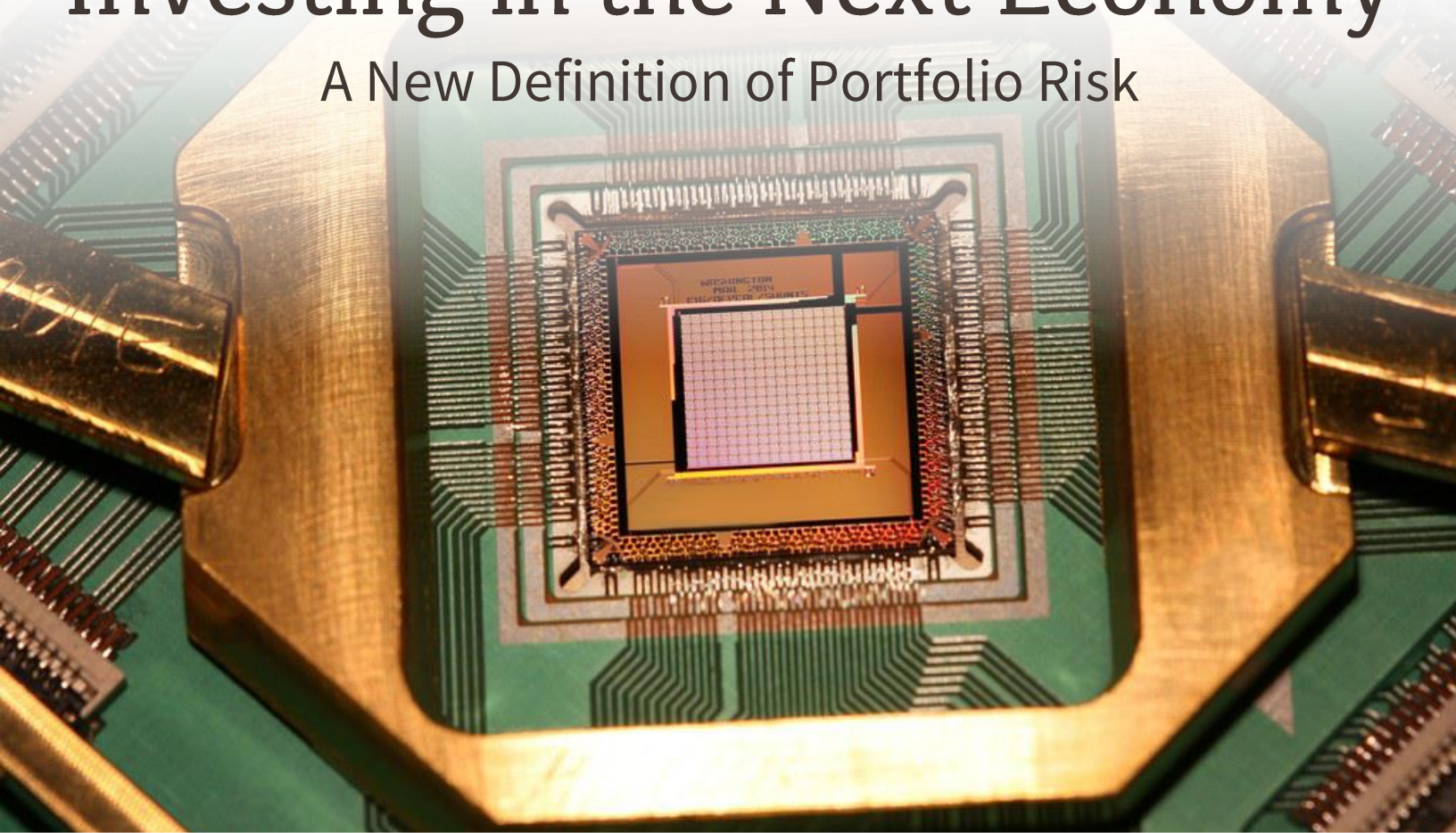


Investing in the Next Economy

A New Definition of Portfolio Risk



The Next Economy™ is the unfolding, solutions-driven way we produce and consume goods and services. As systemic risks — climate change, resource scarcity, widening inequality — continue to materialize, demand for solutions is accelerating. As a result, innovative companies addressing systemic risks are leading long-term economic growth, and investing in them is our best opportunity to preserve and create wealth. By directing capital to solutions creators, investors can catalyze and gain from the highly efficient, sustainable Next Economy.



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A D V I S O R S

About Green Alpha[®]

We have been redefining asset management since 2007 by **Investing in the Next Economy**[™] — one in which creating solutions to systemic risks drives economic growth and enables populations to thrive. We believe that investing in companies creating innovative solutions to climate change, resource scarcity and widening inequality is the greatest wealth creation driver of the 21st century.



About the Authors

Garvin Jabusch is Green Alpha's Chief Investment Officer and chair of the Investment Committee. As a former archaeologist, his mix of science and business experience brings a unique understanding of long-term systemic risk and societal collapse to portfolio management.

Arina Abbott supports the Investment Committee by carrying out responsibilities such as proxy voting and content creation. Her academic background in International Political Economy offers valuable perspective on intersecting global trends.

Jeremy Deems, Chief Financial Officer, is the co-portfolio manager on all Green Alpha investment strategies. Jeremy brings extensive finance, accounting and mutual fund industry experience to Green Alpha's investment committee, including managing fossil free strategies with Garvin since 2002.

Betsy Moszeter is Green Alpha's Chief Operating Officer and participates on the Investment Committee throughout the stock picking and account investing processes. She has been in investment management for more than 18 years and has served in virtually every role possible.

Key Highlights

- **A New Definition of Risk.** Growing systemic risks — including climate change, resource scarcity and widening inequality — have put the business-as-usual economy in peril. Investors need to rethink their investment decision making process with an eye to these material, long-term risks.
- **Solutions as Economic Drivers.** In a rapidly changing world, long-term economic growth will be concentrated among firms finding solutions to these systemic risks. Today, the primary centers of innovation and efficiency — in renewable energy, the Internet of Things (IoT), autonomous transportation and many other applications — are individually and synergistically creating the basis of the Next Economy.
- **Next Economy Portfolio Theory** provides the framework for a solutions-driven investment approach that reduces portfolio risk inherent in the legacy fossil fuels-driven economy, while simultaneously driving capital toward a genuinely sustainable economy.

Table of Contents

Overview	4
Defining the Next Economy: Risks & Economic Drivers	5
Systemic Risks & Economic Impacts	
Solutions as Economic Drivers	
Next Economy Portfolio Theory	9
Next Economy Analysis: Top-Down Search for Solutions Creators	
Fundamentals-Based Analysis: Bottom-Up Search for Leaders	
Result: Next Economy in Motion	
What’s Wrong with Modern Portfolio Theory	
Opportunity for ESG Managers to Have Greater Impact	15
Conclusion	16
Appendix: Systemic Risks & Solutions	17
Disclosures	22
References	23

Investing in the Next Economy

The economy of the future has little to do with markets of the past. For many economists and investment managers, this may seem like a bold claim, but the reasons for it are clear.

Today's expanding list of systemic risks — starting with **climate change, resource scarcity and widening inequality** — has put the business-as-usual economy in peril.

At the same time, **rapidly accelerating innovation**¹ presents a myriad of opportunities to mitigate these risks, while stimulating economic growth. It is this unfolding, solutions-oriented, innovation-driven, connected, highly efficient economy that we call the **Next Economy**.[™]

*“Such a rapidly evolving economy requires an **equally adaptive approach to investment management**. That is why we need **Next Economics and Next Economy Portfolio Theory**.”*

This **solutions-focused, risk-mitigating** economy is materializing across sectors and industries; however, no sound investment approach had been codified to reflect this emerging economy until the creation of Next Economy Portfolio Theory.

A rapidly evolving economy requires an equally adaptive approach to investment management. Likewise, conventional approaches to investing will prove wanting if they fail to keep pace with shifts in

the risk landscape and dramatic increase in innovation.

That is why we need Next Economics[™] and Next Economy Portfolio Theory.[™]

Next Economics is a theoretical framework that incorporates the:

- 1) likeliest outcomes of burgeoning systemic risks and
- 2) resulting opportunities to drive economic growth with creative solutions to these systemic risks.

The Next Economics framework then informs the practical investment application, called **Next Economy Portfolio Theory**. Investment managers that employ this framework may capture gains from companies working to drive progress toward the rapidly evolving, highly efficient, low-carbon, innovation-driven economy, while simultaneously minimizing portfolio risks.

Next Economics centers on two key arguments. The first is that *the growing global economy has and will continue to evolve by factoring in systemic risks*. This first concept is not unusual; sustainable development advocates like the UNEP have explored this for several decades.

The second fundamental argument remains untapped: *creative solutions to these systemic risks are becoming the major drivers of economic growth, which then generates investment returns and creates wealth*.

Next Economy Portfolio Theory must follow. A manager can no longer rely on Modern Portfolio

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Theory (MPT) to fully and accurately assess current and future risk and opportunity sets; nor can they merely overlay “green” or ESG specifications onto existing economic or investment theories and expect to realize anything more than a slightly greener portfolio.

It’s time for a new, indefinitely sustainable system — one that utilizes the best of what traditional models

offer, and sheds outdated and outmoded assumptions about performance and, most importantly, incorporates known long-term risks to the global economy.

Here’s what that truly sustainable system will look like.

Defining the Next Economy: Risks & Economic Drivers

Systemic Risks & Economic Impacts

Traditional approaches to investment management were conceived at a time when:

- natural resources were considered effectively limitless,
- fossil fuels reigned with no viable energy alternatives,
- economic and social disparities, while present, did not yet threaten the social fabric that binds together the economy and
- the widespread impact of a rapidly warming climate was not well known.

Today, we have a new set of objective facts that must be considered when building portfolios. Using all objectively verifiable information available is far more likely to result in predicted outcomes (e.g., better risk-adjusted returns) than inherited investment management approaches yet to be updated.

We must consider how these new facts affect the economy. Once we’ve used these facts to build a framework to understand what the Next Economy looks like and how variables within that economy

interact, we can consider how this plays out in a fully-informed investment process.

These facts — or “key factors” of the Next Economy — involve three central **systemic risks**:

- climate change,
- resource scarcity and
- widening inequality and resulting erosion of social cohesion.

Of course, these broad systemic threats materialize as many downstream hazards. For example, climate change is increasing the severity and likelihood of extreme weather events like flooding, hurricanes and drought. Resource scarcity will continue to take the form of food, water and land degradation and scarcity. Widening inequality has already led to previously-unimaginable political unrest, violence and the expansion of terror organizations, all of which undermine global economic stability and growth.

When these global risks intersect, they create new sets of concerns. For example, the increasing frequency of droughts leads to food and water scarcity, which blends with inequality in the form of

unequal resource access. It would be a mistake to imagine this as an example in the far-off future, when this exact scenario has played out already in Syria.² The ultimate result has been war and mass migration — a sadly fitting demonstration of the unconfined nature of these systemic risks.¹

How do these risks pose a threat to the economy? We can use this same example of extreme weather events to illustrate resulting economic damage. In the face of increasing droughts, a once highly productive bread basket could lose agricultural output, income and jobs.

For a deeper dive into risks and solutions, see Appendix beginning on page 17. While the list is non-exhaustive, it illustrates the pervasive nature of systemic risks, their economic impact at the sector level and corresponding solutions.

Still other neutral inputs, which may be regarded as positive or negative depending on the outcome, include political and trade policy risks, along with the broad impact of globalization. Efforts at nationalistic policy, for example, are likely to result in slower economic growth³ and must be considered when evaluating timing and scalability of Next Economy solutions development.

Solutions as Economic Drivers

While it is clear that the historically fossil-fuel driven, inefficient and wasteful economy has spurred these risks, solutions-creators have been hard at work, too. Enterprises from all sectors and of all sizes have

begun creating opportunities to avoid the worst outcomes of these systemic risks.

These economic leaders recognize that it is both economically crucial and advantageous to address looming risks like climate change, resource scarcity and widening inequality. An economy built on this principle is one that will be truly “sustainable,” meaning it is able to develop and thrive indefinitely. Tackling these risks is necessary, because there are many environmental and social underpinnings required for successful operation of an economy, including: adequate resources (energy, food, fertile land, potable water); a stable climate; diverse ecosystem; and a relatively stable, cohesive, equitable society.

Companies that aim to uphold or enhance these essential underpinnings are finding opportunities to generate long-term revenue, thereby contributing to and profiting from economic growth. By creating innovative solutions to systemic risks, Next Economy companies drive the development of a genuinely sustainable economy. Conversely, companies that threaten to destabilize the climate, damage fundamental ecosystem services or foster a dramatically unequal society are undermining core components of a stable economy.

Economic drivers that can be used as tools to combat these systemic risks include:

- **Innovation**, particularly where addressing systemic risks in an economically efficient and competitive manner
- **Efficiency** — constant improvement in economic output per unit of input, be those inputs person-

¹ For those interested in reading more about systemic threats and their relationship to the economy, we recommend beginning with the World Economic Forum’s annual Global Risks Reports.

hours, natural resources or money — resulting in surplus wealth creation

Today, we perceive the primary centers of innovation and efficiency to be in renewable energies, artificial intelligence (AI), robotics, the Internet of Things (IoT), autonomous transportation, 3D printing, nanotechnology, biotechnology, materials science, energy storage and the applications they individually and synergistically enable.

*“These economic leaders recognize that it is both **economically crucial and advantageous** to address looming risks like climate change, resource scarcity and widening inequality.”*

Just as risks materialize across the economic spectrum, so do solutions. Renewables-powered, autonomous, electric vehicles provide a cheaper, cleaner, safer, more efficient alternative to fossil fuel-powered vehicles of the past.

For a deeper dive into risks and solutions, see Appendix beginning on page 17. While the list is non-exhaustive, it illustrates the pervasive nature of systemic risks, their economic impact at the sector level and corresponding solutions.

As an example of solution creation in action, global investment in renewable power capacity represented \$265.8 billion in 2015 - more than double the dollars allocated to new coal and gas generation. While the huge weight of existing conventional generation capacity meant that new, clean technologies only accounted for just over 10 percent of world electricity last year,⁴ the investment made in renewable energy dwarfed legacy energy investments.

A comprehensive list of advances in and increasing adoption of renewable energies is beyond the scope of this paper, but one can see new headlines touting almost-daily progress, such as “Solar power growth leaps by 50% worldwide [in 2016] thanks to US and China.”⁵

These are clear signals that solutions-creators, rather than risk-creators, are making economic headway.

Systemic Risks & Economic Solutions Snapshot:

WATER

RISKS

Increasing Global Demand, Water Stress

Fresh water demand is projected to increase by 55% globally between 2000 and 2050. At the same time, 3.9 billion people will be living in river basins under severe water stress.



Shifts in Water & Growing Cycles

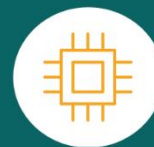
Increasing temperatures, variability of precipitation, & occurrence of severe weather patterns (e.g., drought, flooding) will strain water resources & agricultural output.

Water Pollution

As quality of surface water declines due to human impact, pollutants will cause increased eutrophication, biodiversity loss, and disease.



SOLUTIONS



Efficiency

Integration of IoT, monitoring, and measurement technologies across industries will maximize water's potential.



Infrastructure

Updated transportation and treatment infrastructure can improve sanitation, reduce pollution and leaks, and provide greater access to clean water.



Desalination

Renewables-powered desalination technology reduces water scarcity by increasing freshwater supply.



Vertical Farming

Vertical farming can use critical resources like water, land, and fertilizer more efficiently than conventional farming.

Sources:
"Principles on Water Governance," OECD, 2015.
"Climate Change and Agriculture in the United States: Effects and Adaptation," USDA, 2013.

Next Economy Portfolio Theory

Next Economics and Next Economy Portfolio Theory clearly align with smart investment management practices. An investment manager's decisions are based on what they consider "material" — what will have a considerable positive or negative impact on their portfolio. This means "materiality" is defined by the manager's assessment of forward-looking variables, like economic risks and opportunities. While these variables include risks like climate change, and rapidly evolving solutions like solar power, few managers adequately integrate these material factors into their portfolios.

Next Economy Portfolio Theory enables investors to tap into this proliferating, solutions-driven economy, while reducing portfolio risks created by the fossil-fuel driven economy of the past. Therefore, by applying Next Economy Portfolio Theory one is deploying capital to create a genuinely sustainable economy.

This requires us to step away from some of the traditional tenets of investment management — most notably the perceived requirement for portfolios to exhibit high correlation with a mean or traditional benchmark.

Why depart from the benchmark standard? Because most of the benchmarks that exist today are too focused on the economy of the past, rather than today's realities and the future economy unfolding before us. These conventional benchmarks are usually represented by an index that is itself riddled with systemic risks and often lack the same portfolio construction goals as the portfolio being compared to it.

7 Things to Know:

Next Economy Portfolio Theory

1. Evaluates best objective, scientific evidence about risks facing the economy & solutions to these risks
2. Updates MPT by including economic risks that were not contemplated in the 1950s
3. Applies forward-looking criteria to arrive at a list of companies & stocks
4. Invests in companies, not indexes, and doesn't attempt correlation with any benchmark; does not view correlation with the mean as "safe"
5. Free to capture opportunity sets across geographies, markets, industries
6. Style-box agnostic
7. Does not merely apply "green" to existing economic and investment theories — instead attempts to build model of Next Economy from the ground up, then construct portfolios to reflect that economy

Next Economy Analysis: Top-Down Search for Solutions Creators

Because Next Economy portfolios invest in innovative, forward-looking companies, they have a global, “go anywhere” mandate that seeks fast-growing, quality solutions, wherever they might exist. This provides Next Economy-oriented portfolios the freedom to capture opportunity sets across geographies, sectors, industries and market capitalizations.

The Next Economy stock selection process begins by evaluating and identifying the broadest threats and solutions via the Next Economics framework. Next Economy Portfolio Theory takes the next step by evaluating:

- 1) How solutions can be deployed in specific sectors & industries
- 2) Which solutions are most innovative & scalable
- 3) Which solutions-driven companies are leaders among their peers
- 4) What percent of each firm’s revenue is attributed to solutions

While Next Economics provides the foundation for evaluating risks and opportunities, the top-down process allows the investment manager to refine his or her opportunity set by evaluating which solutions can be most successfully deployed.

This resulting firms are Next Economy candidates, whose financial rigor is then evaluated by the second stage of the Next Economy Portfolio Theory process.

Fundamentals-Based Analysis: Bottom-Up Search for Leaders

Next Economy portfolios utilize fundamental valuation criteria in conjunction with absolute adherence to the top-down Next Economy framework to identify the best investment positions with minimized risk. Just as the Next Economics framework pairs its novel concept of risk and opportunity analysis with a traditional economic growth structure, Next Economy Portfolio Theory pairs its original risk/solution evaluation process with a variation of the tried-and-true Graham-Dodd valuation methodology. This is critical, because market-based solutions won’t be effective if they do not exhibit fundamentals worth investing in.

As such, Next Economy companies generally exhibit high-functioning business models, as demonstrated by:ⁱⁱ

- Diversified & predictable revenue streams
 - *Geography, industry & client*
 - *Intangible assets (IP, long-term contracts, etc.)*
 - *Market leadership*
- Visible path to growth
 - *Organic growth*
 - *Smart acquisitions*
- Consistent track record of delivering on earnings, margin, & dividend growth
- Strong & expanding cash flow
- Healthy balance sheet
 - *Cash on hand*
 - *Low debt relative to peers, or no debt*
 - *Access to low-cost growth capital, if applicable*
- Management team effectiveness (i.e., consistent track record of hitting business goals, such as product delivery dates and volumes)

ⁱⁱ Representative list only

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Finally, Next Economy portfolio constituents are ideally purchased at compelling relative valuations, exhibiting:

- Low price/book
- Low price/sales
- Low forward price/earnings
- Revenue & earnings growth that justify the above-listed multiples

The Result: Next Economy in Motion

The result of the stock selection process is a highly-vetted list of stocks that can indicate the trajectory and velocity of the Next Economy's progress. These are companies that recognize and respond to the growing set of risks by generating or enabling

creative solutions, while contributing to economic growth with proven business models.

Unlike traditional portfolio construction, Next Economy portfolios are allocated via risk-factor analysis rather than by sector categorizations, yet they nonetheless exhibit broad diversification across sectors, industries, geographies and market capitalizations, simply due to the opportunities available to invest in solutions to risks that exist throughout the global economy.

The number of Next Economy companies increases every year, a testament to the evolution of the Next Economy and the critical need for Next Economy Portfolio Theory in a highly dynamic landscape. This also provides increasing levels of portfolio diversification and expanding investment capacities.

*“Because Next Economy portfolios invest in innovative, forward-looking companies, they have a **global, ‘go anywhere’ mandate** that seeks fast-growing, quality solutions, wherever they might exist.”*

Systemic Risks & Economic Solutions Snapshot:

TRANSPORTATION

RISKS

Fossil Fuel Combustion

Transportation directly accounts for 27% of U.S. greenhouse gas emissions and 14% of global emissions – making it a major contributor to anthropogenic climate change.



Pollution

Transportation is a major emitter of damaging pollutants like particulate matter, nitrogen oxides, & volatile organic compounds which have been shown to harm respiratory, cardiovascular, and overall health.

Human Error

Nearly 1.3 million people die in road crashes each year globally, which adds up to a global annual cost of \$518 billion.



SOLUTIONS



EVs

Renewables-powered vehicles allow the transportation sector to sever itself from the internal combustion engine & fossil fuels.



Energy Storage

From personal storage options to grid-scale storage, advances in battery storage will enable clean transportation across the globe.



Driverless Technology

Safety improvements created by autonomous vehicles are projected to save thousands of lives and about \$10 billion per year.



Connectivity

Use of IoT to connect vehicles and infrastructure will make transportation faster, cheaper, safer, and cleaner.

Sources:
 "Sources of Greenhouse Gas Emissions," EPA, 2015.
 "Climate Change 2014 Synthesis Report," IPCC, 2014.
 "Annual Global Road Crash Statistics," ASIRT.
 "Driverless Cars are Coming," Brookings Institute, 2017.

What's Wrong with Modern Portfolio Theory?

Modern Portfolio Theory (MPT) is problematic in two critical, interconnected ways — in its definition of risk and its reliance on historical market data. Next Economy Portfolio Theory aims to resolve these misguided assumptions to provide investors a more accurate method for evaluating risk and investment opportunities, by integrating current and likely near-term future systemic risks and other forward-looking data. Before diving into Next Economy Portfolio Theory, we need to take a good look at MPT.

In application, MPT's risk analysis relies heavily on historical data, which is problematic when the economy is evolving to look so dramatically different from the past. MPT defines risk as any given stock or portfolio's standard deviation from its mean historical return or expected future return. The measurement of the mean, and consequently the risk of a given investment, is entirely based on prior price movement, not on forward-looking data. It completely ignores critical pieces of information, including: current company fundamentals and projections of how specific systemic risks are likely to impact the investment differently in the future than the past.

MPT's five statistical risk measures — alpha, beta, standard deviation, R-squared and Sharpe ratio — are based entirely on reading the historical relative price performance to determine riskiness.

The *reductio ad absurdum* of MPT is that an absolutely safe portfolio has zero variance from its assigned benchmark.

But variance from what? Almost always, this means a preference to correlate with destructive elements of

When “Modern” is Ancient

Traditional investing consists of evaluating stocks and hoping they conform to their past behavior. Modern Portfolio Theory was developed with no knowledge of the fact that 21st century's global economy would be riddled with systemic risks that undermine its continued prosperity. MPT defines risk as any given stock or portfolio's standard deviation from its average historical returns. This definition of risk, which relies solely on backward-looking data, is far too narrow to accommodate the realities of the present global economy. MPT fails to account for our most pressing economic risks, including climate change, resource scarcity and widening inequality. Next Economy Portfolio Theory eschew backward-focused mean variance analysis and instead focuses on the current and forward-looking risks and opportunities that are most material.

the legacy economy, because the index benchmarks used in such measurements are comprised of companies that grew our economy to what it is today, which are often the same companies enabling the systemic risks so pervasive in today's economy. Things like extractive mining, leaky fossil fuel pipelines and inefficient manufacturing. So far, investments in these indexes — and portfolios that correlate with them — hasn't meaningfully hurt

investors' performance, but that can't be expected to continue for long.

Although MPT-adherent managers have traditionally relied on backward-looking data, stock selection is a forward-looking endeavor. A portfolio is an illustration of the portfolio manager's vision of the future — what s/he believes has a chance of growth given their views of how the economy is likely to unfold. Portfolios should; therefore, be positioned to take advantage of growth drivers in response to rational, forward-looking inputs.

In Next Economy Portfolio Theory, no attempt is made to mimic traditional indexes, because they include inherently risky companies and most of them reflect the risky legacy economy.

Economies have always had both constraints and innovation, so why change investing analysis factors now? What's different?

The scale of constraints, for one, are now systemic — even existential. If left unaddressed, these risks threaten to compound and increase exponentially, threatening the global economy as well as its physical, ecological and social foundations.

The rapid acceleration in the pace of innovation is also a differentiating factor. The current pace of technological innovation, including those innovations with the potential to address systemic risks, was unimaginable when MPT was introduced. Backward-looking mean variance calculations do not assimilate realities like the Law of Accelerating Returns.⁶ If portfolio managers continue to assume that risk and opportunities for portfolio performance will maintain the same forms and pace, they will simultaneously expose themselves to more risk

posed by systemic threats, and capture less potential gains from accelerating innovation.

*“Strong investment in sustainable infrastructure — that’s the growth story of the future. This will set off innovation, discovery, much more creative ways of doing things. This is the story of growth, which is the only one available because **any attempt at high-carbon growth would self-destruct.**”*

-Nicholas Stern

This disconnect between MPT's definition of risk and the reality of swelling systemic risks is clear. In applying MPT's backward-looking stock selection strategy, managers have boxed themselves into two kinds of risk, one old and one new.

The old one is that most investable assets now chase the same relatively small group of index constituent stocks, creating a bubble. As Harry Markowitz, who introduced MPT in a 1952 essay, has more recently written, “the ability of diversification to reduce risk is surprisingly limited when returns are correlated.”⁷ With most portfolio managers today seeking high correlation with the same mean returns, risk is becoming more concentrated among popular benchmark-tracking portfolios, not less.

The other risk is that managers remain committed to MPT's diversification across industries that held sway when MPT was popularized. We now know that some of these industries are causing our largest risks. This

means that conventional investment theory fails to adequately map realities of the underlying economy, and thus fails to protect investors from risk.

If high-carbon growth in the global economy will inevitably cause that economy to self-destruct, then it is nonsensical to remain committed to high correlation to an index such as the S&P 500, with its dozens of fossil fuel constituents and the multiple other systemic risks embodied within that index.

The Next Economics framework clearly illuminates the major gaps in MPT's backward-looking evaluation of economic risks and opportunities. Next Economy Portfolio Theory responds to these deficiencies by combining

- 1) Next Economics' key risk and solution inputs, and
- 2) fundamentals-based securities analysis to build portfolios that reflect what the economy is.

Opportunity for ESG Managers to Have Greater Impact

Next Economy Portfolio Theory is not only a departure from Modern Portfolio Theory, but it also re-conceptualizes what it means to be a “socially and environmentally responsible” or “impact-oriented” portfolio. Rather than asking how sustainability can be molded to fit the current economy, it asks which companies are fundamentally driving progress toward a fully sustainable economy — preserving and creating wealth while doing so.

*“Achieving a **truly sustainable portfolio with strong long-term returns** must be more than simply screening an established index and adding a green wrapper.”*

While organizations like the UNEP and World Economic Forum are incorporating climate change and related risks into their models, many managers that market themselves as ESG, SRI or impact-oriented specialists fail to consider these material

inputs as they build portfolios. Instead, they remain tethered to the portfolio construction methodologies resulting in benchmark-hugging portfolios. The benchmarks they seek to mimic; however, represent the risk-pervasive legacy economy. This is a *major* discrepancy that can and must be addressed.

Traditional approaches to responsible investing typically fall into one of two buckets. Negative screening begins with a mainstream index benchmark and uses programmed filters (based on imperfect publicly available lists and historical statistics) to screen out objectionable companies. In the Best of Breed approach, shareholders remain invested in all sectors by investing in the stocks within each that are the least harmful or otherwise the least objectionable relative to their peer group.

These approaches to responsible investing, while noble in intention, are inadequate in determining the best investment opportunities. They also don't create a meaningful impact on the economy, because they fail to drive capital to an entire portfolio of companies creating meaningful change; therefore, they are not genuine “impact” vehicles.

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Neither approach considers the value available in the increasingly sustainable global economy. The most a screening approach can deliver is a somewhat greener or more socially-just version of an existing index. Achieving a truly sustainable portfolio with strong long-term returns must be more than screening an index and adding a green wrapper.

If practice emerges from theory, then an economic theory that envisions an indefinitely sustainable economy is absolutely necessary. From that body of theory, portfolio construction processes appropriate to facts known today can emerge.

Rather than starting with an index constituent list and screening it down to an ESG-oriented portfolio using imperfect publicly available lists, impact-oriented portfolio managers should look at each stock and evaluate whether the majority of a company's revenues contribute to systemic risk(s) or create solutions to systemic risk(s).

For example, if a car company has invested in electric vehicles, but the majority of their revenues are from combustion engine vehicles with a low mile-per-gallon average across their fleet, then that firm is primarily a *contributor* to systemic risk. These are the types of crucial analyses that drive economics, sustainability and investment management forward.

Overlaying criteria meant to address a social or environmental concern upon legacy economic growth and investment strategies only achieves a slightly greener version of the past, not an efficient, innovation-driven future economy.

In order to reflect this evolving economy, the global investing community must re-conceptualize systemic risks, opportunities and, as a result, their investment portfolios. It must be done in order for them to have material impact on behalf of clients.

Conclusion

A rapidly evolving economy requires an equally adaptive approach to investing — one that accounts for global economic risks likely to impact economic growth and investment performance going forward.

Next Economics offers a framework to evaluate this rapidly evolving risk and opportunity landscape. Next Economy Portfolio Theory allows managers to apply this knowledge to their portfolios, while avoiding outdated economic assumptions underlying MPT. Together, this framework and its practical application enable investors to invest in and profit from what the economy is *becoming*, rather than what it *was*.

*“The Next Economy framework and its practical application enable investors to **invest in and profit from** what the economy is becoming, rather than what it was.”*

Appendix: Systemic Risks & Solutions



RISKS

SOLUTIONS



Energy

- **Cumulative effect of high emissions** — legacy, inefficient energy systems are among the greatest threats to the long-term well-being of the global economy
 - *Increased global temperatures leading to*
 - Melting glaciers, snow cover & sea ice, resulting in sea level rise
 - Extreme weather events (e.g., heat waves, droughts, extreme rainfalls, flooding)
 - Initiation of warming feedback loops that result in irreversible warming (e.g., permafrost thaw resulting in major release of methane, a greenhouse gas that is 86 times more potent than CO2 in the short term,⁸ along with other GHGs which would likely result in a climatic & ecological “tipping point” — the switch from a relatively stable state to an unstoppable cycle)⁹
 - *Air pollution (smog, particulate matter, acid rain)*
 - Public health risk
 - Biodiversity loss risk
 - *Ocean acidification, resulting in ecosystem damage*
 - **Decreasing economic competitiveness relative to renewables**
 - **Oil & gas leaks & spills during extraction, transportation**
 - **Inefficiency risks** — only 14% of total generated energy potential becomes economically useful¹⁰
 - **Widening inequality** — stress to social stability
 - *Unequal establishment of pipelines, refineries, drilling operations & plants in marginalized communities*
 - *Disadvantaged communities & countries will bear disproportionate burden of climate change’s negative impacts*
- **Renewable energy**
 - *Far lower greenhouse gas emissions vs. fossil fuels, both direct & in terms of lifecycle¹¹*
 - *Lower risk of malfunction, contamination of environment than fossil fuels*
 - *Regenerative — does not require additional inputs (besides maintenance)*
 - *Cost-effective — investment in technology pays for itself over time, unlike commodities like oil & gas that increase in price as demand increases*
 - **Price stability** — long-term pricing contracts lower cost volatility for users
 - **Energy storage**
 - *Ensures availability during peak demand*
 - *Allows long-term price predictability¹²*
 - *Expands access, combatting energy inequality*
 - *Enables around-the-clock usage of renewables*
 - *Will allow renewables to fully scale*
 - **Measurement, monitoring of energy production & use** (see Internet of Things, page 19)



Appendix: Systemic Risks & Solutions



RISKS	SOLUTIONS
 Agriculture	
<ul style="list-style-type: none">• Heavy reliance on synthetic chemical fertilizers, herbicides & pesticides, leading to<ul style="list-style-type: none">○ <i>Public health risk (reduces labor force, productivity)</i>○ <i>Soil depletion (less consistent & fruitful harvests, followed by zero harvests)</i>○ <i>Contaminated groundwater (damages aquatic, riparian & terrestrial ecosystems; drinking water)</i>○ <i>Oceanic dead zones</i>○ <i>Deterioration of large fisheries</i>○ <i>Nitrous oxide (a powerful greenhouse gas) emission</i>• Dependence on fossil fuel energy• Excessive water use & waste• Depletion & degradation of arable land	<ul style="list-style-type: none">• Cultivating organic lands<ul style="list-style-type: none">○ <i>Avoids risks presented by chemical, synthetic contaminants</i>○ <i>Is higher in soil organic matter & nitrogen</i>○ <i>Requires lower energy inputs</i>○ <i>Can offer comparable yields to conventional systems</i>○ <i>Conserves soil moisture & water resources</i>○ <i>Sequesters more atmospheric carbon</i>• Organic, natural retail<ul style="list-style-type: none">○ <i>Expands access to healthier food (i.e., less processed, fewer to no chemicals)</i>• Indoor, vertical farming<ul style="list-style-type: none">○ <i>Does not use synthetic pesticides & herbicides</i>○ <i>Requires much less fresh water</i>○ <i>Reduces impact on soil & oceans</i>○ <i>Decreases distance required for transportation</i>
 Water	
<ul style="list-style-type: none">• Geometrically increasing demand due to increasing populations & resulting demand by industry• Changes to water & growing cycles as a result of climate change, resulting in more frequent droughts, floods, etc.• Contamination of water due to pollution	<ul style="list-style-type: none">• Improving efficiency of use via monitoring & measurement• Increasing supply of freshwater via desalination• Improvement in transportation & treatment infrastructure• “Smart” agriculture (integration of IoT)• Indoor & vertical farming• Indoor & outdoor raising of halophytes (saltwater-tolerant plants)

Appendix: Systemic Risks & Solutions

RISKS	SOLUTIONS
 Transportation	
<ul style="list-style-type: none"> • Reliance on fossil fuel combustion • Pollution <ul style="list-style-type: none"> ○ <i>Public health risk (reduces labor force, productivity)</i> ○ <i>Ecosystem damage</i> • Human error — nearly 1.3 million people die in road crashes each year globally¹³ • Inefficient transportation, infrastructure systems exacerbates existing issues 	<ul style="list-style-type: none"> • Electric-powered vehicles (i.e., renewables-powered) • Driverless technology • Safety improvements are projected to save thousands of lives & ~\$10 million per year • Connected vehicles • Connected infrastructure, transportation systems • Effective, efficient, practical, zero-emissions public transportation
 Internet of Things (IoT)	
<ul style="list-style-type: none"> • The more connected the economy, the more it can address legacy-, system-wide risks stemming from <ul style="list-style-type: none"> ○ <i>Legacy energy dependence</i> ○ <i>Legacy agricultural practices</i> ○ <i>Fresh water contamination & use</i> ○ <i>Fossil fuel-based transportation & infrastructure systems</i> ○ <i>Excessive creation of waste materials & contaminants</i> ○ <i>Health risks of legacy business practices</i> ○ <i>Systemic risks from financial services</i> ○ <i>Inequality of access to information & education</i> • Specific risks to increased connectivity <ul style="list-style-type: none"> ○ <i>Cybersecurity risks</i> ○ <i>Network stability & vulnerability risks</i> 	<ul style="list-style-type: none"> • Smart sensors & meters <ul style="list-style-type: none"> ○ <i>Collects & channels data for commercial & individual monitoring, troubleshooting</i> ○ <i>Faster transmission of resource consumption data to utility/smart grid</i> ○ <i>Remote management of energy usage</i> ○ <i>Reduced energy use</i> ○ <i>Enables analysis at “big data” scale, empowering further advances¹⁴</i> • Smart grids (detects & reacts to changes in energy usage) <ul style="list-style-type: none"> ○ <i>Enables system-wide use of smart meters, appliances</i> ○ <i>Reduced energy use</i> • Interconnected infrastructure & devices (e.g., buildings, roads, cars, phones, sanitation systems, etc.)¹⁵ • Cybersecurity enhancement <ul style="list-style-type: none"> ○ <i>Greater safety & privacy in increasingly connected economy, society</i>

Appendix: Systemic Risks & Solutions

RISKS	SOLUTIONS
 Waste-to-Value	
<ul style="list-style-type: none"> • High extraction & input of raw, over-exploited natural resources that are necessary for climate & ecosystem services (e.g., trees act as oxygen producers, carbon sinks, soil stabilizers, wildlife & habitat support, etc.) • High output of emissions & waste • Higher resource prices as a result of resource scarcity (increasing demand, decreasing supply) • High cost of end-of-product-life disposal 	<ul style="list-style-type: none"> • Replacing raw, extracted resources with recycled materials (e.g., wood, steel, wastewater, lithium, animal byproducts, etc.) <ul style="list-style-type: none"> ○ <i>Decreases cost in many cases</i> ○ <i>Reduces need for extraction & impact on source</i> ○ <i>Lessens GHG footprint</i> ○ <i>Decreases need for waste disposal</i> ○ <i>Creates new value in economic systems by changing a cost center to a profit center</i>
 Biotech & Medicine	
<ul style="list-style-type: none"> • Heightening risk of epidemics & pandemics due to habitat encroachment & expanding/changing plant, animal & microbe territorial ranges • Unequal access to quality diagnoses, & treatments, including pharmaceuticals • Women’s health risks • Cancer risks • Infectious disease <ul style="list-style-type: none"> ○ <i>Vector habitat expansion</i> ○ <i>Encroachment on previously undisturbed habitats</i> 	<ul style="list-style-type: none"> • Hyper-efficient care models (integration of IoT to streamline patient care process) • Cleaner, safer, less invasive care (e.g., blood tests for cancer, liquid biopsies vs. tissue biopsies, minimally invasive surgeries, customized cancer vaccines & antigens) • AI/algorithm-driven disease modeling & prevention • Female-specific health services • Cost-effective healthcare

RISKS	SOLUTIONS
 Financial Services & Real Estate	
<ul style="list-style-type: none"> • Financial exposure & contribution to systemic risks (climate, resources, inequality) <ul style="list-style-type: none"> ○ <i>Financing for systemic-risk-exacerbating projects</i> ○ <i>Insuring near-sea-level communities</i> ○ <i>Urban & agricultural land price declines associated with droughts or other large-scale changes to original climate¹⁶</i> ○ <i>Consequences of exploitative business practices¹⁷</i> 	<ul style="list-style-type: none"> • Financers of risk-mitigating projects (renewables infrastructure, energy storage, water supply & infrastructure, efficiency projects) • Insurance for climate risks • Basic banking & financial literacy for underserved communities • LEED & higher certified building development • Water recapture infrastructure development
 Education	
<ul style="list-style-type: none"> • Unequal access to education, perpetuating widening inequality • Skewed perceptions of environmental, social phenomena, resulting in resistance to action in response to systemic risks¹⁸ • Low critical evaluation skills & basic scientific literacy • Economic growth is hampered by uneducated, non-competitive workforces 	<ul style="list-style-type: none"> • Providers of broadly available formal education <ul style="list-style-type: none"> ○ <i>E-Learning</i> <ul style="list-style-type: none"> – Fulfills present need for workers to be continually learning & reinventing their careers – Rising industry figures show the importance, with E-Learning representing a \$165 billion industry in 2017, from near zero in 2005¹⁹ – Major cost benefits for universities & students – Learn-anywhere model enable greater access to valuable programs²⁰ • Providers of verifiable informational content for informal learning • Access to the world's knowledge • Technologies & platforms to enable access to learning, data & general information

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