



THE ECONOMIC CASE FOR DIVESTING FROM FOSSIL FUELS

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ABSTRACT

If you own fossil fuels you own global warming. You own the most likely cause of global economic and possibly even civilization-level failure, and moreover, you own a power source that is having an increasingly tough time competing economically. And yet, the fossil fuels industry, big oil, big coal, natural gas, and its allied sectors, including some large financial institutions, will not quietly or willingly retire into the history of ideas whose time has passed. That fossil fuels represent the single greatest systemic risk to our collective economic wellbeing, however obvious to increasing numbers of fiduciariesⁱ, is not a consideration for the industry itself or to many investors. A divestiture campaign to get money out of fossil fuels stocks has emerged, indicating an emerging popular awareness that we must and will transform our energy society into one that can coexist with and even thrive on a finite earth. That a massive global transition away from fossil fuels and towards renewable energies, led by solar, also means that there are and will continue to be competitive investment returns earned from carefully selected investment exposure to renewables.

To minimize the systemic risks around resource scarcity, greenhouse gas emissions, toxic emissions, degradation of water and other resources, fossil fuels now clearly have to be replaced everywhere that they practically can be throughout the global economy: car fleets, electricity generation, some chemicals and plastics. As such, the future of global energy is the electric power grid and distributed electricity generation, with oil persisting in a crucial support role – not gone by any means but greatly diminished.

And this transition is already well underway: oil has lost global share of energy mix 15 years in a row.ⁱⁱ Largely, oil is losing this share to natural gas, but also to renewables like wind and solar. To illustrate the rapid growth of renewable energies and how difficult it has been to foresee their growth, consider that the International Energy Agency (IEA) solar and wind forecasts have been too low every year this decade. Solar beat IEAs 2000 estimate for 2014 by 40 times. Solar prices - of whole systems - are now 59% below what IEA forecast in 2010.ⁱⁱⁱ

Economically, oil in particular is restraining the global economy due to its price volatility and difficulty of growing supply at viable cost levels. The summation of these effects can be seen in Lewis' paradox which hypothesizes that the world can't grow GDP with oil higher than \$100 per barrel, and the oil industry can't grow supply with oil less than \$100 per barrel. Indeed, Major oil companies started cutting capital expenditure in Q1 of 2014, before current price declines, because \$100 per barrel was not enough to outrun declining ROI on runaway costs.^{iv}

Meanwhile, on the climate change side, The IPCC brings a powerful fossil fuels free investing argument in their latest report: in order to minimize the chances of damaging warming, 'Fossil fuels should be gone by 2100.'^v

As a result of these and other factors, fossil fuels as a generalized group are now a less likely growth industry for investors than they have been historically. Predictions as to when oil, gas and coal will become smaller investment sectors compared to renewables (such as solar, wind and ocean energies) vary, ranging from 2060 on the long side (this prediction from oil industry powerhouse Shell^{vi}) to as soon as 2030 (Bloomberg^{vii}). But until recently, markets appear to have been mispricing the risk this presents to fossil fuels companies, and their share prices have been more or less stable, but recent declines show how vulnerable the industry is to weakness of demand. In our opinion, it's far from too soon to consider divesting from fossil fuels while one can still recover significant value. It is important to note that the fossil fuels industry has been waging a war on renewables that could one day disrupt their profitable businesses. The early signs of fossil fuels' decline are clear.

Investor Jeremy Grantham, Co-Founder of GMO, LLC, who "began his investing career as an economist at Royal Dutch Shell"^{viii}, discussed signs of this in a recent shareholder letter,

"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... That we will replace oil for land transportation with electricity or fuel cells derived indirectly from electricity is also certain, and there, perhaps, the timing question is whether this will take 20 or 40 years. To my eyes, the progress in these areas is accelerating rapidly and will surprise almost everybody, I hope including me. Because of this optimism concerning the technology of alternative energy, I have felt for some time that new investments today in coal and tar sands are highly likely to become stranded assets, and everything I have seen, in the last year particularly, increases my confidence... Even when considering oil, with enough progress in alternatives and in electric vehicles one begins to wonder whether this year's \$650 billion spent looking for new oil will ever get a decent return... 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. Also, we drill the best sites in the best fields first, so do not expect the costs to fall per barrel (although the costs per well drilled certainly will fall with experience, the output per well will also fall). No, fracking, like extracting tar sands, yields a relatively costly type of oil that you resort to only when the easy, cheap stuff is finished. Fracking wells also run off fast... [and] are basically done for in three years."^{ix}

Cheap Oil and the Next Economy

Next economics posits that for the global economy and earth's tolerances/carrying capacities to run in a mutually tolerable equilibrium, we must continue to make rapid advances in economic efficiencies in all sectors. For 7.3 billion of us (and counting) to thrive on finite resources and avoid the worst effects of climate change, we have to drive more and more economic output from less and less input. Fortunately, energy is one of the areas where we can quickly make huge strides in this respect - but not with fossil fuels in the mix. On the contrary, in fact. Efficiency gains across the global economy in the last few years have been such that, according to a Bloomberg piece^x titled "America is Shaking Off Its Addiction To Oil," "the U.S. is consuming

less oil per dollar of gross domestic product in more than 40 years.” In part, it is this slowdown in oil demand growth that’s causing downward oil price volatility. The long and slow shift away from dependence on some fossil fuels, in other words, is finally starting to cause ripples.

Short Term Effects of Less Expensive Oil

Oil's recent narrative has become familiar: worldwide supply-and-demand economics (mostly declining demand, according to the World Economic Forum^{xi}), expansion of both Libyan field and U.S. shale production, and as always, speculation. All well and good, but fundamentally what does it have to do with the prices of renewable energy stocks? At present, very little.

Investors are understandably concerned with solar, wind and other renewable energy stocks following the same pattern of oil trades in the market. The perception that all energy production is similar and can be treated and traded as a monolith, however, is a false one. As general awareness of the differences between types of energy advances, we expect this trend to slow, and then reverse itself. Solar, wind and other renewables will not follow the same trading patterns as oil, because more people will soon know better.

Many experts and other pundits have been weighing in to make this point. Lyndon Rive, CEO of SolarCity Corp. in a CNBC interview^{xii} said, “the market doesn’t understand the dynamics; this is a great opportunity to understand the issue and truly see if this is a big problem or not a problem and then capitalize on the opportunity. Oil has no effect or almost no effect on the cost of electricity in the U.S. In the U.S., almost no oil is used to create electricity, so even if oil went down to fifty [\$50/barrel], it will have almost zero effect on the cost of electricity but the opposite is true too. If oil went up to a hundred and fifty [\$150/barrel], it will have almost zero effect on the cost of electricity.”

Rive’s comments fit with Green Alpha’s belief that investors are currently presented with a rare moment of market inefficiency, as broad markets struggle to clarify the role of a disruptive technology. In the near term, renewable energy investors should have little to fear from falling oil prices as there isn’t much of an underlying reason why the two distinct assets classes should be valued in tandem. On the contrary, since the price of oil should not be affecting the price of renewables, one could use this moment of misunderstanding as an opportunity to initiate or add to a select solar and wind portfolio. (Disclosure, SolarCity Corp. is a Green Alpha Advisors holding.)

The first reason we believe this is that solar provides a competitive, economic advantage over diesel, coal or natural gas, because fossil-fuel prices, even if low at this moment, have proven to be quite volatile over time. A recent *New Yorker* piece^{xiii} on oil prices points out that “...oil has historically been more volatile than most other commodities; a 2007 study found that in the U.S. it was more volatile than ninety-five per cent of other products.” The same can’t be said of wind or sunlight – once the capital expenditure for the systems to capture them and convert them to usable energy has been made, the price for fuel is zero. Indefinitely.

Again, Rive: “Fluctuations in oil prices have little impact on solar or many other renewable energy sources. This is partly why the economic proposition of solar is so compelling, unique

and valuable...For example, up to 50% of the cost of a fossil plant is the expense of the fuel over the life of the plant, while sunlight is essentially free.”

A recent energy cost analysis^{xiv} by investment firm Lazard validates the idea that oil pricing logically should be having a diminutive impact on renewables pricing, and goes on to calculate that the cost of energy from new utility-scale solar and wind power plants is increasingly competitive with more electricity-relevant comparative conventional fuels like coal, natural gas and nuclear, even without subsidies in some markets.

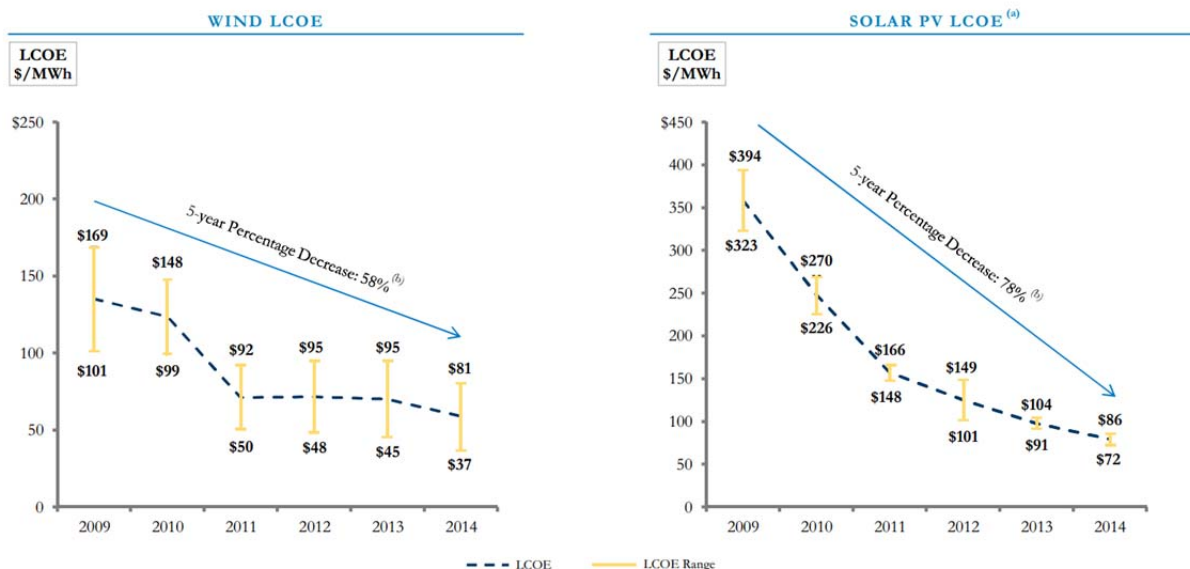


Image: Lazard, *Levelized Cost of Energy Analysis – Version 8.0*, 2014

According to Lazard, the reason for this newfound economic advantage is that the long-term costs of utility-scale solar has fallen 20% just in the past year and 78% in the last five years. Declining almost as rapidly, wind energy costs are down 60% over the last five years.

With the application of Gordon Moore's famous law now visibly applicable^{xv} to solar photovoltaic (PV) technology, and showing no signs of slowing anytime soon, it's plainly manifest that technology-based and commodities-based means of deriving energy do not belong to the same class of investable assets. Solar and oil, economically, scarcely share the same world.

In the Longer Run

Jeremy Grantham has titled his latest quarterly letter (Q3 2014) “The Beginning of the End of the Fossil Fuel Revolution (From Golden Goose to Cooked Goose).” He writes, “As a sign of the immediacy of this problem, we have never spent more money developing new oil supplies than we did last year (nearly \$700 billion) nor, despite U.S. fracking, found less – replacing in the last 12 months only 4½ months’ worth of current production! Clearly, the writing is on the wall. It is now up to our leadership and to us as individuals to read it and act accordingly.” Grantham refers to U.S. fracking as “the Largest Red Herring in the History of Oil,” noting that its economic advantages may be short-lived.

The International Energy Agency (IEA) has recently written^{xvi} 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, although that could be a growth factor as well.

The key point in this analysis is that solar is a technology, and it’s past and future cost dynamics will look like technology – becoming ever cheaper. Fossil fuels are commodities – finite and expensive to locate, extract, refine and ship – and fossil fuels have had and will have cost dynamics to match: very volatile. In the long run, 10-20 years from now, as our economy and infrastructure can make more and better use of renewables, the two will compete directly in a way that they do not now, but by then renewables, led by solar, will be so inexpensive that the cost comparison will no longer spark argument but will seem quaint. So different are the commodity and technology means of deriving energy that we at Green Alpha have proposed that they be classified as different sectors altogether.

Ultimately, as the next economy advances and we increasingly transition to using renewables (electricity) to power things that currently rely primarily on liquid BTU (such as transportation and some heating) solar and oil will indeed compete with each other directly. When that time comes, oil will again become cheap, because demand for it will have fallen dramatically as renewables, ever cheaper, command more and more market share. Even then, though, oil won’t be economically competitive, because no matter how inexpensive any “cheap” fossil fuel becomes, it will always be more expensive than the free fuels employed by wind and solar. And any power plant converting fossils to electricity will also have far higher operating costs than do most renewables.

As Bloomberg’s Michael Liebreich recently 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.”^{xvii}

Ultimately, the next economy can only thrive on power that is nearly free, inexhaustible, that does not contribute to systemic risks such as climate change and a toxic atmosphere, and that can be sourced nearly anywhere with a relative minimum of effort. Only solar PV, and to a slightly lesser extent wind, can reach this extraordinary level of economic efficiency. The writing is indeed on the wall, and the days of high market correlation between tech power and fossil power will soon be behind us.

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, “[e]nergy 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.”^{xviii} Less than half of the \$40 trillion investment in energy supply [global total] goes to meet growth in demand, the larger share is required to offset declining production from existing oil and gas fields and to replace power plants and other assets that reach the end of their productive life. Compensating for output declines absorbs more than 80% of upstream oil and gas spending.^{xix} One can’t help but notice that this will not leave much capital capacity to support the share prices of either fossil fuels or nuclear power firms.



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Meanwhile, on the regulatory side, the risks of remaining invested in fossil fuels are no longer going unnoticed. As former SEC Commissioner Bevis Longstreth^{xx} recently wrote:

"For fiduciaries, the planet's present condition and trajectory pose major, and growing, portfolio risks. Prudence requires that they be well informed about these risks and act with the requisite caution and care...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.*" (Italics mine.)

All these respectable sources feel this way because recent innovation in renewable energy and its efficiencies and cost gains are dramatically changing the energy landscape. **Our Next Economy thesis asserts that the energy and material resources we need to host an indefinitely thriving economy presently exist in more than sufficient quantities (particularly energy), if we collect and use them in smart and efficient ways. The innovations required to put world economies on a long-term sustainable path largely exist today.** For example, the various forms of solar energy collection have become so efficient over the last 20 years that all of civilization's energy requirements could presently be met by covering 0.3% of the earth's land surface with solar^{xxi} panels and concentrated solar thermal systems.

A recent case study in the outcomes of these developments comes to us from Texas, where City-owned Austin Energy has just signed "a 25-year PPA [power purchase agreement] with Sun Edison for 150 megawatts of solar power at "just below" 5 cents per kilowatt-hour." This is remarkable in that this "5-cent price falls below Austin Energy's estimates for natural gas at 7 cents, coal at 10 cents and nuclear at 13 cents."^{xxii} (Disclosure, SunEdison is a Green Alpha Advisors holding.)

Resting on inputs like these, our investment models insist that through promoting true sustainability solutions in materials and energy, we can indeed maintain a healthy, thriving biosphere, all while growing our economies and potentially improving standards of living everywhere, for everyone.

This in mind, here are 10 primary reasons why fossil fuels investments, in *Next Economy* terms and indeed in general economic terms, no longer appear to offer the attractive risk-adjusted

returns they have historically enjoyed, and are becoming economically subprime.

1. Fossil fuels have the capacity to threaten basic systems.

This is the primary macroeconomic and ecological reason that fossil fuels and the shares of the companies that exploit them will continue to diminish in scale and importance. Warming and the ramification of severe weather, droughts, floods, frequent and intense storms and attendant uncertainties undermine our basic economic foundations. A recent World Bank report conceded that “There is ... no certainty that adaptation to a 4° C world is possible,” referring to a global average temperature increase of 7.2 degrees Fahrenheit from pre-industrial times that is considered likely by scientists over the next few decades if fossil fuels’ use is not soon severely limited. To rephrase, the traditionally conservative World Bank believes that *human economies may not be able to adapt to a world that has on average warmed four degrees Celsius or more*. Note that the global temperature has risen nearly one degree Fahrenheit^{xxiii} since 1975.

On this key point, at the risk of being redundant, we want to be absolutely clear: if fiduciaries own fossil fuels, they own global warming, meaning they own the primary systemic risk to the long-term well-being of the global economy and civilization, and moreover, they own a power source that is having an increasingly tough time competing. This runs exactly contrary to the fiduciary responsibility to safeguard their members’ economic security.

Millions of pages have been written on the underlying reason for the unsustainability of fossil fuels. Their power to disrupt basic climate and therefore world societies is vast, complicated and is a topic best left to specialists. I suggest to the interested reader the works of Dr. James Hansen,^{xxiv} Lester Brown^{xxv} and Bill McKibben^{xxvi}.

2. Fossil fuel assets present asset abandonment risk.

Fossil fuels companies are now confronted by the risk that many of the still-in-the-ground assets they count on their balance sheets and/or in their future revenue projections may never be recovered or realized. As this becomes apparent, their asset valuations and revenue guidance may be revealed as currently far too high, and the values of their companies and stocks overvalued. Citing abandonment risk, Bloomberg^{xxvii} has stated, “Investors in carbon-intensive business could see \$6 trillion wasted as policies limiting global warming stop them from exploiting their coal, oil and gas reserves.” Carbon Tracker reports^{xxviii} “Between 60-80% of coal, oil and gas reserves of publicly listed companies are ‘unburnable’ if the world is to have a chance of not exceeding global warming of 2°C.”



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More recently, Bloomberg has noted^{xxxix} that “A growing minority of investors and regulators are probing the possibility that untapped deposits of oil, gas and coal -- valued at trillions of dollars globally -- could become stranded assets as governments adopt stricter climate change policies.”

The Australian press is reporting that “Australian based analysts at Citigroup say fossil fuel reserves in Australia face significant value destruction in a carbon constrained world, with the value of thermal coal reserves likely to be slashed dramatically if governments get serious about climate action...Fossil fuel asset owners could be best advised to dig the resource up as quickly as they can.”^{xxx}

HSBC has released a similar report, encompassing a global scale, essentially saying don't count all the fossil fuel reserves on firms' balance sheets because it is unlikely that they will burn them all and therefore “Oil and gas majors, including, BP, Shell and Statoil, could face a loss in market value of up to 60 percent should the international community stick to its agreed emission reduction targets.”^{xxxi} (It may be unlikely that policymakers in governments around the world currently have the wherewithal to honor their various carbon reduction treaties, but that may not matter. Peak oil demand is upon us because the alternatives are simply becoming far more competitive and awareness of fossil fuels' dangers is rapidly advancing.)

What Bloomberg, Citi and HSBC are saying, in sum, is that infinite growth of a known harmful asset – in this case an asset with the ability to disrupt climate and civilization – must come to an end, and soon. Shares of the firms exploiting this asset are at risk. Most recently, Bloomberg has gone as far as to launch an online “BLOOMBERG CARBON RISK VALUATION TOOL” in order to “illustrate the potential impact of stranding on a company's earnings and share price.”^{xxxii} Bloomberg economists have used this new tool to speculate that “Exxon could be worth 45% less in a carbon-stranding scenario.”^{xxxiii}

3. Renewables are becoming too competitive for fossil fuels.

We saw above how cheap solar PV on a utility scale can be. In more general terms, Rick Needham, director of energy and sustainability at Google has said, “While fossil-based prices are on a cost curve that goes up, renewable prices are on this march downward.”^{xxxiv} In just the last five years, solar photovoltaic module prices have fallen 80 percent^{xxxv} and wind turbines have become 29 percent less expensive. Moreover, after the initial investment, renewables such as wind and solar, having no cost of fuel, will prove far too competitive for fossil fuels no matter how cheap those may appear to be. Cheap fuel is still more expensive than free fuel.

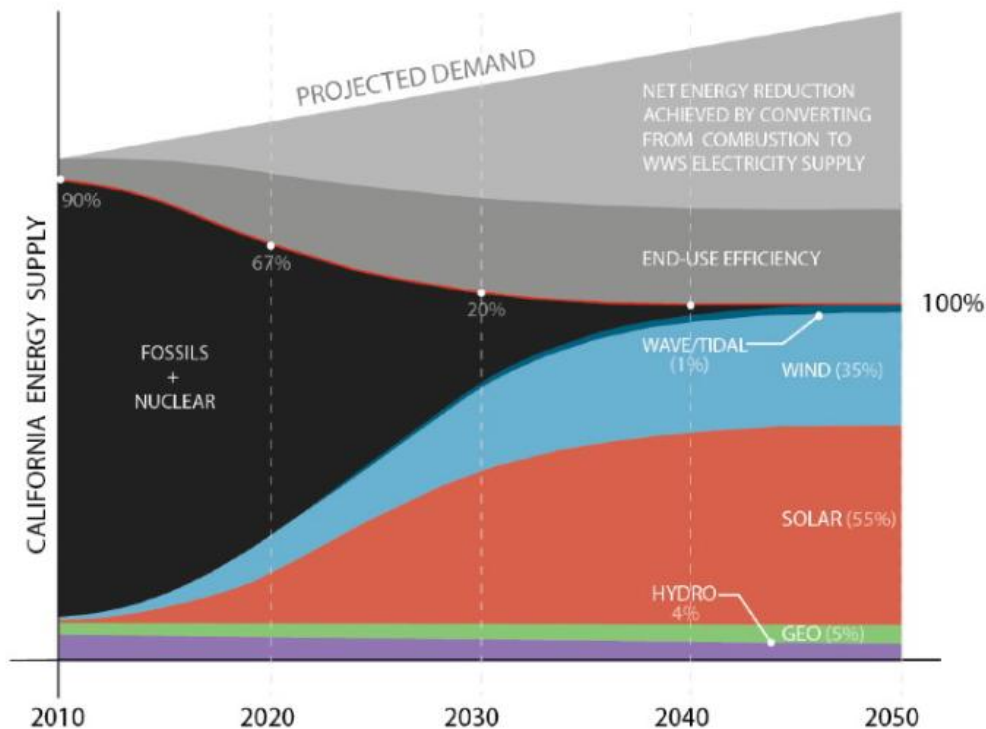
One of the first major investors to recognize this was Warren Buffett. Via his MidAmerican Energy subsidiary, he has quietly made Berkshire-Hathaway America's single largest owner of both solar and wind electrical power generation capacity. Patrick Goodman, Buffett's CFO of MidAmerican said simply “We believe renewables is the better investment right now.”^{xxxvi} Warren Buffet, who believes that once a good investment has been identified it's time to “back up the truck,” is showing no signs of giving up his leader status on solar, having begun construction on the “largest solar plant in the world.”^{xxxvii}

The rate at which solar PV is falling in price is nothing short of astonishing. “Between 2009 and 2014, HSBC estimates, the difference between the median levelized cost of electricity (LCOE) of solar and conventional coal has fallen by around 80 percent...This, it notes, is a global average, and even includes regions with poor solar resources.”^{xxxviii}

Thin-film PV industry leader First Solar, Inc., recently punctuated this by announcing that they expect their solar module prices to drop nearly in half in the next five years. As a story in *Renew Economy* states, “[s]olar companies are meeting those [mandated, inexpensive] PPA prices – not making a whole lot of profit, but with costs to come down as dramatically as SunPower, SunEdison and First Solar have suggested, they are making enough to secure their future. *Gas developers can simply no longer compete because the forward gas prices are pushing gas generation costs well beyond this.*”^{xxxix} (Italics mine; Disclosure: SunPower, SunEdison and First Solar are all Green Alpha Advisors’ holdings.)

All this is happening now, today, with today’s technologies and today’s economics. That the smart money already sees renewable energies as more competitive long term than fossil fuels is obvious. The ‘smart money,’ by the way means individuals as well as institutions. Solar crowdfunding pioneer Mosaic in April of 2013 sold out the first tranche of \$100 million in solar project investments to Californians in just hours^{xl}.

Further technological advances aren’t required to make renewables competitive, but advances are occurring nevertheless. Fossil fuels will represent only a small percentage of all energy investments in just a few years for a simple reason: few will want to invest in the less profitable technologies of the past.



Energy supply mix through 2050 for California, America’s largest economy.^{xli}

4. Fossil fuels firms are beginning to have to pay for their externalities.

Fossil fuels companies historically never had to pay for their economic externalities such as pollution, warming, health effects and contaminated water and farmland. There are signs that this is beginning to change, and firms will increasingly be liable for taxes and damages in the tens if not hundreds of billions, and with good reason. A 2013TEEB For Business Coalition Study found that “[t]he value of the Top 100 externalities [arising from the use of fossil fuels] is estimated at US\$4.7 trillion.”^{xlii} That’s \$4.7 trillion in externalities currently borne by taxpayers, health care systems, insurers and so on.

One high profile example not directly related to carbon emissions is BP’s Deepwater Horizon spill, the worst oil spill in U.S. history. BP has already been required to set up a US\$20 billion fund to cover cleanup and damage costs, and perhaps far more significantly, is facing potentially “tens of billions” in additional damage payments pending the outcome of what the *Financial Times* calls the “trial of the century,”^{xliii} now underway in Louisiana. The *FT* also reports that BP is facing an additional 2,200 lawsuits related to the spill. Even if BP should prevail in most or even all of these suits, the massive costs of these litigations will start to become a drag on the firms’ traditionally easy profitability.

Newsweek details additional BP liabilities including, “That BP lied about the amount of oil it discharged into the gulf is already established. Lying to Congress about that was one of 14 felonies to which BP pleaded guilty last year in a legal settlement with the Justice Department that included a \$4.5 billion fine, the largest fine ever levied against a corporation in the U.S.”^{xliv} BP’s continuing potential liabilities from this one incident, including “uncapped class-action settlements with private plaintiffs^{xlv}” and “civil charges brought by the Justice Department” and “a gross negligence finding [that] could nearly quadruple the civil damages owed by BP under the Clean Water Act to \$21 billion,” show the danger to shareholders. Any representative of an asset class carrying this kind of risk can justifiably be labeled a subprime investment.

Other firms facing liability issues surrounding the dangerous nature of their products include Chevron, which has had to abandon Ecuador altogether to avoid paying a \$US19 billion settlement there in a “nightmare case^{xlvi}” that threatens to drag on around the world as Ecuador seeks payment via Chevron’s assets in other nations.

5. Fossil fuels are likely to face carbon taxes.

There will be carbon taxes in many if not most countries that will directly impact the profit margins of fossil fuels firms. *The New York Times* Op-Ed framed the argument in the following way: “Substituting a carbon tax for some of our current taxes — on payroll, on investment, on businesses and on workers — is a no-brainer. Why tax good things when you can tax bad things, and increase long-run growth by nudging the economy away from consumption and borrowing and toward saving and investment.”^{xlvii}

Economists too largely recognize that the global economy would benefit from taxes on carbon, especially as opposed to taxes on labor income, and would raise much needed revenue that could be used to lower other taxes or develop infrastructure, for example. A December 2012 poll

of economists by the University of Chicago's Booth School found that 86%, across backgrounds and political orientations, agreed or strongly agreed with the statement, "The Brookings Institution recently described a US carbon tax of \$20 per ton, increasing at 4% per year, which would raise an estimated \$150 billion per year in federal revenues over the next decade. Given the negative externalities created by carbon dioxide emissions, a federal carbon tax at this rate would involve fewer harmful net distortions to the US economy than a tax increase that generated the same revenue by raising marginal tax rates on labor income across the board."^{xlvi}

And it's not just economists who see the value in a carbon tax. A 2013 Yale University survey found that 61% of Americans favor "Requiring fossil fuel companies to pay a carbon tax and using the money to pay down the national debt."^{xlix}



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The usual rejoinder here is that carbon taxes will result in loss of jobs and slow the economy. However, research indicates the opposite effect. According to a recent analysis of California's economy, even at a very high tax rate of \$200 per ton of carbon emissions, a "tax swap" [wherein income tax is reduced by the amount of carbon taxes collected] could mean 300,000 more jobs in the state by 2035, an extra \$18 billion in GDP, an additional \$16 billion in annual income, and carbon emissions less than 75% of 1990 levels.¹

Acknowledging these realities, nations have begun to act. The "U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation"^{li} is the highest-profile example. In addition to the U.S.-China deal, according to the World Bank, Mexico and other nations appear poised to act on a carbon tax.^{lii} Significantly, overall global greenhouse gas emissions leader China has implemented a seven-city pilot cap-and-trade system for carbon, "as a foundational element in its war on pollution."^{liii} California's new cap and trade system^{liiv} has just kicked off as of January 1st, 2015.

A carbon tax is good for everyone but fossil fuels companies, who will see their profits reduced (or attempt to pass the costs on to consumers, reducing demand for their products further). So far, several nations, provinces and individual municipalities have implemented a carbon tax, and many others have carbon trading schemes (the Carbon Tax Center^{lv} is a good resource for keeping up with these). Carbon taxes can raise revenues, shrink deficits, and move tax burden away from citizens, all while slowing the worst effects of warming. And even if we discount the benefits of avoiding the worst effects of global warming, placing a tax on carbon emissions would still reduce non-greenhouse gas pollution, and promote energy independence.

As the think tank Carbon Tax Center put it, "[a] carbon tax will do everything the clean-energy credits will do, and much more. While simplifying and rationalizing the current hodgepodge of

energy subsidies is all to the good, only a carbon tax can course through our entire economy and reward energy efficiencies and conservation along with low-carbon production.”^{lvi}

6. Fossil fuels will soon face diminishing governmental subsidies and benefits.

Fossil fuels have received as much as half a trillion dollars per year in subsidies from the U.S. alone^{lvii}. To the extent that austerity or desires to balance budgets, combined with legislation to limit greenhouse gas emissions, reduce the scale of this windfall, the seemingly easy profitability of these companies will be undermined. Further, there is growing acknowledgement that, as Fatih Birol, Chief Economist at International Energy Agency has said, “Fossil fuel subsidies are the no.1 enemy to sustainable development.”^{lviii} A report from the Overseas Development Institute (ODI) has gone so far as to recommend that the G20 phase out subsidies altogether by 2020. “This is a reckless use of public money at a time when people are very concerned about energy costs,” Kevin Watkins, executive director of the ODI, commented to BBC News.^{lix}

Venerable journal *The Economist* concurs, writing, “MOST economists agree that fossil-fuel subsidies are a bad idea. They promote a misallocation of resources in the economy, namely, the over-consumption of fossil fuels. They can be a burden on the public finances. What’s more, this waste increases global carbon emissions. Some countries have already wised up to the foolhardy nature of energy subsidies and have sought to trim them back. Over the past year or so, Jordan, Morocco, Indonesia and Malaysia have all cut subsidies and raised fuel prices.”^{lx} Here we note that the U.S. has yet to act on removing subsidies, but even here, there are signs of momentum, such as Sen. Bernie Sanders’ sponsored “End Polluter Welfare Act of 2013,” which “would remove tax breaks, close loopholes, end taxpayer-funded fossil fuel research and prevent companies from escaping liability for spills or deducting cleanup costs.”^{lxi}

These and other leading economists and policymakers are making no excuses for the fossil fuels industry anymore. Perhaps the best summation to the mainstreaming of momentum to withdraw subsidies from fossil fuels companies has been articulated by International Monetary Fund chief Christine Lagarde in a speech in February 2014: “Overcoming climate change is obviously a gigantic project with a multitude of moving parts. I would just like to mention one component of it—making sure that people pay for the damage they cause.



We are subsidizing the very behavior that is destroying our planet, and on an enormous scale.

Both direct subsidies and the loss of tax revenue from fossil fuels ate up almost \$2 trillion in 2011—this is about the same as the total GDP of countries like Italy or Russia.”^{lxii}

7. There is growing global institutional belief that transition to renewables solves climate AND economy.

We've already seen the dire warnings about warming coming from the World Bank, and discussed the positions of Bloomberg, Citi and HSBC. These institutions are far from alone. The International Monetary Fund, in calling for "Energy Subsidy Reform,"^{lxiii} calculated that between directly lowered prices, tax breaks, and the failure to properly price carbon, the world subsidized fossil fuel use by over \$1.9 trillion in 2011 — or eight percent of global government revenues, representing a huge drag on economies. The United States taxpayer is fossil fuels' largest benefactor at \$502 billion in 2011. China came in second at \$279 billion, and Russia was third at \$116 billion. For perspective, that \$502 billion is just over 3% of the US economy, currently being given away to big fossil fuels companies.

The IMF concluded that the "link between subsidies, consumption of energy, and climate change has added a new dimension to the debate on energy subsidies." The IMF's solution to both economic and climate risk is in two simple parts: "end fossil fuel subsidies and tax carbon."^{lxiv} The solution to both climate and economy is worldwide conversion from fossil fuels to renewables.

In aggregate there are now 66 countries, those responsible for approximately 88 percent of total world greenhouse gas emissions, that have completed or pending legislation governing climate plans, according to a study by Globe International.^{lxv} Climate change news website *Responding to Climate Change* (RTCC) quoted UN climate chief Christiana Figueres as saying of the study, "Domestic legislation is critical because it is the linchpin between action on the ground and the international agreement. At the national level, it is clear that when countries enact clean energy policies, investment follows. At the international level, it is equally clear that domestic legislation opens the political space for international agreements and facilitates overall ambition." RTCC also writes of Globe International's report that "the UN says is the most comprehensive analysis to date of the reach and depth of national climate change laws around the world."^{lxvi} The study is important, because it shows the breadth of efforts around the world to begin reining in greenhouse gasses and addressing warming and climate. In our view, this clearly indicates a high probability of a stranded assets scenario for fossil fuels.

8. Fossil fuels are the ultimate non-circular: they're completely consumed upon first use, so more primary source extraction is required.

As mentioned above, to get global economies on an indefinitely sustainable foundation, we need to make far more efficient use not only of energies but also of raw materials. Fossil fuels represent both raw resources and energy sources, and they represent the worst of both. Smart, efficient use of materials means reusing nearly everything at the end of its lifecycle to repurpose into something else we need. For a thriving, sustainable long-term economy, we need to get close to perfect recycling of resources of all kinds so we can minimize our depletist impacts on earth and avoid the basic environmental degradations that go along with those.

This approach excludes fossil fuels and other resources that are consumed entirely on their first use. Raw materials can keep economies growing for a long time if we preferentially mine our

huge stockpiles of already extracted resources and minimize extraction from primary, geological sources. But fossil fuels, unlike materials used to make solar panels and wind turbines, don't work like that. Since they are consumed entirely on their first use, reuse is impossible and we have to literally go back to the well for more. This means ever more greenhouse gasses in the atmosphere, ever more degrading of the local environments where extraction takes place, ever more risk of accidents, and the possibility of eventually exhausting the resource completely.

9. Distributed renewable energy grid is more secure than traditional hub and spoke systems, even those powered by domestic fossil fuels.

It's as simple as this: "Destroy nine interconnection substations and a transformer manufacturer and the entire United States grid would be down for at least 18 months, probably longer," as Federal Energy Regulatory Commission analysts wrote recently.^{lxvii} FERC Chairman Jon Wellinghoff similarly concluded, "It wouldn't take that much to take the bulk of the power system down. If you took down the transformers and the substations so they're out permanently, we could be out for a long, long time,^{lxviii}" and "A more distributed system is much more resilient...Millions of distributed generators can't be taken down at once."

The idea of a resilient, distributed electrical power grid is common sense. And short of equipping every home and business with its own diesel or natural gas generator – which of course would be disastrous for local areas' air quality – fossil fuels can never offer anything like the kind of security and resilience that distributed renewables like rooftop and local solar can. This is the key reason that the U.S. military has embraced renewable energies and local base-only power micro-grids. "The United States Department of Defense's (DOD) interest in improving energy security through microgrid technology stems from its heavy reliance upon all forms of fossil fuels, often imported from regions of the world hostile to U.S. interests. Microgrids can shrink the amount of fossil fuels consumed to create electricity by networking generators as a system to maximize efficiency. They can also be used to help integrate renewable energy resources (such as wind and solar) at the local distribution grid level. Simultaneously, microgrids enable military bases – both stationary and forward operating bases – to sustain operations, no matter what is happening on the larger utility grid or in the theater of war," according to analysts at Navigant Research.^{lxix} Referring back to Jeremy Grantham's 4th quarter 2013 investor letter, his wry comment on this topic was, "[w]ho would have guessed that on several vital long-term issues the military here and in the U.K. seems to have the most sensible views of any establishment entity?" Well, considering that the military's primary power goals are reliability and defensibility from attack, we would have. The same benefits and economic stability that accrue to military installations apply equally to civilian power generation from distributed renewables and can never be matched by centralized wheel-and-spoke coal or gas generation.

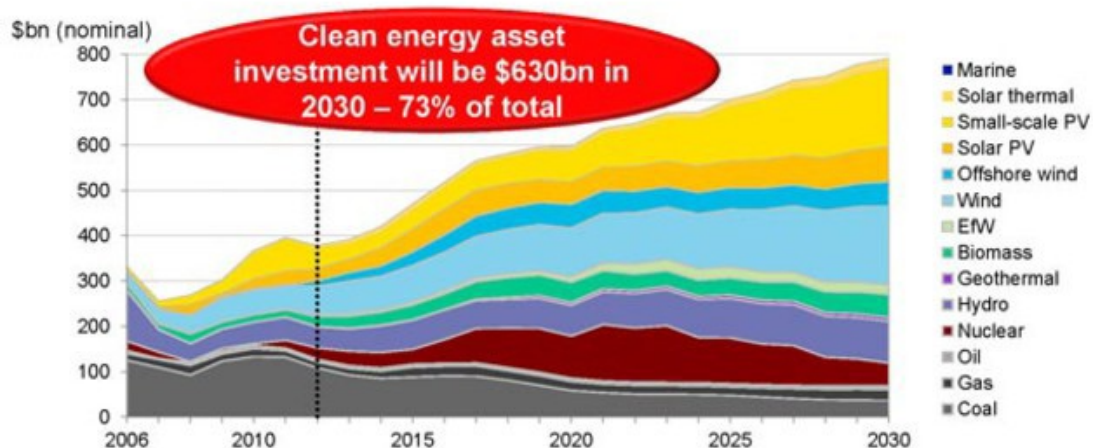
10. Renewables will counter fossil fuels' endless 'boom and bust' economic cycles.

The price of oil and other fossil fuels has, at least since World War II, been the main control knob permitting expansion and causing contraction of world economies. It's widely known that peaks in oil prices preceded 10 of the last 11 major recessions, including the great recession of 2008.^{lxx} Rising oil prices are inflationary, adding to the costs of almost everything from

transportation to fertilizers to plastics, and they therefore cause demand for all these affected items to become depressed, slowing economic production. Renewables, relying as they do on free fuels like sunlight, present no such economic pressures, and as they become an ever-larger percentage of our energy mix, fossil fuels' huge GDP drag will begin to disappear.

Conclusion

What then is the future for fossil fuels versus renewables? Fossil fuels have already begun to rapidly lose market share. In 2012, most new electricity-generating capacity brought online in the United States was from renewables^{lxxi}, and in January, March and November 2013, *all* new U.S. electrical generating capacity was provided by renewables^{lxxii}. As of November, 2014 renewables had provided 47.43 percent of new capacity in the U.S.^{lxxiii} So where is this headed?



Destinations of new energy investments in the U.S. through 2030; Image courtesy BNEF^{lxxiv}

Bloomberg New Energy Finance (BNEF) has calculated that “70% of new power generation capacity added between 2012 and 2030 will be from renewable technologies (including large hydro). Only 25% will be in the form of coal, gas or oil.^{lxxv}” BNEF CEO Michael Liebreich stated “I believe we're in a phase of change where renewables are going to take the sting out of growth in energy demand,^{lxxvi}” which goes to our thesis that we can both lighten our ecological footprint and increase our standards of living.

So add Bloomberg to the growing group of financial analysts warning that fossil fuel investments are poised to become a bad bet^{lxxvii}.

Citibank, in its note about the Australian coal industry, went as far as to warn investors that it will be difficult to extract value from their still-in-the-ground resources as action on climate change advances, stating, “If the unburnable carbon scenario does occur, it is difficult to see how

the value of fossil fuel reserves can be maintained, so *we see few options for risk mitigation*.^{lxxviii}"

Well, with all due respect to Citi, I can think of one option: we, like Buffett and Google, can instead invest in civilization's non-carbon sources of power. As the IMF pointed out, the solution to both climate and economy is worldwide conversion from fossil fuels to renewables. This massive conversion program will lead to powerful economic growth, less economic drag from energy costs, higher revenue for treasuries, and strong employment drivers.

As fiduciaries, it is paradoxical for us to attempt to mitigate portfolio risks by remaining invested in fossil fuels, which themselves represent perhaps our greatest systemic risk. What we do now will bring about the future for better or worse. If we're to emerge from our destructive 19th century energy system into a new paradigm of energy generation that will permit economies to persist indefinitely, it must be us, today, who set that emergence in motion via our portfolio allocations. Leave fossil fuels and their attendant risks for those who prefer to look backwards.

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While much of the content of this paper is original, significant elements have been taken from the author's blog, Green Alpha's Next Economy, appearing on sierraclub.org, and from comments prepared for his public speeches.

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