that business model across sectors. Imagine every company that is using materials extracted from the natural world. Over time, those materials can be made better, safer and cheaper using the tools and advances beginning now in the BioRevolution. If you know where to look as an investor, you could potentially ride that wave a long way. That’s what [WDNA](#) is all about.

Q: We hear there’s a great story about Michael Steinhardt’s reaction to this Fund.

[Dr. Metzl]: [Laughs] It was the day Jeremy called me about my book, Hacking Darwin: Genetic Engineering and the Future of Humanity, and said it would make a really interesting ETF. We had a great conversation where I explained why I felt the biology revolution was about much more than health care and why a broader, cross-sectoral approach made so much sense. At the end of our call, I said “I waited to tell you this, but Michael Steinhardt (former WisdomTree Chairman and largest individual shareholder) is actually a good friend of mine.” When we hung up, I called Michael to tell him about our conversation. After describing my conversation with Jeremy, Michael asked me to “call Jono (Jonathan Steinberg, CEO and Founder of WisdomTree), tell him you spoke to me and that I said I think this is the best ETF idea I’ve ever heard in my life!” That may have helped get the ball rolling even faster.

[Jeremy Schwartz]: We’re all really excited and confident about the future of this Fund.

For more compelling insights from Dr. Metzl, check out the [June 1, 2021, issue of Newsweek](#) and his [recent blog post on human genome editing](#).

¹ This SPAC is not a holding in the [WisdomTree BioRevolution Fund \(WDNA\)](#) but Gingko Bioworks would be eligible after the combined entity is formed.

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There are risks associated with investing, including possible loss of principal. The Fund invests in BioRevolution companies, which are companies significantly transformed by advancements in genetics and biotechnology. BioRevolution companies face intense competition and potentially rapid product obsolescence. These companies may be adversely affected by the loss or impairment of intellectual property rights and other proprietary information or changes in government regulations or policies.

Additionally, BioRevolution companies may be subject to risks associated with genetic analysis. The Fund invests in the securities included in, or representative of, its Index regardless of their investment merit, and the Fund does not attempt to outperform its Index or take defensive positions in declining markets. The composition of the Index is governed by an Index Committee, and the Index may not perform as intended. Please read the Fund's prospectus for specific details regarding the Fund's risk profile.

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Special Purpose Acquisition Company (SPAC) : A company with no commercial operations that is formed strictly to raise capital through an initial public offering (IPO) for the purpose of acquiring an existing company.