Redefining Sustainable and Responsible Investing

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Redefining Sustainable and Responsible Investing

The next global economy is emerging in a new world full of unprecedented innovation, technologies, new ideas about resources and capital, and new approaches to business. It is also being confronted with environmental and economic challenges never before imagined. The 'next economy' model approach to investment management asserts that the basics of the global economy are evolving in tandem with these changes and that methods of investment management must evolve with them or risk irrelevance. Green Alpha Advisors contemplates a future economy in which the global economy can thrive indefinitely without succumbing to the looming systemic risks presented by climate change and resource scarcity, so we conclude that the next generation of asset management must be integral to and reflective of that next economy which both functions to support the integrity of Earth's systems and also can function within Earth's tolerances and finite resource base.

To appropriately invest in this fast-growing, next, efficient economy, one must appreciate that the next economy is by definition not the legacy economy of previous generations, and that it therefore requires a new understanding, new definitions and a new set of rules. To some degree, this requires redefining the parameters of modern portfolio theory to reflect this new world with its technologies and challenges. Specifically, we contemplate a reengineering of how we think about risk-adjusted returns. Measures of returns are today thought of as relative to an established benchmark, yet the established benchmarks all reflect the incumbent and legacy economies that are replete with causes of systemic risks such as fossil fuels. Meaning that today, the world defines a low-risk portfolio as one that has high correlation with one of the high-systemic risk traditional benchmarks. But what if we modeled a low-risk economy and began building portfolios to reflect that world? They would probably not correlate well to today's common benchmarks, but, long-term, they may be lower risk.

Model of Next Economy Identification and Transition

In simplest terms, the next economy approach involves modeling what a near-future, growing, sustainable economy that can maintain high levels of capacity utilization (including employment) might look like, and then seeks to build portfolios of companies that are already operating in a fashion consistent with that model. Avoiding three degrees Celsius net average warming (keeping in mind that warming of four degrees Celsius has been called "incompatible with an organized global community"[1]), improving public health, minimizing future extreme weather events, achieving greater use of our national and global production capacities (and their resources), expanding economies, and shrinking deficits are all possible by focusing capital, time, energy and deliberate thought on the solutions to the world's key climatic-macroeconomic issues.

These solutions, fortunately, largely exist (and are being profitably deployed) today and others will continue to emerge as applied science advances. But even with recent growth in popular and practitioner awareness of these technologies and techniques, we can't help but observe that the dangers of our enviro-economic situation remain underestimated overall, as evidenced by

[1] http://grist.org/climate-change/2011-12-05-the-brutal-logic-of-climate-change/

continuing denial of climate change in some influential quarters and the enthusiastic support at the highest business and political levels of massive new development of fossil fuel resources (such as widespread natural gas hydrofracturing and development of Canadian tar sands for oil). In assessing the risks, we share the view of Christine Lagarde, Managing Director of the International Monetary Fund and former finance minister in the conservative French administration of Nicolas Sarkozy: "[i]ncreasing vulnerability from resource scarcity and climate change, with the potential for major social and economic disruption: This is the real wild card in the pack...the greatest economic challenge of the 21st century." (In prepared remarks at the World Economic Forum at Davos, 2013[2].) Challenge of course presents opportunity.

Our belief in economic opportunities within the next economy rests on a simple premise: as popular awareness of the magnitude of global economic and climate risks advances, the technologies and means of doing business represented by firms in our next economy portfolios will become the objects of ever increasing investment, for the simple reason that these companies will be growing rapidly in proportion to real and perceived need for their methods, products and services. Society's collective desires to mitigate and adapt to climate change, severe weather, resource scarcity and population growth, among other things, will cause both investment capital and client patronage to accrue rapidly to these companies.

The next economy approach to investment management is fundamentally simple: Don't invest in the causes of our primary systemic risks, notably fossil fuels, and do invest in the solutions to those risks. For every function provided by the legacy economy, we believe there already is or soon will be a sustainable, next economy equivalent, that is often far better than its legacy economy predecessor. So we strive to build a portfolio of next economy analogs for legacy economy functions. In addition to hopefully serving and advancing the cause of sustainability, we believe this to be an effective equity growth strategy because it means investing in disruptive innovation and also in rapidly advancing economic efficiencies, meaning getting more and more dollars out of less and less economic inputs. This in turn allows us to have less and less impact on our underlying ecosystems. Thus our approach to economics and investing can become a sustainable, virtuous cycle. We believe we live in a time of nonlinear, even geometrically rapid change, and the innovations emerging now will allow us to have great standards of living, while also giving our underlying ecosystems a chance to begin recovering.

How then does a transition from the legacy economy to the next economy occur? Begin with a high-level definition of a next economy firm: next economy companies are market leaders both in adding economic efficiencies and responding to the challenges presented by a warming, increasingly populous, resource-constrained world. Through technology and innovation, these companies have potential to deliver strategic growth via opportunities most crucially in but not limited to transportation, communications, commerce, infrastructure, materials, energy, agriculture and water.

[2] http://www.theglobeandmail.com/commentary/roasted-toasted-fried-and-grilled-climate-change-talk-from-an-unlikely-source/article8077946/

That definition in hand, one may further define the next economy in aggregate as comprised of enterprises that:

1. are powered by energies and use material inputs that have not had demonstrable deleterious impacts on global economic underpinnings (be these macroeconomic or basic environmental); and
2. present better-than-legacy economy opportunities to keep national and international production functions running closer to their capacities than has recently been the case, or than is likely to be the case under legacy fossil fuels economies. In other words, companies that increase the globe's economic efficiency in that they are deriving more outputs from ever fewer inputs.

Both of these conditions are crucial; the first helps secure the basic environment necessary to have an economy: adequate resources, reasonably mitigated climate change, potable water, sufficient agricultural output, etc. The second drives continued economic growth and therefore may not only provide a basis for society to continue with minimal political and environmental disruption, but also to thrive, for greater numbers of individuals, and at an increasing standard of living, potentially indefinitely.

Necessarily, though, these conditions and their formational goals require us to recognize and enable the methods, technologies and material inputs that can enable us to advance. Recognition of these must be, and increasingly is, from all engaged quarters: financial institutions, central banks, policy makers and regulators, the financial and popular media, and companies themselves. In addition, financial markets, hopefully encouraged by firms such as Green Alpha, must enable these companies to flourish, completely aside from political headwinds, debates over global warming, and other noise which distracts from the requirements for a thriving economy on a balanced planet. We believe this transition is inevitable over the long run, whether aided by forward looking professionals, policy makers and academics actualizing it in the near future, or whether forced upon us by dramatic climate and scarcity-related events in the medium-term future (and to some degree already upon us).

Leaving climate momentarily aside and addressing the second condition necessary for next economy transition, we assert that next economy economics, properly applied, can also counteract underused economic capacity, thus spurring both demand and growth. Underused capacity of course results partly from inadequate demand, from which the global economy is currently suffering: growth is sluggish in the Euro zone, China's growth is slowing, Japan is stagnant, the U.S. is experiencing growth, but thus far it is paltry. Austerity crushed demand globally and so production and so jobs and so, circularly, both production and demand. Next economy economics addresses these limitations on several fronts. First, with truly renewable energies.

If energy, as it now has the potential to do, becomes in practical terms limitless and far less costly, economies will have been unburdened of their single largest drag, and trillions of dollars will be liberated over time. We now know without question that solar and wind at scale can generate all the energy civilization will ever require, and, once entrenched, will do so at nominal

continuing fixed costs as there will no longer be a need to identify, locate, mine, process or transport fuel. This previously unimaginable scenario is within our technological grasp to make real: zero cost of fuel for all the energy we will ever need. We hold the economic truth of the emancipating nature of this transition as obvious. But renewable energy is far from the only next economy accelerator of economic production and means of capital conservation.

Waste-to-value economics also will unlock enormous quantities of capital that presently are sequestered everywhere from landfills to oceans, in expensive mining operations and generally in procuring far more expensive materials from primary sources than can often be the case from secondary, circular-economy sources. To provide just one "waste to value" example, Trex Company, Inc. (TREX) is the world's largest manufacturer of high performance wood-alternative decking. We consider Trex a prime example of waste-to-value economics that not only keeps huge quantities of waste out of landfills and oceans (1.5 billion recycled grocery bags are used to manufacture Trex products every year, 70% of all plastic bags recycled in the U.S. are part of an in-store collection program used by Trex, and Trex has never harvested a single tree to make its product[3]), but also delivers a superior product with better long term value. In a world of constrained resources, making great stuff from leftovers is the best of all worlds, increasing production without using additional primary resources and increasing demand by keeping people thus employed.

Next, mitigation, via far more efficient irrigation, water management, farming and soil conservation technology and methods, of key resource scarcities in water and food has two material economic benefits. The first is simply that avoiding scarcity situations means prices are stabilized and resulting economic drags and disruptions are thus avoided. Second, minimizing scarcity in basic needs heads off social and political strife which otherwise would severely depress production and demand in affected areas. Consider places where food and water scarcity are already critical. In Somalia, there is little to no production capacity left. Demand, such as it is, is increasingly being met by non-production enterprises such as piracy. In aggregate, the world is now in food supply terms living year to year [4](Lester Brown, Earth Policy Institute, 2013); Far better resource management is required to prevent more and more nations from following Somalia's devastating course.

Separately but concurrently, we believe that the impact of information, communications, M2M, cognitive computing and automation technology should in the end be measured primarily by two things 1. How much does it propel economic efficiency and 2. How many people benefit from that. Fortunately, these two goals are complimentary and provide many and various opportunities for investment. Connectivity and the Internet of Things (IoT) do greatly improve economic efficiencies but also represent needed solutions in enabling less energy and resource use. This is at the heart of how we think about next economics, because getting more from less is the only way to reduce our extractive and destructive economic activities to the point where our underlying ecosystems can begin to recover, and in turn reduce some of the now most visible risks to the global economy. We see the IoT as a key part of our overall solutions set.

[4] http://www.earth-policy.org/book_bytes/2013/fpepch1

Summarizing, we believe the four next economy drivers of growing future economies under new world conditions are limitless clean energy, waste-to-value economics, constantly improving resource management, particularly in water and agriculture, and the general yet massive efficiencies to be gained by the complex of connectivity, machine learning, the Internet of Things and application of algorithms to innumerable economic functions

When considering the next economy, it is important to keep in mind that all types of business activity are required in the next economy, it is by no means limited the four drivers already discussed (clean energy, waste-to-value, agriculture, IoT). The following image shows how universal next economy investing truly is.

To return to the first condition necessary to construct a next economy (de-risking the global economy from the most serious threats posed by systemic causes around climate and resources), it's now clear that the reality of global warming fundamentally touches all factor areas so far discussed. Increasingly severe weather shuts down local economies for varying periods of time, destroys value in real property, and puts large strains on vulnerable populations and industries. "Disasters with a price tag exceeding $1 billion, previously limited to one or two per year, now occur at least five to 10 times per year. Recent payouts for events like Superstorm Sandy have shattered previous records, taking a toll both on the federal budget and on the National Flood

Insurance Program, which is now more than $23 billion in debt." (Bracing for the Storm, SmarterSafer, April 2015[5]). This is bad enough, but an increasingly severe climate (as opposed to weather) has the capacity to depress very large regions for far greater periods of time. Here, consider the recent histories of agriculture in the U.S. Midwest and, half a world away, in Australia. NASA has recently concluded that the current drought in the Eastern Mediterranean is the worst in 900 years. Surely, scarcity of a fundamental water resource is one driver of conflict.[6] In these places, and in many others worldwide, extreme heat and drought have crushed agricultural production, placing strains on local populations, on food supplies and on governments. These are observed effects of our disrupted climate that are occurring here, already, at the very beginning of the climate change era. For a more complete review than the scope of this paper allows, see Coral Davenport's compilation of what we now know about the economic effects of climate change in a piece for the National Journal (February 8th 2013[7]).

Finally, relating to both required next economy conditions and from a pure valuation point of view, investing in fossil fuels presents a particularly devious feedback loop in that we cannot burn all listed owned assets in that class (abundance and scarcity arguments aside) without significantly reducing value in virtually all other asset classes. In other words, "the benefits to the [fossil fuels derived] energy supply deteriorate at the same time as the collateral damage to climate (in the form of increased carbon dioxide emissions per barrel of oil produced) goes up." (Pierrehumbert, Slate, February 6th, 2013[8].) This can be viewed as fundamental to the case that transition to a global next economy footing is ultimately not optional, and is discussed in detail by the International Energy Agency in their World Energy Outlook 2015 – Special Report on Energy and Climate Change[9]. A truly sustainable next economy portfolio therefore must eschew fossil fuels altogether.

Fossil fuels, with their high energy density and historical abundance, have in large part brought us to the technologically advanced global economy we live in today. This is not, and cannot be in dispute. And yet, now, the portfolio risks of holding fossil fuels securities over the medium and (especially) long term are increasingly apparent. The primary driver of these risks is that while the costs of fossil fuels are notoriously volatile and tend to trend upwards over time, costs for renewable energies, particularly solar, behave like electronics and other semiconductor-based technologies, and have been trending sharply downwards for decades. Broadly speaking, the intersection of costs between fossil fuels and renewable energies occurred in 2012 or 2013, and from that moment forward, fossil fuels have, and will continue to become, less and less competitive over time. Consider the analysis of industry expert Tony Seba: "Should solar continue on its exponential trajectory, the energy infrastructure will be 100-percent solar by 2030...the only reason for this not to happen is that governments will protect or subsidize conventional coal, nuclear, oil, gas generating stations—even when this means higher prices for consumers."

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[5] www.smartersafer.org/wp-content/uploads/Bracing-for-the-Storm.pdf
[6] http://phys.org/news/2016-03-nasa-drought-eastern-mediterranean-worst.html
[7] http://www.nationaljournal.com/magazine/the-scary-truth-about-how-much-climate-change-is-costing-you-20130207
[8] http://www.slate.com/articles/health_and_science/science/2013/02/u_s_shale_oil_are_we_headed_to_a_new_era_of_oil_abundance.single.html
[9] http://www.worldenergyoutlook.org/energyclimate/

Solar PV is a technology, and its past and future cost dynamics will behave like those of a technology -- becoming ever cheaper. Oil is a finite commodity that is expensive to locate, extract, refine, and ship; it and other fossil fuels have had and will continue to have cost dynamics to match: economically volatile and forever affected by the cost of extraction. The economic fundamentals of solar and fossil fuels derived energies are so different, we have suggested that tech and commodities be classified as different, unique investment sectors altogether.[11]

As a result, many top analysts are predicting the rapid decline of fossil fuels as a portion of the global economy's total energy mix. Deutsche Bank recently published a comprehensive report[12] projecting that solar energy will be the dominant source of energy worldwide by 2030, within just 15 years. Not only that, but Deutsche Bank says the solar industry will generate $5 trillion in revenue in that time, *while displacing fossil fuels* (italics added). Meaning, fossil fuels will be losing market share to renewables from today on. In the same report, Deutsche Bank estimates that the cost of solar panels will continue to fall by as much as 40 percent over the next four to five years. The more solar panels that are installed, the more prices drop; the more costs drop, the more economically competitive solar becomes.

The International Energy Agency (IEA), which has consistently missed their renewable energy projections to the low side, is only slightly more conservative then Deutsche Bank, and has recently written[13] that "The sun could be the world's largest source of electricity by 2050." Mostly, it says, because of declining costs, and not so much because it can help battle climate change.

In an article titled, "Fossil Fuels Just Lost the Race Against Renewables. This is the beginning of the end,"[14] published this week, Bloomberg Business reported that "the race for renewable energy has passed a turning point. The world is now adding more capacity for renewable power each year than coal, natural gas, and oil combined. And there's no going back... Despite the change in oil and gas prices there is going to be a substantial build out of renewable energy that is likely to be an order of magnitude larger than the build out of coal and gas." In a separate comment[15], Michael Liebreich, chairman of the advisory board at Bloomberg New Energy Finance, said: "The story should not be how falling oil prices will impact the shift to clean energy, it should be how the shift to clean energy is impacting the oil price."

Indeed. The National Bank of Abu Dhabi recently reported that "Dubai set a new world benchmark for utility scale solar PV costs, showing that photovoltaic technologies are

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[11] Jabusch, Garvin, "Tech Energy and Commodity Energy: Different Worlds," Green Alpha's Next Economy, February 4, 2015.http://blogs.sierraclub.org/gaa/2015/02/tech-energy-and-commodity-energy-different-worlds.html

[12] Deutsche Bank, *Deutsche Bank's 2015 solar outlook: accelerating investment and cost competitiveness*, January 13, 2015.https://www.db.com/cr/en/concrete-deutsche-banks-2015-solar-outlook.htm

[13] International Energy Agency, *How solar energy could be the largest source of electricity by mid-century*, September 29, 2014.http://www.iea.org/newsroomandevents/pressreleases/2014/september/name-125873-en.html

[14] Randall, Tom, "Fossil Fuels Just Lost the Race Against Renewables. This is the beginning of the end." *Bloomberg Business*, April 14, 2015.http://www.bloomberg.com/news/articles/2015-04-14/fossil-fuels-just-lost-the-race-against-renewables

[15] Bloomberg New Energy Finance, "OIL PRICE PLUNGE AND CLEAN ENERGY – THE REAL IMPACT," December 22, 2014. http://about.bnef.com/press-releases/oil-price-plunge-clean-energy-real-impact/

competitive today with oil at US$10/ barrel and gas at US$5/MMBtu."[16] At the risk of being repetitive, solar is now competitive with a US $10 barrel of oil in at least one place, and solar is projected to be 40 percent cheaper still in four or five years.

On this point, investor Jeremy Grantham has written, "The economic establishment is letting us down again. Fossil fuels once brought prosperity - then they brought global warming."[17] And, separately, he has noted, "The real oil problem is its cost -– that it costs $75 to $85 a barrel from search to delivery to find a decent amount of traditional oil when as recently as 15 years ago it cost $25. And fracking is not cheap. The fact that increased fracking has been great for creating new jobs should give you some idea: it is both labor- and capital-intensive compared to traditional oil...the potential for alternative energy sources, mainly solar and wind power, to completely replace coal and gas for utility generation globally is, I think, certain."[18]

Small wonder then that economists at Bloomberg New Energy Finance are predicting that "By 2030, the growth in fossil fuel use will almost have stopped," and subsequently that, "energy growth will continue, just not fossil fuels' contribution. Investment in new energy capacity will double by 2030. About 73 percent of that investment, or $630 billion annually, will be devoted to renewable energy".[19] We can't help but notice that this will not leave much capital capacity to support the share prices of either fossil fuel or nuclear power firms.

Meanwhile, on the regulatory side, the risks of remaining invested in fossil fuels are no longer going unnoticed. As former SEC Commissioner Bevis Longstreth has written: "...fiduciaries have a compelling reason on financial grounds alone to divest these holdings before the inevitable correction occurs. I'm certain any reputable investment manager, if directed by an endowment to accept that assumption, would agree with this conclusion... Anticipatory divestment in recognition that at some unknown and unknowable point down the road, markets will suddenly adjust the equity price of fossil fuel company shares downward to reflect the swiftly changing future prospects of those companies, however wise today, is probably not yet compelled in the exercise of prudence. At some point down the road towards the red light of 2 Degrees Centigrade, however, it is entirely plausible, even predictable, that continuing to hold equities in fossil fuel companies will be ruled negligence."[20]

To be clear, all discussed economic impacts are here now, and they're going to get worse, incrementally (and not so incrementally) destroying value year by year until we achieve a fundamental transition to a global macro production function that rests both on sustainable energy and sustainable, more circular material and capital inputs (both conditions 1 and 2). In

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[16] University of Cambridge and PwC, *Financing the Future of Energy*, *The opportunity for the Gulf's financial services sector*, March 2015.http://www.nbad.com/content/dam/NBAD/documents/Business/FOE_Full_Report

[17] Grantham, Jeremy, "The Beginning of the End of the Fossil Fuel Revolution (From Golden Goose to Cooked Goose)," *GMO Quarterly Letter, Third Quarter, 2014.* https://www.gmo.com/websitecontent/GMO_QtlyLetter_3Q14_full.pdf

[18] Wile, Rob, "GRANTHAM: The Great American Shale Boom Is A Dangerous Waste Of Time And Money," *Business Insider*, February 6, 2014. http://www.businessinsider.com/grantham-against-shale-2014-2#ixzz3XQTmwjbK

[19] Randall, Tom, "'Peak Fossil Fuels' Is Closer Than You Think: BNEF."*Bloomberg Business*, April 24, 2015.http://www.bloomberg.com/news/articles/2013-04-24/-peak-fossil-fuels-is-closer-than-you-think

[20] Longstreth, Bevis, "The Financial Case for Divestment of Fossil Fuel Companies by Endowment Fiduciaries," *Huffington Post Politics*, November 2, 2013. http://www.huffingtonpost.com/bevis-longstreth/the-financial-case-for-di_b_4203910.html

their Politico essay “Climate Change is a Force Multiplier[21]” (February 7th, 2013), Goodman and Sullivan note that the intelligence and military communities now take as given that the legacy economy and climate change are already disrupting global economic stability and have the potential to do far worse, lest we rein them in. It’s not a coincidence the U.S. military is among the institutions deploying the most renewable energy in America (Pike Research, Renewable Energy for Military Applications[22], 2012).

Next Economy Portfolio Construction Model

Having perceived the need for transition to the next economy, one must develop methodologies to practically apply these observations in meaningful ways. To accomplish that, we begin by discussing portfolio management as generally practiced today. Traditional portfolio management practices – largely developed and made canon in the 1930s and ‘40s and still in mainstream practice today under the general term ‘modern portfolio theory’ (MPT) – were made for and unavoidably reflect a world where fossil fuels were the only imaginable primary power source, where there were fewer material resource constraints, a far lower global population, where the word ‘scarcity’ did not apply to the natural world, and no one had heard of climate change or global warming.

Over the last couple decades, though, attempts to work within the traditional paradigm to make portfolios more environmentally and/or socially progressive have emerged. These may be broadly categorized into two methodologies, ‘negative screening’ and ‘best of breed.’ But each of these approaches has its own limitations that make each in its way inadequate to the task of next economy portfolio construction.

“Best of breed” (also known as “Best in Class”) methods, which seek to identify and hold the “best” (meaning most green, most socially responsible, etc.) examples of companies from each sector (including oil and other deleterious industries) will prove insufficiently robust in addressing climate change and resource scarcity. This is because even the best companies from a given industry or ‘breed’ are hardly beneficial where that industry is creating negative environmental-economic conditions.

Both screening and best-of-breed methodologies are in reality attempts to juxtapose MPT and modern ESG concerns, and as a result most currently commercially available portfolios contain elements of both. One does not have to look far to find mutual funds and separate accounts that market themselves as "sustainable" or “ESG” or even "green" that, due to desires to adhere to MPT and therefore to hold all economic sectors, contain holdings such as Chevron (CVX; oil and gas), MDU Resources (MDU; natural gas and fracking), W&T Offshore (WTI; deepwater offshore oil exploration and natural gas), Denbury Resources (DNR; Gulf Coast oil and gas development) and many more across many industries.

Enough with the 'all of the above' and ‘best of breed’ rhetoric. We are required by reality to massively reduce use of fossil fuels wherever there are practicable alternatives. Renewables plus

[21] http://www.politico.com/story/2013/02/climate-change-is-threat-multiplier-87338.html?hp=l8
[22] http://www.pikeresearch.com/research/renewable-energy-for-military-applications

natural gas plus oil plus coal does not equal 'all' when the consequences of thus powering economies are economic destruction. Modern capitalism is faced with a decision between destroying the biosphere and other global economic underpinnings and evolving its rules, and thus far it's not clear which ideology will prevail. Species level wisdom (crowdsourced or general average of opinion) will ultimately lead us to getting whatever, on mean, we decide and deserve. We know now that humans by dint of our genetic attributes possess almost endless plasticity and resourcefulness, so the macroeconomics of solutions via mitigation and adaptation seem like a high probability function factor for long term competitive returns derived from companies delivering next economy solutions. The alternative, equally deterministic, is that the human brain and organism is fundamentally wired in a way that will always seek to maximize immediate term benefits in a way not compatible with existing indefinitely in a finite world. If that turns out to be the case, it will have mattered little what we invest in now. But to paraphrase FDR, one may not face in both directions at once. To invest for the future as though we could is paradoxical and will not result in a healthy future economy or, long term competitive returns.

All the traditional equity market indexes were built by, of, and for the old business-as-usual economy. Index rules of economic sector allocation demand ownership of all areas of the economy that were important when these indexes were devised in the middle part of the last century, before anyone had heard of climate change, could imagine resource scarcity on a global scale, or could fathom 7.3 billion people and a mass extinction event (the sixth great extinction)[23] likely to rival the largest in prehistory. There are massive economic risks now that simply did not exist when our stock market indexes and the body of theory that supports them, Modern Portfolio Theory, were devised.

Modern Portfolio Theory has another big limitation: It requires measuring risk by analysis of past performance. It asks, of any stock portfolio, "what would the return for that have been over the last 10 or 20 years, and at what level of risk?" Here again, this seems eminently reasonable, but it has the negative result of making the economic causes of our most threatening risks appear to be wise investments. Today, though, our primary risks are so obvious, and human innovation is advancing solutions so rapidly, that there's no economic outcome 10 or 20 years hence that looks anything like the last 10 or 20 years. Where legacy economy stocks have traded historically is irrelevant now. Causes of economic and environmental risks, like fossil fuels, are not the safe source of risk-adjusted returns that they used to be. The world has changed, and following Bogle's advice to invest in a broad market index fund[24] doesn't give you much access to this new world of profitable innovation and investing opportunity, but it does keep you invested in the causes of our problems.

Like it or not, we've ushered in a new era. It's the Anthropocene now, yet we're still largely investing with old Holocene methods.

It's time for a new investing philosophy, one that reflects what we have learned at last about how to sustainably inhabit the earth. So, what updates could portfolio construction theory employ? If we believe we can arrive at an indefinitely sustainable and even thriving economy, here are some ideas:

[23] http://news.nationalgeographic.com/2015/06/150623-sixth-extinction-kolbert-animals-conservation-science-world/
[24] http://www.businessinsider.com/investing-in-low-cost-index-funds-2015-7

1. No more blind use of traditional sector allocations. Even some green, SRI, and ESG funds use the old allocations schemes, and then try to screen out some of the objectionable companies. This won't work. Instead, we must allocate portfolio investments by evaluating forward-looking risk. It's time we created portfolios from the bottom up, intentionally, by selecting the economic areas to invest in via risk-factor allocation, rather than traditional sector allocation methods. That is, we must stop investing in causes of systemic risks, wherever they may exist, and start investing in the most economically exciting, innovative solutions to those risks, economy-wide. Continuing to invest in all sectors of the economy regardless of the risks that a given sector has to our future viability has no place in today's investing world.

2. Stop evaluating risk using backward-looking models. In order to create portfolios that accurately factor in today's and tomorrow's risk continuums, investors need to change their paradigm and begin using forward-looking economic modeling. Innovation is far more rapid now than at any time in all human history, and we can finally now bring to investing a vision of where the economy is going, and where it should go, in both economic and sustainability terms. Modern Portfolio Theory's rearview mirror approach to risk evaluation can actually be said to violate the causality principle in physics, in that it expects past outcomes to emerge from present events. They won't.

3. We must each be aware that the rules, habits, and institutions of the past do not have to bind the future, and indeed they must not. We must be aware of as much as we can, studying science and basic principles, and working hard to suggest new, better ways forward.

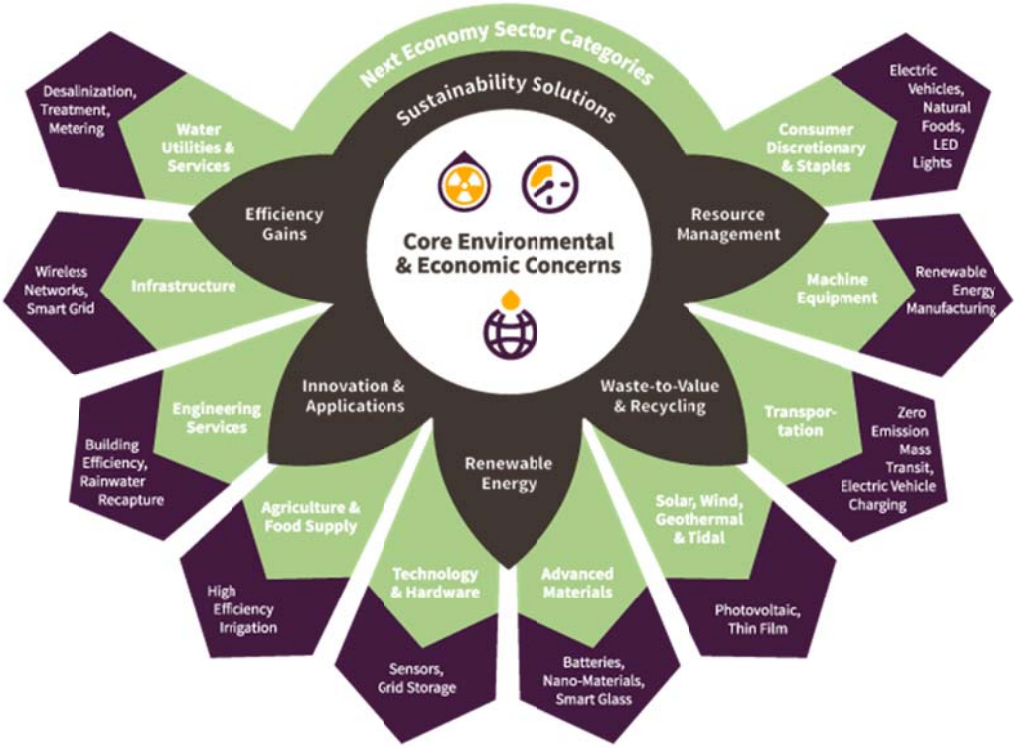
And so MPT must evolve. What the economists who originally invented the now-sanctified mix of sectors and industries mandatory to ensure appropriate portfolio diversification must have meant when requiring oil and coal investment was: 'make sure you have portfolio exposure to civilization's primary sources of energy that are required to power production.' In their day that could only mean fossil fuels. But the innovation that has occurred since then could allow us to power society as we know it (and much more), and do it all at a cost that could emancipate us to pursue the next great accelerando of human endeavor. At the time the rules of modern portfolio theory were devised, there was no way of foreseeing this future we now inhabit; nevertheless, we accept all legacy MPT assumptions as required background. Now, many of us ask, "What could we possibly do differently?" Well, the answer is "nothing," if we continue to accept all of MPT's now dated assumptions! This is why 'best of breed,' based as it is on the legacy MPT models of the academy, ultimately will have to either advance to adapt to the next economy, or fail.

So, in a reversal of traditional models of asset management, our first step in portfolio construction is to begin at the highest macro-level and make an objective assessment regarding the most pressing dangers confronting world economies via climate change and resource scarcity. Having identified these threats, the next step is to rigorously research scientific consensus and new approaches to the technologies, ideas and business practices best positioned and most likely to successfully aid in mitigation of and/or adaptation to the key threats. Of these approaches, then, we ask in the third step which can practically be deployed or practiced. Then, of the likely functional, practical approaches, we fourth ask which can also be aligned with

economic interests such that they can attract market capital and inspire both entrepreneurs and established companies to engage. Only now, at this point, do we in our fifth step identify specific companies that come as close as possible to purely meeting these criteria.

Looking at granular company-level financial data comes last for us, and is only applied to qualified next economy companies, as identified via the five-stage methodology briefly described above. In the final step then, we apply quantitative, rigorous, bottom-up financial analysis to identify stocks of next economy companies that we believe offer the best financial positions with minimized risk, with particular focus on growth potential and market liquidity and bankruptcy risks. The tools applied in this final step are universally known and practiced and do not bear detailed describing here. And in any case this is not the piece of portfolio management we're redefining. Suffice it to say that from a bottom-up fundamental perspective, we don't believe one can improve much on tried and true Graham-Dodd methodology.

In order for the economy of the future to support people and the planet indefinitely it must reflect the broad range of human needs and desires. The Green Alpha Next Economy map is an overlay of sustainable principles on traditional investment sectors. It reflects practical, achievable and innovative approaches to population growth, resource scarcity and climate change:



Conclusion

Long-term, the need to establish a zero-risk economy will drive efficiency solutions in every economic category. This will mean that as a global economy, we'll be getting more and more

output out of less and less economic, material, and time inputs. This in turn will allow us to have less and less impact on our underlying ecosystems. Thus, our approach to economics and investing can become a sustainable, virtuous cycle. We believe we live in a time of nonlinear, even geometrically rapid change, and the innovations emerging now will allow us to build tremendous economic growth, while also giving our underlying ecosystems a chance to begin recovering, thus de-risking our economy for long-term sustainability.

Sustainability, on a global macroeconomic level, isn't so much a choice as a requirement. As the World Economic Forum put it in 2013, the year that we launched the Shelton Green Alpha Fund[25], "On the economic front, global resilience is being tested by bold monetary and austere fiscal policies. On the environmental front, the Earth's resilience is being tested by rising global temperatures and extreme weather events that are likely to become more frequent and severe. A sudden and massive collapse on one front is certain to doom the other's chances of developing an effective, long-term solution." (Global Risks, 2013 – Eighth Edition.) More recently, according to Fortune[26], "climate change ranks as the No. 1 concern of global leaders, according to a new survey from the World Economic Forum. It's the 11th year that the World Economic Forum has published the survey, which polls 750 of the group's members, including CEOs and leaders and experts in various fields." Meaning that, for the first time, the most influential business leaders in the world have identified climate as the top global risk.

Next economics models what a human economy that can work for everyone, indefinitely, might look like. And next economy portfolio theory exists to contrast with the business-as-usual investment strategies mandated by modern portfolio theory. Green Alpha therefore cares far less about slavishly following sector allocation rules. Instead, we use risk-factor allocations across sectors and industries, choosing companies of all sizes from the USA and around the world. In other words, if a company is, in aggregate, not providing a solution, then it's not in a Green Alpha portfolio.

Next Economy Portfolio Theory may sound radical to some, but I argue that now, in 2016, it has become traditional portfolio construction that is driving us toward terrible economic and environmental outcomes. If investment in the causes of major systemic risks is what we still consider safe and prudent, then, it's hard to see how the global economy avoids negative outcomes. But in the end, a portfolio is nothing more than a vision for the future -- a set of predictions.

Not that any of this is easy or immediate. As much as we might wish otherwise, "pathbreaking creativity requires many years of acquiring a deep knowledge base from which you can draw to make novel connections" (NYU Adjunct Professor of Psychology Barry Kaufman, 2013[27]), and evolving new methodologies is a slow and painstaking process.

But we have to make the effort, because it's clear to us that we're in for a hard landing both economically and environmentally (to the degree that the two can still be disambiguated) if we don't use what's left of our fossil-fuels era prosperity and excess resources both to develop new

[25] http://www.weforum.org/reports/global-risks-2013-eighth-edition
[26] http://fortune.com/2016/01/16/davos-risk-report-world-economic-forum/
[27] http://blogs.scientificamerican.com/guest-blog/2013/02/05/the-virtues-of-a-cognitive-workout-new-research-reveals-some-neurological-underpinnings-of-intelligence/

and to deploy existing technologies and innovative business practices to secure a worldwide production function that is powered by limitless clean power and supplied by indefinitely sustainable material inputs. Building portfolios as if that future was already upon us – and perhaps it is – remains the clearest path to long term competitive capital gains for ourselves and for our clients.

Top 10 Holdings of the Shelton Green Alpha Fund (NEXTX) as of 12/31/2016	**Ticker**	**% of portfolio***
First Solar	FSLR	5.08%
Canadian Solar	CSIQ	4.89%
Vestas Wind Systems A/S	VWDRI	4.71%
SunPower	SPWR	3.85%
Alphabet	GOOG	3.66%
Universal Display	OLED	3.50%
Trina Solar LTD – Spon ADR	TSL	3.33%
Int'l Business Machines	IBM	2.92%
Tesla Motors	TSLA	2.77%
SolarCity	SCTY	2.75%

Important Disclosures pertaining to the Shelton Green Alpha Fund:

Green Alpha's environmental focus may limit Investment options available to the Fund and may result in lower returns than returns of funds not subject to such investment considerations. There are no assurances that the fund will achieve its objective and or strategy.

Investing in securities of small and medium sized companies, even indirectly, may involve greater volatility than investing in larger and more established companies.

Fund information is not intended to represent future portfolio composition. Portfolio holdings are subject to change and should not be considered a recommendation to buy individual securities.

Investors should consider a fund's investment objectives, risks, charges, and expenses carefully before investing. The prospectus contains this and other information about the fund. To obtain a prospectus, visit www.sheltoncap.com or call (800) 955-9988. A prospectus should be read carefully before investing. Investments are not FDIC insured or bank guaranteed and may lose value. Shelton Funds are distributed by RFS Partners, a member of FINRA and affiliate of Shelton Capital Management, 3/2016.

The Shelton Green Alpha fund is offered only to United States residents.