ON MATTERS THAT MATTER

The Rise of Environmental Business Markets

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An Occasional Essay on Matters that Matter

The Rise of Environmental Business Markets

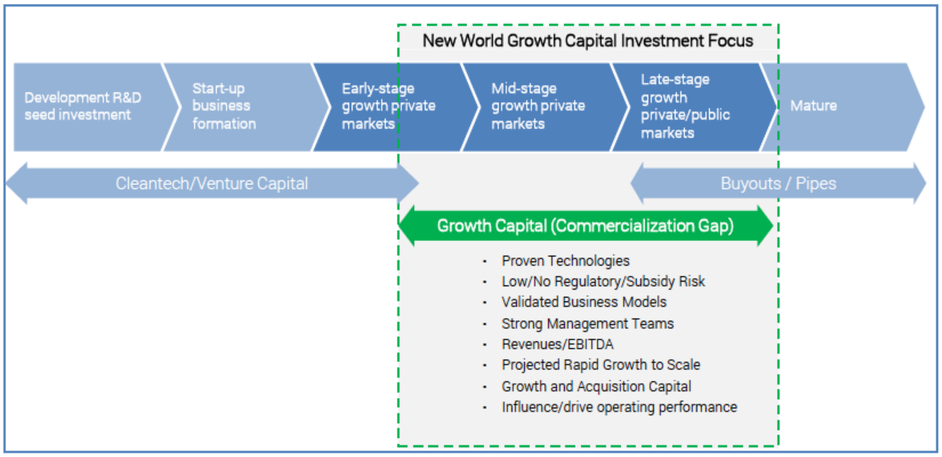
As private equity investors in selected environmental markets in North America, NewWorld Capital Group publishes occasional essays on matters that matter in our investment strategy. We seek to present an analysis of the forces at work that are shaping investment opportunities and related risks in our target markets and the overall environmental opportunities sector.

A number of powerful macro-forces centered on rising and increasingly volatile commodity costs and existing inefficient resource management practices, along with certain special attributes of environmental markets, create openings to earn top-tier economic returns from investing in the environmental business sector. Environmental markets are already large, are growing rapidly and offer a significant opportunity to the specialist investor.

The purpose of this essay is to demonstrate the rise of environmental business markets in North America for investors, specifically in five industrial segments: energy efficiency, clean energy, water resources and reclamation, waste-to-value, and environmental services. In recent years, these markets have been developing rapidly but have typically been given wide berth by investors because of painful memories of Silicon Valley's disastrous foray into cleantech investing, the collapse of public equity markets during the Great Recession, and the political stigmatization resulting from partisan battles over environmental regulation, energy policy and climate change. Recent successes in the environmental products and services industry, however, are showing the way and investors have begun to pay attention.

This essay is focused on investing in North America's middle- and lower-middle-market of rapidly growing companies in the environmental business sector, specifically in companies that are already validated by a market response and have sustainably differentiated products and/or business systems together with a growing sales record—and are working to achieve full competitive scale. The authors believe that early stage investing is very risky in these markets, in view of technological uncertainties, the challenges of business scaling, the capital intensity of many environmental businesses, and the advantages held by incumbent players. The authors further believe that large company investing is not as attractive in these markets, because large mature companies usually do not enjoy rapid growth (their markets are more mature and they usually face strong head-to-head competition) and are likely to be fully priced. Figure 1 below illustrates NewWorld's recommended focus of environmental business investing.

Figure 1: NewWorld Growth Capital Investment Focus



Investing in environmental markets generally yields broader beneficial outcomes beyond attractive economic returns, as the societal co-benefits of such investments are usually quite significant. Pollution of the air, water and land is increasingly perceived as a major socioeconomic problem by governments at all levels, the public at large and a growing number of business leaders, as are dwindling supplies of freshwater and resultant water stress and the growing costs and environmental burden of waste management. Improved resource use thus should lead to many benefits for society, such as cleaner air and water and reduced waste and pollution.

Such societal co-benefits help make environmental markets attractive destinations to invest not only for profit but also for impact—without the need to trade-off on either objective. With many resource management challenges urgently needing to be addressed, environmental markets are rich with opportunities for impactful investing that can deliver strong economic returns while benefitting society in important ways.[1]

I. Macro-Forces: The Driving Reality

The environmental opportunities industry in North America is experiencing rapid growth, as a confluence of macro-forces create market dynamics that are relentlessly driving more resource-efficient practices. These strong macro-forces include: (i) rising and increasingly volatile commodity prices; (ii) changing corporate considerations; (iii) historic investment that laid the foundation for many environmental technologies and businesses today; (iv) market scaling and evolution in the wake of the cleantech bubble; and (v) growing migration of skill and talent into the environmental business sector.

[1] For a discussion of the opportunity to engage in top-tier returns while also creating valuable societal co-benefits in environmental investing, see the essay entitled "Impact Investing: Trading Up, Not Trading Off," in the NewWorld Essay Series *On Matters that Matter*.

A. Rising and Increasingly Volatile Commodity Prices

Natural resource prices have not only risen substantially, but they are also becoming more volatile and less predictable.

Since 2000, resource prices have increased sharply, largely erasing all the declines of the twentieth century. The McKinsey Global Institute has found that average resource prices have more than doubled since 2000, although resource prices had decreased annually by slightly more than one-half percent (on average, in real terms) over the entire twentieth century.[2]

Since the 1980s in particular, the rise in commodity prices is even more apparent (see Figure 2). In the even longer-run, the National Bureau of Economic Research (NBER) examined 30 commodity prices over a span of 160 years and found that real commodity prices (energy and non-energy) have been on the rise since at least 1950 across all weighting schemes.[3] Though the NBER report saw deviations from the rising commodity prices in the context of larger cyclical trends, the consistent upward trend suggests that innovation, substitution, and conservation (previously thought to mitigate price rises) has not been wholly effective at offsetting price gains.[4]

An increasing price baseline over the longer-term provides a backdrop to shorter-term volatility in resource prices. Oil prices are one of the most visible examples, but overall commodity price volatility has increased nearly threefold since the 1990s.[5]

Despite recent fluctuations, commodity prices are still around pre-global financial crisis levels, and they are likely to remain well above price levels seen before the early 2000s. These higher natural resource prices are based largely on higher marginal supply costs and the tension between competing forces: geological constraints and extraction challenges on one side, and technological innovation and resource productivity improvements on the other.[6]

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[2] Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Sigurd Mareels, Scott Nyquist, and Sunil Sanghvi, *Resource Revolution: Tracking global commodity markets*, Trends Survey 2013, McKinsey Global Institute (September 2013).

[3] David S. Jacks, "From Boom to Bust: A Typology of Real Commodity Prices in the Long Run," *NBER Working Paper No. 18874*, National Bureau of Economic Research, March 2013.

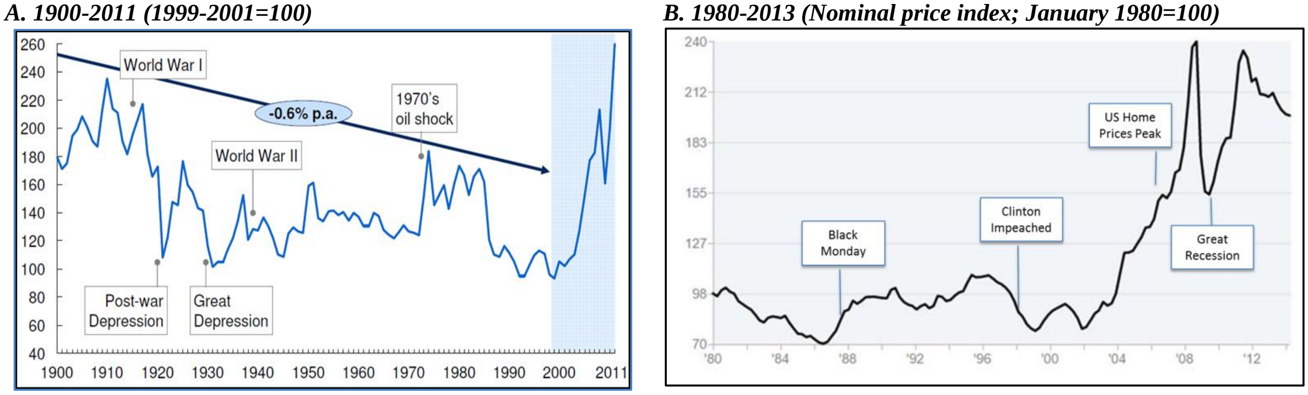
[4] *The Economist*, "Commodity Prices in the (very) long run," Free Exchange, March 12, 2013, http://www.economist.com/blogs/freeexchange/2013/03/resource-prices.

[5] Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Sigurd Mareels, Scott Nyquist, and Sunil Sanghvi, *Resource Revolution: Tracking global commodity markets*, Trends Survey 2013, McKinsey Global Institute (September 2013).

[6] Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Sigurd Mareels, Scott Nyquist, and Sunil Sanghvi, *Resource Revolution: Tracking global commodity markets*, Trends Survey 2013, McKinsey Global Institute (September 2013).

Figure 2: McKinsey Commodity Price Indices

A. 1900-2011 (1999-2001=100) ***B. 1980-2013 (Nominal price index; January 1980=100)***



Source: McKinsey & Company, based on Grilli and Yang; Pfaffenzeller; World Bank; International Monetary Fund (IMF); Organization for Economic Co-operation and Development (OECD) statistics; United Nations Food and Agriculture Organization (FAO); United Nations Commodity Trade Statistics Database (UN Comtrade); United Nations Conference on Trade and Development (UNCTAD); World Bank commodity price data; McKinsey Global Institute analysis.

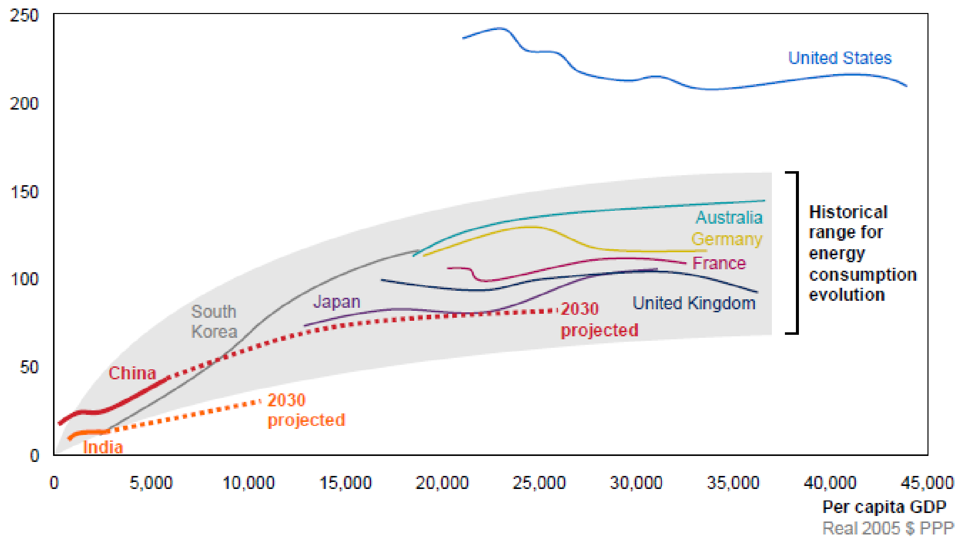
Moreover, higher resource prices (relative to pre-2000 levels) are driving a systemic shift, in large part because most of the world's resource-related infrastructure was constructed in the context of expectations about lower prices, as were many companies and technologies related to natural resources. Relative prices matter more than absolute price levels: for example, while $66/bbl crude may seem extraordinarily low relative to where oil was trading earlier in 2014, it is still far higher relative to oil prices in the early 1990s.[7] So long as resource prices are elevated relative to where they were when the majority of today's resource-related infrastructure was built (roughly prior to early 2000s), they will help facilitate an adjustment toward a more resource efficient economy in the longer term.

Since the early 2000s, increasing demand and rising production costs are two major drivers of these commodity price gains. Strong demand growth (from countries like China) played a major role, and world population growth will continue to push these trends. As of early 2014, world population exceeded seven billion; however, world population is not merely growing, it is also evolving as the consumer class expands and gains purchasing power. Although world population growth rates have begun to slow, as an increasing percentage of the global population enters the middle class (approximately three billion or more estimated by 2030[8]) resource consumption is expected to rise sharply. Many countries illustrate that demand for resources rises faster than incomes rise.[9] For example, per capita energy use for emerging market countries like China and India in 2030 is projected to be far above historical precedent (see Figure 3). To the extent that

[7] For example, the annual average spot price of WTI in 1995 was $18.42/bbl. BP, *Statistical Review of World Energy*, June 2014 (London: BP, 2014).
[8] See for example Richard Dobbs, Jeremy Oppenheim, and Fraser Thompson, "Mobilizing for a resource revolution," *McKinsey Quarterly* (January 2012) and Homi Kharas, "The Emerging Middle Class in Developing Countries," Working Paper No. 285, OECD Development Centre (January 2010).
[9] Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Sigurd Mareels, Scott Nyquist, and Sunil Sanghvi, *Resource Revolution: Tracking global commodity markets*, Trends Survey 2013, McKinsey Global Institute (September 2013).

demand growth remains strong and outpaces other drivers (like innovation), rising commodity prices will likely be sustained.[10]

Figure 3: Per Capita Energy Consumption (1970-2008), and Projections for India and China to 2030 (Million Btu/person)



Reproduced from Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Sigurd Mareels, Scott Nyquist, and Sunil Sanghvi, *Resource Revolution: Tracking global commodity markets*, Trends Survey 2013, McKinsey Global Institute (September 2013), based on International Energy Agency (IEA), IHS Global Insight, and McKinsey analysis.

Increases in commodity prices broadly are, in large part, a result of increasing costs for energy, particularly oil. As illustrated by Figure 4, commodity prices have become increasingly correlated with oil prices over time. These increasingly strong price relationships have been driven in part by strong demand growth from China but the increased correlations between natural resources have also been caused by other factors. Certain resources represent large portions of input costs of other resources. For example, oil costs directly affect food commodity prices (such as wheat, corn, and rice) through energy-intensive fertilizers, transport, and fuel used for planting, cultivating, and harvesting.[11] In addition, technological advances have helped facilitate greater substitution between resources and linked markets more closely (such as biofuels like ethanol, which has become a major user of corn).[12]

[10] *The Economist*, "Commodity Prices in the (very) long run," Free Exchange, March 12, 2013, http://www.economist.com/blogs/freeexchange/2013/03/resource-prices.
[11] Fatimah Mohamed Arshad and Amna Awad Abdel Hameed, "The long run relationship between petroleum and cereals prices," *Global Economy and Finance Journal* 2, no. 2 (2009): 91-100.
[12] Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Sigurd Mareels, Scott Nyquist, and Sunil Sanghvi, *Resource Revolution: Tracking global commodity markets*, Trends Survey 2013, McKinsey Global Institute (September 2013).

Figure 4: Correlation of Selected Commodities to Oil

Commodity	Q1 '80– Q4 '00	Q1 '00– Q1 '14	Q1 '12– Q1 '14	Q1 '80– Q1 '14
Gas	0.64	0.69	-0.42	0.86
Corn	0.29	0.89	-0.21	0.85
Aluminum	-0.19	0.67	0.44	0.61
Copper	-0.28	0.94	0.4	0.92
Gold	0.42	0.89	0.12	0.9
Steel	-0.28	0.87	0.29	0.87
Coal	0.52	0.9	0.54	0.91
Tin	0.83	0.71	-0.13	0.74
Cotton	0.36	0.65	0.62	0.43
Timber	-0.53	0.92	0.26	0.6

Note: Correlation coefficient, which ranges between –1 (perfect negative correlation) and +1 (perfect positive correlation).

Source: McKinsey & Company Commodity Price Index, based on IMF; UN Comtrade; UNCTAD; World Bank commodity price data; McKinsey Global Institute analysis.

Extracting and producing oil today is simply much more expensive. As the former chief economist of CIBC World Markets, Jeff Rubin, said in 2010, "No, the world is not running out of oil. It's just running out of the oil we can afford to burn."[13] Since 2000, energy prices have increased by 260% (on average, in nominal terms) because of demand growth and rising supply costs, as traditional energy resources have been depleted and production shifts to sources like unconventional oil and gas (*e.g.*, deep water extraction or tar sands).[14]

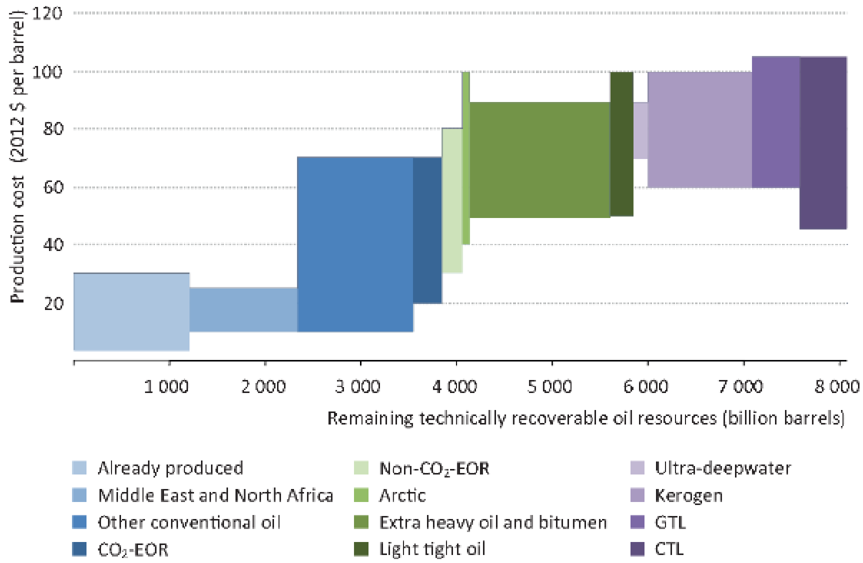
Unconventional crude oil (tight oil, oil sands, deep-water, and natural-gas liquids) accounted for over two-thirds of world production increases in 2013, which is typically more expensive than conventional crude, requiring more capital expenditure (Capex).[15] For the industry overall, exploration and production (E&P) Capex per barrel of oil has been rising nearly 11% Compound Annual Growth Rate (CAGR) per year during the period 1999-2013, or roughly 10x faster than in

[13] Jeff Rubin, "We have run out of oil we can afford to burn," *Globe and Mail*, October 6, 2010.
[14] Based on an index of various energy prices (oil, coal, gas, and uranium), as described in Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Sigurd Mareels, Scott Nyquist, and Sunil Sanghvi, *Resource Revolution: Tracking global commodity markets*, Trends Survey 2013, McKinsey Global Institute (September 2013).
[15] International Energy Agency, *World Energy Outlook 2013* (Paris: OECD/IEA, 2013).

the period from 1985 to 1999.[16] The marginal cost of oil production has increased by 250% over just ten years, from just under $30 a barrel in 2002 to $104.5 a barrel in 2012.[17]

Figure 5 shows the supply cost curve of liquid fuels, as estimated by the International Energy Agency (IEA) in 2013. As the cost of energy production rises, the potential to capitalize on resource efficiencies will grow as well.

Figure 5: Supply Costs of Liquid Fuels



Note: Figures in the chart above differ from those displayed in our main document because the figure above is displaying "remaining technically recoverable resources", whereas we focus on Estimated Ultimate Recovery (EUR). For more discussion see Appendix C in our *Carbon Supply Cost Curves* study.

Source: Resources to Reserves (IEA, 2013).

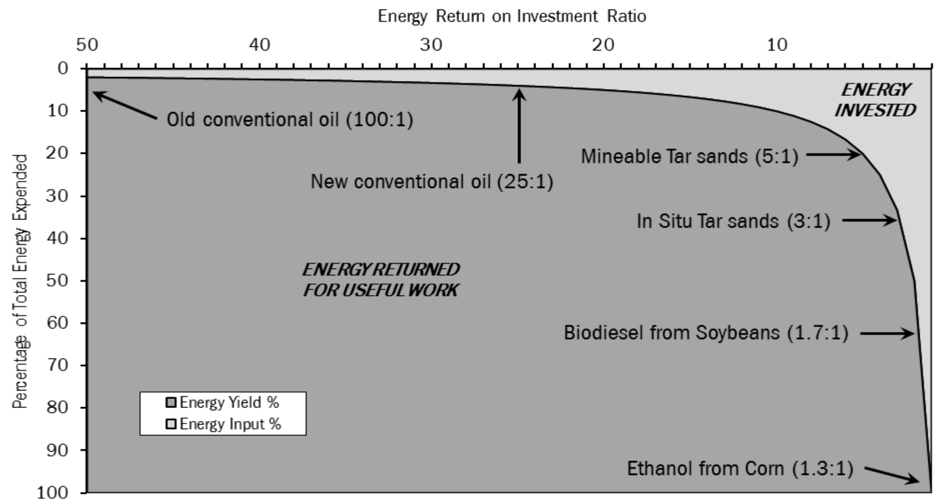
Reproduced from "From Capex Growth to Capital Discipline? Cost, Risk, and Return Trends in the Upstream Oil Industry," Carbon Tracker Initiative (May 2014), based on IEA's *World Energy Outlook 2013*.

Another important metric for production cost relative to gain that illustrates the increasing economic scarcity of many resources is Energy Return on Energy Invested (EROEI). As increasingly energy intensive extraction methods are employed by drillers, energy companies face a declining EROEI. Figure 6 shows the decline along in EROEI by different types of fuel, with ratios that show units of energy consumed through the extraction process to unit of energy returned.

[16] IEA and Barclays Research data. As cited in Steven Kopits, "Oil and economic growth: a supply-constrained view," presentation to Columbia University Center on Global Energy Policy, February 11, 2014, 43, http://tinyurl.com/mhkju2k.

[17] Estimate by Sanford C. Bernstein. As described in Richard Dobbs, Jeremy Oppenheim, Fraser Thompson, Sigurd Mareels, Scott Nyquist, and Sunil Sanghvi, *Resource Revolution: Tracking global commodity markets*, Trends Survey 2013, McKinsey Global Institute (September 2013).

Figure 6: The Net Energy Cliff



Source: Richard Heinberg, *Snake Oil,* adapted from J. David Hughes, "Drill, Baby, Drill: Can unconventional fuels usher in a new era of energy abundance?" Post Carbon Institute, February 2013, Figure 38.

Conventional oil fields discovered before World War I are believed to have returned 100 units of energy for every unit consumed in their extraction. Since that time EREOI has been dropping: in 2013, it was 15:1 and it is forecast to decline to 10:1 by 2020.[18] Declining productivity of energy extraction means that the energy infrastructure capacity, and therefore spending on energy, must increase at a faster rate. To the extent that environmental products (like renewable energy) can replace this increasing energy investment, opportunity exists for successful investment in the energy sector.

The U.S. power sector has also evolved to create more space for renewable generation as traditional fuel sources like coal, natural gas, and nuclear have experienced change in recent years. In 2013, two-thirds of U.S. electricity was generated from fossil fuel (coal, natural gas, and oil), with over one-third from coal alone.[19] Natural gas prices, particularly for electricity generation, have fallen in the U.S. in recent years due to abundant domestic resources and the application of improved production technologies.[20] By 2035, natural gas will take over from coal as the largest electricity generation source, according to the U.S. Energy Information Administration (EIA).[21] Coal plant retirements also play a role in this shift, as coal prices have increased over the past decade and environmental concerns from associated carbon emissions and other pollutants have become legislation (*e.g.*, mercury emissions regulation).[22]

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[18] Tim Morgan, *Life After Growth: How the global economy really works - and why 200 years of growth are over* (United Kingdom: Harriman House, 2013).

[19] U.S. Energy Information Administration, "What is U.S. electricity generation by energy source?" Frequently Asked Questions, http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3. Accessed October 2014.

[20] The lack of substantial U.S. natural gas exports has also contributed to lower prices in the U.S. market.

[21] U.S. Energy Information Administration, "Market Trends: Electricity demand," *Annual Energy Outlook 2014,* May 7, 2014, http://www.eia.gov/forecasts/aeo/MT_electric.cfm; U.S. Energy Information Administration, "Natural Gas Prices," Release Date: September 30, 2014, http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm.

[22] U.S. Energy Information Administration, "Market Trends: Electricity demand," *Annual Energy Outlook 2014,* May 7, 2014, http://www.eia.gov/forecasts/aeo/MT_electric.cfm; and U.S. Energy Information Administration, "Coal Data Browser," http://www.eia.gov/beta/coal/data/browser/. Accessed October 2014.

Oil prices tend to be cyclical, highly responsive to changes in broader economic conditions and economic activity. For example, research has demonstrated that all but one post-World War II recessions were preceded by a spike in oil prices, and every oil market disruption was followed by an economic downturn.[23] Oil price shocks explain a 3% cumulative reduction in U.S. real gross domestic product (GDP) in the late 1970s and early 1980s, and a 5% reduction in U.S. real GDP during the recent financial crisis.[24]

The intuition is relatively straightforward: when economic growth slows or becomes more uncertain, oil demand tends to slow as well, thus weakening prices and deterring investment into expanding oil supply. Oil prices fell sharply in 2008 in the midst of the Great Recession, as economic growth and oil demand slowed significantly, before recovering in 2009-2010 along with broader economic improvement.[25] Lower oil prices tend to facilitate economic growth by lowering energy and other input costs for many industries, which over time strengthens demand for oil as broader economic conditions improve. To the extent that investment in oil infrastructure decreases such that supply tightens in the face of rising demand, prices rise and additional investment into oil production is encouraged. Higher oil prices, however, tend to have a dampening effect on economic output, slowing growth and beginning the cycle all over again. (On the other hand, demand for oil is relatively inelastic with respect to price—meaning that even large changes in oil price do not lead to large changes in demand for oil.[26])

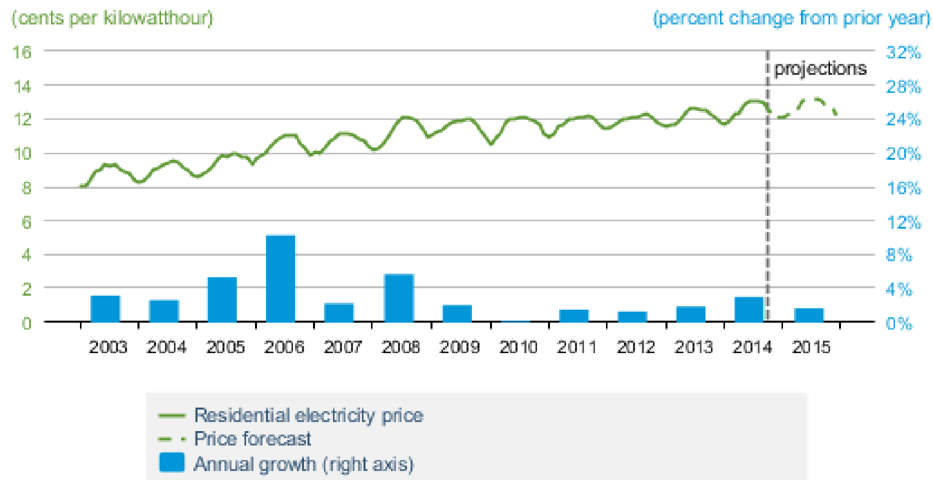
In contrast to the positive correlations to volatile oil prices observed in other resource commodities, natural gas prices in the United States have declined and remained relatively low, reflecting expanded production in the U.S. market. But lower prices from abundant gas supply within the U.S. market have not translated into large gains for American consumers.

Take electricity, for example, an increasing proportion of which is generated from low-cost natural gas. In contrast to spot prices, electricity retail prices have held steady—or even increased for many areas in the United States—due to the cost of transmission and distribution of electricity, which makes up roughly 40% of the retail price (on average, across residential, industrial, and commercial consumers).[27] Indeed, less than half the delivered cost of natural gas is supply cost when taxes are added to the cost of transmission and distribution. These costs have largely offset recent declines in generation costs (for example, natural gas-generation), particularly as investment by utilities into transmission and distribution infrastructure has risen.[28] New electricity transmission investment increased five-fold from 1997-2012.[29] Electricity retail prices have largely remained steadily high in most geographic markets since at least 2010 (see Figure 7). To the extent that transmission and distribution components of retail electricity prices have increased

[23] With one exception: the recession of 1960. See James Hamilton, "Historical Oil Shocks," in *Routledge Handbook of Major Events in Economic History*, edited by Randall E. Parker and Robert Whaples (New York: Routledge Taylor and Francis Group, 2013), 239-265.
[24] Lutz Kilian and Robert J. Vigfusson, "The Role of Oil Price Shocks in Causing U.S. Recessions," *International Finance Discussion Papers* no. 1114, Board of Governors of the Federal Reserve System, August 2014.
[25] Jean-Marc Fournier, Isabell Koske, Isabelle Wanner and Vera Zipperer, "The Price Of Oil – Will It Start Rising Again?" *ECO/WKP (2013)23,* OECD Economics Department, March 2013.
[26] James Hamilton, "Understanding Crude Oil Prices," *NBER Working Paper* No. 14492, National Bureau of Economic Research, 2008.
[27] For 2011, 41% and for 2012, 42% (in 2012 dollars). U.S. Energy Information Administration, "Electricity Supply, Disposition, Prices, and Emissions," *Annual Energy Outlook 2014,* May 7, 2014.
[28] U.S. Energy Information Administration, "Investment in electricity transmission infrastructure shows steady increase," August 26, 2014, http://www.eia.gov/todayinenergy/detail.cfm?id=17711.
[29] U.S. Energy Information Administration, "Investment in electricity transmission infrastructure shows steady increase," August 26, 2014, http://www.eia.gov/todayinenergy/detail.cfm?id=17711.

or held steady (in real terms), utilities have been reluctant to commit additional capital to infrastructure improvements in the near term.

Figure 7: U.S. Residential Electricity Price



Reproduced from the U.S. Energy Information Administration, *Short-Term Energy Outlook*, October 2014.

Moreover, natural gas prices are not expected to remain long in decline in the United States, according to recent projections from the EIA. As producers move into areas where natural gas is more difficult and expensive to extract, prices are forecast to increase by an average of 3.7% annually to 2040.[30] Export opportunities could also create upward pressure on domestic natural gas prices, as companies seek higher price opportunities elsewhere in the world. Moreover, U.S. demand growth from the electric power and industrial sectors is expected to remain strong, particularly in the 2015 to 2018 period.[31] Oil and natural gas prices are also expected to be strengthened by declining tight oil production in the U.S. after 2021.[32] The era of strong and volatile commodities prices—notably, energy commodities—is just beginning.

B. Changing Corporate Considerations

Commodity price increases are beginning to spur change in corporate decision-making. Upwards price trends are posing challenges for many corporations, from increasing costs of raw materials and natural resources, to supply chain concerns and interruptions, to brand value (assuming affordability, consumers are increasingly more likely to purchase products from companies whose values align with their own).[33] For the majority of their development, corporations in the U.S.

[30] U.S. Energy Information Administration, "Market Trends: Natural gas," *Annual Energy Outlook 2014*, May 7, 2014, http://www.eia.gov/forecasts/aeo/MT_naturalgas.cfm#natgas_prices.
[31] U.S. Energy Information Administration, "Market Trends: Natural gas," *Annual Energy Outlook 2014*, May 7, 2014, http://www.eia.gov/forecasts/aeo/MT_naturalgas.cfm#natgas_prices.
[32] U.S. Energy Information Administration, "Executive Summary," *Annual Energy Outlook 2014*, May 7, 2014, http://www.eia.gov/forecasts/aeo/executive_summary.cfm.
[33] In June 2014, BBMG and GlobeScan released *The 2014 Aspirational Consumer Index*. According to the study, "Aspirational consumers represent more than one-third of consumers globally (38%) and are defined by their love of shopping (93%), desire for responsible consumption (95%) and their trust in brands to act in the best interest of society (50%)."

have relied on hydrocarbon energy resources, which have been subject to rising and volatile prices, dependent on increasingly uneconomic sources, and reliant on inefficient or aging resource infrastructure. Corporations today are increasingly rethinking their resource strategy, as the old assumptions are increasingly in question, particularly when viewed against longer-term trends of growing resource scarcity and resource repricing and substitution.

In particular, many corporations are increasingly recognizing that sustainability efforts can be essential drivers of competitive advantage. Notably, the combination of cost reduction opportunities and supply chain or sourcing process revision is leading to higher levels of corporate investment in resource efficiency. Consumer pressure has also driven many corporations to implement more environmentally appropriate practices, from increasing energy efficiency in retail stores to using non-toxic dyes for textile manufacturing.[34] Consumer preferences reflect growing environmental considerations. In 2014, Pew Research Center reported that 54 percent of registered voters indicate that the environment is "very important".[35] A 2013 report looking at social impact in the communications industry found that 88% of Americans "would buy a product with a social or environmental benefit if given the opportunity" and over half reported having done that in the last year, compared to 41 percent in 2010 and 20 percent in 1993.[36] A McKinsey study found that roughly 80% of consumers are aware of energy efficiency, its benefits, and energy efficient-options, and that, after price, energy efficiency is the most important characteristic when considering an appliance or a home-improvement project.[37] The expansion of the energy-efficient heating, ventilation, and air conditioning (HVAC) sector, for example, reflects this growing appetite for energy efficiency improvements, and it is projected to grow to $33.2 billion by 2020.[38]

Such efforts and preferences fit into a broader trend of increasing emphasis on corporate social responsibility (CSR). These changes across multiple companies are leading, in turn, to increased capital productivity, competitive and standardized best practice, competitiveness in the global marketplace, and economic growth that coincides with social and environmental co-benefits. The Corporate Social Responsibility Newswire predicts that key trends in corporate activity will include the search for alternative materials (*e.g.*, textiles and packaging), as well as climate resiliency plans around issues such as water scarcity, extreme weather events, raw materials reliability, and sustainability. Another network, Business for Social Responsibility (BSR) in partnership with GlobeScan, reported in 2013 that, while attention was given predominantly to supply chain and workers' rights in recent years, practitioners believed that the most significant developments in sustainable business going forward would be around environmental issues (including climate change and water management).[39]

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[34] For example, Macy's has embarked on converting their retail store lighting to LEDs, which has enabled them to cut lighting energy consumption by up to 73%, reduce the amount of energy needed for air conditioning (since the lights produce significantly less heat than traditional lights), and improve sales from improved lighting environments—all the while also allowing Macy's to tout itself as an environmentally conscious store.

[35] Pew Research Center for People and the Press, "Wide Partisan Differences Over the Issues That Matter in 2014," Pew Research Center, September 12, 2014, http://www.people-press.org/2014/09/12/wide-partisan-differences-over-the-issues-that-matter-in-2014/.

[36] Cone Communications, *2013 Cone Communications Social Impact Study: Next Cause Evolution* (2013), http://www.conecomm.com/stuff/contentmgr/files/0/e3d2eec1e15e858867a5c2b1a22c4cfb/files/2013_cone_comm_social_impact_study.pdf.

[37] David Frankel and Humayun Tai, "Giving US energy efficiency a jolt," McKinsey & Company, December 2013.

[38] Navigant Research, *Energy Efficient HVAC Systems*, June 2013.

[39] BSR and GlobeScan, State of Sustainable Business Survey, October 2013.

Increasing focus on environmental, social, and governance (ESG) factors within the investment community also illustrates these changing corporate considerations. The UN Environment Programme published a series of reports in 2005, which connected ESG factors to investors' fiduciary duty and put ESG onto the mainstream investment consciousness.[40] The rising level of awareness since has been aided by the sustained attention of several organizations, which have developed some guidelines for best practices. Launched in 2006, the UN-supported Principles of Responsible Investment (PRI) provides a framework for incorporating sustainability and ESG management into investment decisions and ownership practices; the Sustainability and Accounting Standards Board (SASB) is gaining traction in environmental reporting for public companies; while the Private Equity Growth Capital Council has similarly developed Guidelines for Responsible Investment that focus on environmental, health, safety, labor, governance and social considerations specifically in the context of private equity investment.[41] Private equity firms have also begun to require ESG audits of their portfolio companies, an increasing trend. Today, with over 800 asset manager signatories, PRI represents more than $45 trillion, up from $4 trillion in 2006.[42]

Corporate engagement and open communication about initiatives is growing steadily as companies and shareholders increasingly realize that ESG practices like sustainable resource management can support the bottom line. These trends suggest sustained opportunities for companies with products and services that promote resource efficiency.

C. Historic Investment in Environmental Technologies

Most technologies and business approaches for more efficient resource use are not new. In fact, many energy-related research and development (R&D) efforts were initially funded by taxpayers through U.S. government programs in the post-World War II era, which aimed to pursue energy-related R&D to support economic growth. The energy crisis of the 1970s spurred President Carter to create the Department of Energy (DOE), which centralized energy-related responsibilities of disparate parts of the Federal government. The DOE was responsible for R&D of energy technologies across all sectors, including fossil fuels, nuclear, energy storage, and electricity systems. The crisis also focused attention on energy efficiency development, and expanded the government's modest R&D efforts in renewable energy (in particular, wind, solar, biomass, geothermal, and hydro).[43]

Since then, the DOE has continued to be the main supplier of renewable energy R&D funding: from 1948 through 2012, roughly 12% of funding was directed toward renewables, compared with 10% for energy efficiency, 25% for fossil fuels, and 49% for nuclear.[44] While funding levels declined from their 1979 peak of roughly $8 billion (in 2011 dollars) to around $2 billion in the 1990s, such funding has increased slowly but steadily since—with the exception of a one-year

[40] Global Private Equity Initiative, *ESG in Private Equity: A Fast-Evolving Standard*, INSEAD Business School, May 2014.
[41] Global Private Equity Initiative, *ESG in Private Equity: A Fast-Evolving Standard*, INSEAD Business School, May 2014.
[42] Principles for Responsible Investment, PRI Fact Sheet, http://www.unpri.org/news/pri-fact-sheet/. Accessed October 2014.
[43] Fred Sissine, "Renewable Energy R&D Funding History: A Comparison with Funding for Nuclear Energy, Fossil Energy, and Energy Efficiency R&D," *Congressional Research Service*, March 7, 2012.
[44] Fred Sissine, "Renewable Energy R&D Funding History: A Comparison with Funding for Nuclear Energy, Fossil Energy, and Energy Efficiency R&D," *Congressional Research Service*, March 7, 2012.

spike to around $12 billion in 2009 from the American Recovery Act. In 2012, the DOE funding energy R&D was $3.3 billion.[45]

Figure 8: Department of Energy Funding for Energy Technology (billions of 2011$)

	Period		
Technology	**FY2003-FY2012 (10 years)**	**FY1978-FY2012 (35 years)**	**FY1948-FY2012 (65 years)**
Renewable Energy	$ 6.83	$ 20.94	$ 22.55
Energy Efficiency	6.54	18.64	18.79
Fossil Energy	10.12	32.23	48.41
Nuclear Energy	10.32	46.87	95.69
Electric Systems	6.03	8.35	8.53
Total	$39.85	$127.03	$193.97

Sources: *DOE Budget Authority History Table by Appropriation*, May 2007; *DOE Congressional Budget Requests* (several years); DOE (Pacific Northwest Laboratory), *An Analysis of Federal Incentives Used to Stimulate Energy Production*, 1980. Deflator Source: *The Budget for Fiscal Year 2013*. Historical Tables. Table 10.1. Gross Domestic Product and Deflators Used in the Historical Tables, 1940-2017.

Reproduced from Fred Sissine, "Renewable Energy R&D Funding History: A Comparison with Funding for Nuclear Energy, Fossil Energy, and Energy Efficiency R&D," *Congressional Research Service*, March 7, 2012.

Government investment in energy technologies and other R&D efforts starting in the 1970s was a significant starting point for U.S. environmental markets, forming many of the base technologies used in the successful and growing companies of today. These technologies include: initial solar power technology and PV panels; wind turbines; variable speed and electronically commutated motors; scrubbers and selective catalytic reduction for coal combustion; compressors for heating, ventilation, and air conditioning; and even improved glazing. Other government investment into basic research (often for military and defense applications) and technical research has given rise to the broader proliferation of what are now critical technologies, such as the Internet, semiconductors, microprocessors, or memory processors.[46] Many of these technologies also come into play when considering how to capitalize on resource management challenges today. In 2014, the DOE reported on its clean energy loan guarantee program, citing a surplus return and $5 billion in expected profits.[47]

The massive expenditures after the oil crises of the 1970s created many of the technologies needed to capitalize on today's energy inefficiencies, and many new technologies can be vetted against proven technologies from the 1970s and 1980s. Because the federal government via agencies like the DOE and others was willing to take the initial technology risk for many of these opportunities, there is now a market of middle- and lower-middle market environmental companies with de-risked technologies and track records of customers and revenues sufficient to support private market investments.

[45] Fred Sissine, "Renewable Energy R&D Funding History: A Comparison with Funding for Nuclear Energy, Fossil Energy, and Energy Efficiency R&D," *Congressional Research Service*, March 7, 2012.
[46] Mariana Mazzucato, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* (New York: Anthem Press, June 2013).
[47] Jonathan Silver, "Former DOE Official: Critics of the Clean Energy Loan Program Were Proved Wrong," *Greentech Media*, November 24, 2014.

D. Market Scaling in the Wake of the Cleantech Bubble

Environmental markets have reached an inflection point in their development. After an influx of venture capital and government support beginning in the mid-2000s, the cleantech bubble burst in the midst of a confluence of factors, such as insufficient investment, cheap natural gas, volatile silicon and other component prices, the global financial crisis, the rise of international competition (for example, China's solar industry), and more.[48] Some companies in the United States disappeared. However, as a consequence of these dynamics, companies in North American environmental markets are today more resilient, capitalizing on the benefits of lower manufacturing costs and other developments such as innovative financing models to thrive.

Though international competition and expanded manufacturing (particularly in China) was a death knell for some in the U.S. cleantech industry, which could not compete with the falling costs of production overseas, the low-cost development of cleantech components and products such as solar photovoltaic (PV), improved batteries, and light-emitting diodes (LEDs) have proved to be a strong driver of clean energy markets today. Massive investment in environmental technologies by some countries like China helped reduce per-unit costs without reducing overall revenue, helping scale the markets for downstream players. The U.S. residential solar industry has grown rapidly in this context (see Case Study: The Rise of Residential Solar). Since the beginning of 2011, the average price of a solar panel has declined by 60%, while LED prices have been falling, over 9% last year alone.[49] Lithium-ion battery modules (used in electric cars) have also been coming down in price: the DOE has reported that the cost of manufacturing lithium-ion batteries has dropped by 50% since 2008.[50]

Technological advances and innovation have also been major factors in this market scaling by expanding resource productivity and efficiency. In particular, it is the rate at which technology is advancing and becoming adopted, rather than the technology itself in many cases, that is disrupting markets. Companies may make use of the Internet, data, and social media platforms to create and develop asset-light businesses that have the potential to scale up quickly and commercialize.

Additionally, for many environmental markets, free—or, at a minimum, undervalued feedstock—plays a major role in market scaling as well. This is because the cost of renewable energy (like wind or solar energy) is based only on technology costs, unlike the cost of non-renewable energy sources, which is based on technology and fuel extraction, procurement, and delivery. As nonrenewable resource prices like natural gas or oil rise, and the capital costs of renewable technologies—particularly solar and wind—decrease through technological improvements and innovation, renewable generation will only become more competitive.

As a consequence of dynamics such as these, many renewable energy markets have already scaled or are reaching efficient scale, and are experiencing substantial cost declines at rates that far exceed those experienced by conventional energy sources. This has facilitated strong market

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[48] Juliet Eilperin, "Why the Clean Tech Boom Went Bust," *Wired Magazine*, Wired.com, January 20, 2012, http://www.wired.com/magazine/2012/01/ff_solyndra/.

[49] Ian Clover, "US solar power costs fall 60% in just 18 months," *PV Magazine*, September 20, 2013, http://www.pv-magazine.com/news/details/beitrag/us-solar-power-costs-fall-60-in-just-18-months_100012797/#ixzz3GzkAk7ur; and IHS Technology, "LED Lamp Retail Price Tracker," as described in "Average LED lamp price drops 9% in one year," April 3, 2014, http://optics.org/news/5/4/5.

[50] Stephen Lacey, "Four Charts That Prove the Future of Clean Energy Is Arriving," GreenTechMedia, September 18, 2013, http://www.greentechmedia.com/articles/read/four-charts-that-prove-the-future-of-clean-energy-has-arrived.

growth. To take just a few examples: in the United States alone, the number of hybrid vehicles on the road rose from 10,000 in 2000 to more than 1.4 million in 2010, and the number of LEED-certified green buildings rose from close to zero to more than 8,000 during the same time period.[51] The global solar PV market grew from $2.5 billion in 2000 to $71.2 billion in 2010, while the wind power market grew from $4 billion to over $60 billion during the same period.[52]

While renewable and clean energy markets continue to see improvements in technology and corresponding cost reductions, there are still some barriers to scaling and reaching grid parity; notably, the lack of federal policies to effectively foster sustainable market demand, private sector financing and development of the necessary infrastructure. Some renewable markets still require government support (not necessarily the United States) to drive sufficient investment and scaling to, for example, overcome the substantial incumbent scale advantages of traditional industries as well as to align consumer incentives. Feed-in tariffs in Germany and other European countries has helped fuel small-scale solar and distributed generation projects by providing longer-term certainty in policy and the regulatory environment.

This is not to say that further expansion of renewables in the United States in particular is wholly dependent on U.S. federal policy and subsidies, as many renewables are cost-competitive with standard electricity pricing without subsidy, but hurdles remain. There is massive government support already in place for fossil fuels and traditional forms of energy. Similar to scale advantages, incumbents in the U.S. hydrocarbon industries enjoy substantial government support through tax arrangements, subsidies (explicit or implicit), or other financial or legal support that inhibits not only market entry but also renewables development.

It is worth noting that fossil fuel subsidies are challenging to assess on a relative basis, based in large part because they include both explicit and implicit subsidies that are provided at multiple stages, from the production phase to the consumer end-use stage. A direct comparison of the explicit subsidies provided to hydrocarbons and renewables in the United States can, therefore, be misleading. For example, subsidies for oil companies in the U.S. tax code in the strictest sense alone reach roughly $5 billion annually, leading to a lower subsidy than renewables on a per unit basis.[53] But this figure does not include implicit subsidies to the U.S. fossil fuel industry, which are both challenging to quantify, hard to assess, and difficult to compare. These implicit subsidies include below-market royalties (particularly at a federal level), low lease rates (at a federal as well as at a state level), uncompensated environmental degradation, and more.[54] A holistic comparison of fossil fuel subsidies to renewables subsidies is an incredibly complex endeavor. However, on a global scale, fossil fuel subsidies at the consumer level reach into the hundreds of billions

[51] Andrew Shapiro, "Clean Tech Needs Scale to Succeed," GreenBiz, June 17, 2011, http://www.greenbiz.com/blog/2011/06/17/clean-tech-needs-scale-succeed.

[52] Bloomberg New Energy Finance, *Global Trends in Renewable Investment 2010: An Analysis of Trends and Issues in the Financing of Renewable Energy*, United Nations Environment Programme, 2010.

[53] Estimates for the amount of subsidies enjoyed by oil companies vary widely. This figure is a 2014 calculation of the ten-year score for tax credits to the U.S. hydrocarbon industry, from the Office of Management and Budget. As referenced in Joseph E. Aldy, "Money for Nothing: The Case for Eliminating US Fossil Fuel Subsidies," *Resources* 186 (2014), http://www.rff.org/Publications/Resources/Pages/186-Money-for-Nothing-The-Case-for-Eliminating-US-Fossil-Fuel-Subsidies.aspx.

[54] For example, in 2007 the U.S. Government Accountability Office (GAO) found, based on several studies, that the U.S. government received one of the lowest percentages of value of oil and gas produced in the world. In a 2008 analysis, GAO found that Interior had not evaluated the federal oil and gas fiscal system for over 25 years. Since 2008, the Department of the Interior has changed offshore lease terms and considered but has not changed onshore lease terms. See U.S. Government Accountability Office, "Actions Needed for Interior to Better Ensure a Fair Return," *GAO-14-50*, December 2013.

annually,[55] and it is difficult to dispute that hydrocarbon consumption is supported at levels far beyond renewables.

Some federal support for renewables development has helped address these challenges. State-level measures and policy innovations (like green banks, Renewable Portfolio Standards, or utility revenue decoupling[56]) have also played a role in helping renewable markets overcome incumbent advantages or systemic barriers, particularly in the absence of significant federal action.

Maryland for example, has experienced rapid growth in PV adoption compared to its peer states: The state's total solar PV installed capacity in 2009 was less than 6 MW, and it rose to approximately 80 MW only three years later, by the end of 2012.[57] Maryland has a RPS with a solar set-aside and a market-based Renewable Energy Credit (REC) system, which created additional value for electricity produced by renewable energy, and specifically, long-term (15 years minimum) Solar-RECs (SRECs), creating certain stability.[58] Maryland's policies aim to reduce economic barriers by lowering initial capital requirements and reduce investment risk by requiring long-term contracts. The state also provides certain stability for PV developers, with strong easement and property rights that protect them from any restrictions that would result in a significant increase in system cost or decrease in system efficiency. Maryland also offers production tax credits, equipment sales tax exemptions, property tax exemptions, and rebate programs.[59] With inclusive net-metering policies and third-party ownership of renewable energy generating assets, Maryland's solar PV market has continued to flourish, rising to 161 MW as of 2014.[60] Maryland is just one of many states with these types of facilitative policy and regulatory arrangements. Even so, contrary to widespread belief, economics rather than policy will increasingly drive the proliferation of renewable generation.[61]

The dynamics that helped burst the cleantech bubble in recent years are now powerful drivers of the development and expansion of environmental markets in North America—and around the world. Taking advantage of and harnessing these constructive developments, the U.S. environmental industry has evolved, focusing on its comparative advantages. This includes customer-facing companies that are able to take advantage of products manufactured in lower cost places like China while focusing on higher value parts of the supply chain. The low silicon prices and cheaper Chinese PV panels that previously undermined the cleantech industry in the U.S. have greatly benefited the renewable energy distributed-generation businesses.[62] The dynamics that contributed to the failures of the cleantech industry thus represent a positive opportunity for investors who are able to find the surviving and thriving companies.

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[55] See, for example, International Energy Agency, *World Energy Outlook 2014* (Paris, France: OECD, November 2014), which calculated that global fossil fuel subsidies in 2013 were $550 billion.

[56] In 2013 alone, 15 states implemented utility revenue decoupling policies for electricity. See Clean Edge, *2014 U.S. Clean Tech Leadership Index*, State & Metro, July 2014.

[57] D. Steward, E. Doris, V. Krasko, and D. Hillman, *The Effectiveness of State-Level Policies on Solar Market Development in Different State Contexts*, NREL/TP-7A40-61029, National Renewable Energy Laboratory, February 2014, pp. 14-16.

[58] D. Steward, E. Doris, V. Krasko, and D. Hillman, *The Effectiveness of State-Level Policies on Solar Market Development in Different State Contexts*, NREL/TP-7A40-61029, National Renewable Energy Laboratory, February 2014, pp. 14-16.

[59] D. Steward, E. Doris, V. Krasko, and D. Hillman, *The Effectiveness of State-Level Policies on Solar Market Development in Different State Contexts*, NREL/TP-7A40-61029, National Renewable Energy Laboratory, February 2014, pp. 14-16.

[60] Solar Energy Industries Association, "State Solar Policy: Maryland Solad," http://www.seia.org/state-solar-policy/maryland. Accessed November 2014.

[61] Bloomberg New Energy Finance, *2030 Market Outlook*, June 2014.

[62] Juliet Eilperin, "Why the Clean Tech Boom Went Bust," *Wired Magazine*, Wire.com, January 20, 2012, http://www.wired.com/magazine/2012/01/ff_solyndra/.

E. Growing Migration of Skill and Talent

A key feature of successful businesses is a cohesive and able management teams. Environmental and sustainability-focused businesses require skilled management teams and leadership that is particularly focused on creating long-term value within their business. An emphasis on corporate sustainability has been found to have beneficial effects for businesses: a 2012 NBER working paper found that "high sustainability" companies (corporations that voluntarily adopted sustainability standards) outperformed their counterparts over the longer term, in terms of stock market and accounting performance.[63]

Evidences of trends in growing business and management attention on the environmental sector and environmentally-focused companies can be seen, at least by proxy, in the developments among top business school programs. After 2008, there was a significant change in focus of many MBA programs to reflect the increasingly attractive nature of developing both sustainable business practices and sustainable businesses. The Aspen Institute Center for Business Education's initiative "Beyond Grey Pinstripes," which conducts periodic surveys of top MBA programs that are integrating the social, environmental, and economic issues into management teaching and research, has recorded 38% more required MBA coursework related to environmental issues (in addition to social and ethical issues) since 2009.[64] Additionally, 79% of schools surveyed required students to take courses focusing on business and societal issues in 2011, up from 34% in 2001.[65]

Some examples of these trends can be seen in the growing popularity of initiatives such as the Social Enterprise Initiative at Harvard Business School, the Center for Business and Society at the Tuck School of Business, and various dual-degree programs at the Yale School of Management and Stanford Graduate School of Business for MBA students interested in supplementing their management educations with specialties in resource management.

Case Study: The Rise of Residential Solar

The recent rise of residential solar offers a powerful example of how environmental macro-forces can converge to create market opportunity in quick order within the larger North American environmental opportunities industry.

Beginning in the early 2000s, commodities prices began to skyrocket and become more volatile, driven by strong emerging market demand in places like China—in fact, oil prices rose to over $140 per barrel by 2008. Against this backdrop, a cleantech bubble emerged. In the mid-2000s, Silicon Valley venture capitalists led the charge into cleantech investing, thanks to interest in mitigating climate change, post-9/11 dreams of weaning the U.S. off foreign energy sources, and the promise of capitalizing a new market opportunity in the wake of the Internet bubble. By then,

[63] Robert G. Eccles, Ioannis Ioannou, George Serafeim, "The Impact of Corporate Sustainability on Organizational Processes and Performance," *NBER Working Paper No. 17950*, National Bureau of Economic Research, March 2012.
[64] The Aspen Institute Center for Business Education, *Beyond Grey Pinstripes 2011-2012 Top 100 MBA* (September 21, 2011), www.BeyondGreyPinstripes.org.
[65] The Aspen Institute Center for Business Education, *Beyond Grey Pinstripes 2011-2012 Top 100 MBA* (September 21, 2011), www.BeyondGreyPinstripes.org.

many environmental technologies had been struggling to achieve scale, and the investors were confident that their capital would be the game changer.[66] In 2005, venture capital (VC) investment in cleantech was hundreds of millions of dollars; in 2006, it measured $1.75 billion; and by 2008, it had reached $4.1 billion in the U.S.; VC in U.S. solar alone rose from $32 million in 2004 to nearly $1.85 billion in 2008.

But the investment surge abated in short order, and VC capital decreased from $4.1 billion in 2008 to $2.5 billion in 2009 as VC firms more fully realized the technology and scaling risk associated with asset-heavy energy start-ups or unproven technologies. Additionally, though solar PV was far from an unproven technology (the U.S. government has invested in solar R&D since the 1970s), intense international competition lowered solar PV panel prices. In particular, in the years following the global financial crisis, Chinese solar industries were provided large loans at very low interest from government-owned entities and banks.[67] This support helped make Chinese products exceptionally cheap: by 2012, China accounted for over 50% of PV output, at prices up to 20% cheaper than U.S. counterparts.[68] U.S. manufacturers could not compete. As capital inflows dried up, technologies that were not commercially viable failed and many companies crashed. Driven by a number of factors such as the global financial crisis and the rapid expansion of China's solar manufacturing industry, the U.S. cleantech bubble burst.[69]

What heralded the end of the cleantech bubble proved a powerful driver of residential solar today. Chinese manufacturing commoditized solar PV and helped lower cost for all, thus scaling the market. While residential solar was non-economic ten years ago, today it compares favorably on a cost basis to retail electricity rates for a majority of the U.S. population.[70] In the U.S., PV module prices fell nearly 80% from 2008 to 2012, and balance of system (BOS) costs fell as well in 2013, continuing into 2014.[71] The U.S. residential solar industry evolved to focus on its comparative advantages in the service and customer-facing ends of the supply chain, becoming "survivors".

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[66] Juliet Eilperin, "Why the Clean Tech Boom Went Bust," *Wired Magazine*, Wired.com, January 20, 2012, http://www.wired.com/magazine/2012/01/ff_solyndra/.

[67] Keith Bradsher, "As LED Industry Evolves, China Elbows Ahead," *New York Times*, June 17, 2014.

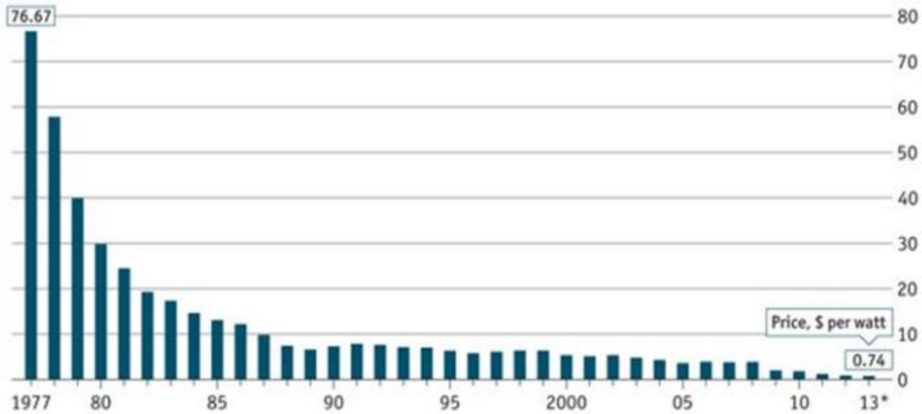
[68] Juliet Eilperin, "Why the Clean Tech Boom Went Bust," *Wired Magazine*, Wired.com, January 20, 2012, http://www.wired.com/magazine/2012/01/ff_solyndra/.

[69] Juliet Eilperin, "Why the Clean Tech Boom Went Bust," *Wired Magazine*, Wired.com, January 20, 2012, http://www.wired.com/magazine/2012/01/ff_solyndra/.

[70] Based on 2012 average retail residential electricity prices by state from the U.S. Energy Information Administration, *Annual Energy Outlook 2013* (early release); 2013 installed cost of $2.73/W (BNEF, PV Market Outlook, Q3 2012); ITC based on Fair Market Value of $5/W; capacity factor of 15%; 20-year financing with a 10% interest rate; 10% installer margin; does not include any depreciation benefit.

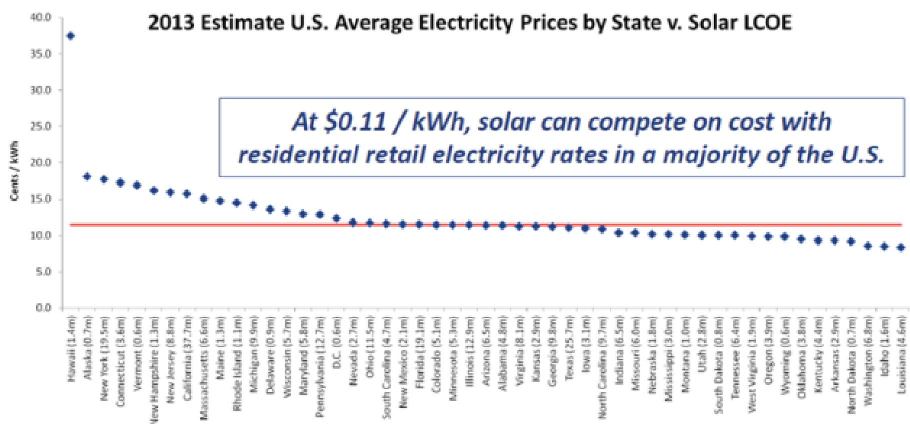
[71] Michael Liebreich, "A Year of Cracking Ice: 10 Predictions for 2014," Bloomberg New Energy Finance, January 2014. Total installed costs for residential solar systems decreased by 35% between 2010 and 2012 alone, according to Bloomberg New Energy Finance.

Figure A: Price of Crystalline Silicon Photovoltaic Cells ($ per watt)



Source: Bloomberg New Energy Finance.

Figure B: 2013 Estimated U.S. Average Electricity Prices by State versus Solar LCOE



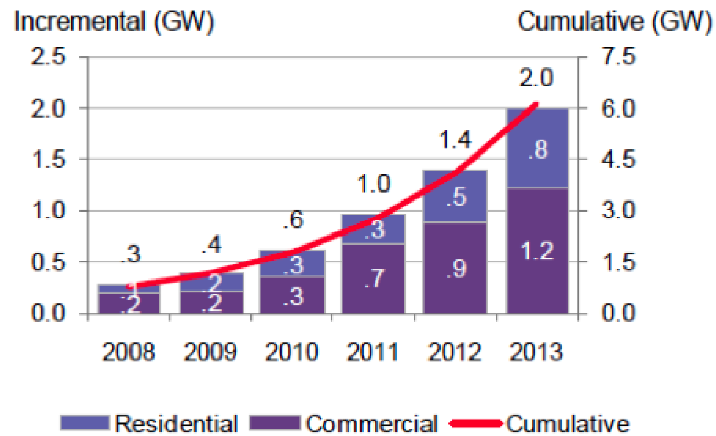
Source: NewWorld calculations. NewWorld assumptions: 15% capacity factory, 20 year financing at 10% interest, 10% developer margin, 30% Investment Tax Credit (ITC) on $5/W fair market value, no local subsidy.

Although the developments that facilitated today's solar PV market caused some investors to lose money, grid-competitive solar PV has now created a sustainable market opportunity for higher margin, customer-facing businesses and distributed-generation projects in North America. The market for residential solar PV has also changed dramatically over the past several years, from early adopters willing to pay a premium for "green" to homeowners simply wishing to reduce their electricity costs.

For many customer-facing businesses and distributed-generation projects in North America, these positive developments in residential solar are poised to continue, as high electricity prices, financing mechanisms allowing installation without up-front cost to homeowners (the third party model), high electricity prices, net metering agreements, and favorable Investment Tax Credit

(ITC) make residential and commercial solar installations financially attractive in most U.S. states.[72] In particular, financing models that help consumers overcome the first cost bias in purchasing decisions have played a major role.

Figure C: U.S. Small-scale PV by Type (2008-2012



Reproduced from Bloomberg New Energy Finance. *Sustainable Energy in America: 2014 Factbook*, February 2014.

The residential solar market segment has experienced healthy and sustained growth in recent years. New residential PV installations increased more than a third (year over year) in 2013, to roughly 770MW, which accounted for 20 percent of total U.S. PV capacity installed that year.[73] In 2014, there were more than half a million homes and businesses nationwide with a solar installation, and 53% of all new installed electric capacity was solar in the first half of the year.[74] Customer-sited PV capacity growth is expected to exceed utility-scale solar growth between 2013 and 2015 (which is projected to double over that period).[75]

Furthermore, there is room for significant further development of the solar residential market, particularly given rising electricity prices, low costs of solar PV, available financing, and increasing consumer interest. In particular, decreases in residential solar PV costs in the U.S. are expected to be further driven by efficiency gains in installation and Balance-of-System (BOS) costs rather than reduced panel costs. The future of solar in North America appears bright.

II. An Improved—and Improving—Investment Record

As the environmental opportunities sector continues its growth trajectory, and more resource efficient practices are increasingly adopted by corporations, the investment record of environmental markets has markedly improved. 2013 was an inflection year for clean energy investing in public stocks: from 2008 (the low point in the crisis) to 2013, returns were relatively

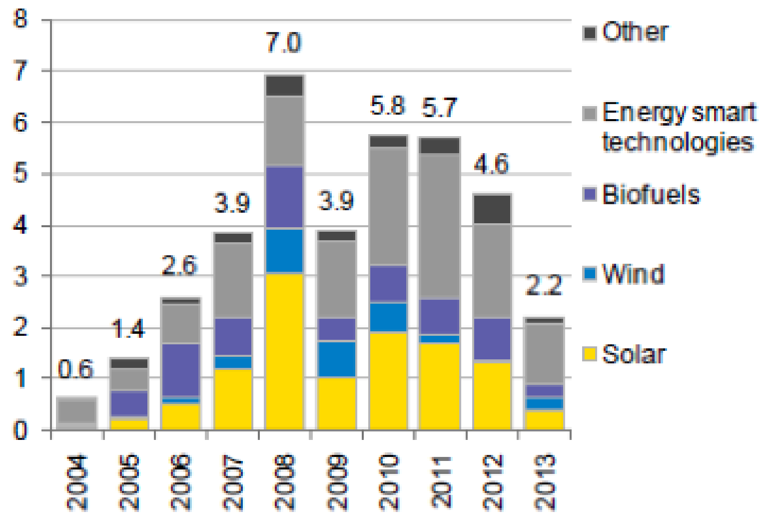
[72] In January 2017, the ITC is set to be reduced from 30 percent to 10 percent.
[73] Bloomberg New Energy Finance, *Sustainable Energy in America: 2014 Factbook*, February 2014.
[74] Solar Energy Industries Association, "Solar Energy Facts: Q2 2014," http://www.seia.org/research-resources/solar-industry-data.
[75] U.S. Energy Information Administration, "Renewables and CO2 Emissions," *Short-Term Energy and Winter Fuels Outlook*, Release Date: October 7, 2014, http://www.eia.gov/forecasts/steo/report/renew_co2.cfm.

uninspiring; however, 2013 saw shares trend sharply upwards, suggesting greater confidence in the market. According to Bloomberg New Energy Finance:

> "Investors in publicly-traded companies in this sector saw share prices appreciate in 2013… Clean energy indexes across the board saw returns well above market benchmarks. For example, the NEX, a global index of publicly-traded companies active in renewables and low-carbon energy, gained 53.9% in 2013, far outpacing gains of 29.6% for the S&P 500, 26.5% for the Dow Jones Industrial Average, and 20.3% for the MSCI World & Emerging Markets Index."[76]

In renewable energy investment overall in the year 2013, there were many constructive signs, including lower costs, renewed profitability of some leading manufacturers, unsubsidized market uptake in some countries, and more interest in renewables from public sector investors—though renewable energy dollar investments in the U.S. dipped compared to earlier years.[77] For example, PV cost reductions was a main contributor: even as dollar investment in solar decreased, the number of PV systems added (in gigawatts) went up.[78]

Figure 9: U.S. VC/PE Investment in Clean Energy by Sector, 2004-2013 ($ billions)



Reproduced from Bloomberg New Energy Finance. *Sustainable Energy in America: 2014 Factbook*, February 2014. Values nominal, not normalized.

Much ground remains to be gained by private equity. Of U.S. and Canadian investment transactions in 2007, approximately $74 billion of capital was deployed in environmental opportunities, with 66% of the capital coming from private equity funds, 5% from venture funds, and 29% from M&A. By 2013, total capital invested into the sector dropped significantly to $38 billion, and M&A grew to be approximately 92% of private clean energy transactions in the U.S.

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[76] Bloomberg New Energy Finance. *Sustainable Energy in America: 2014 Factbook*, February 2014.

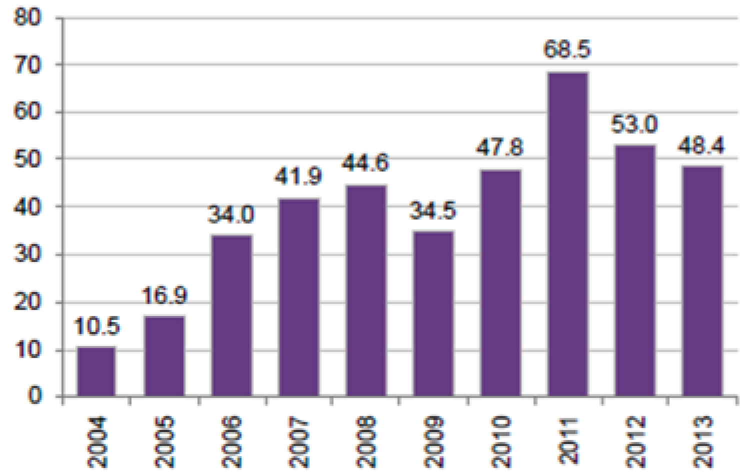
[77] Frankfurt School-UNEP Centre and Bloomberg New Energy Finance, *Global Trends in Renewable Energy Investment 2014: Key Findings* (2014), 12.

[78] Frankfurt School-UNEP Centre and Bloomberg New Energy Finance, *Global Trends in Renewable Energy Investment 2014: Key Findings* (2014), 12.

and Canada, with private equity accounting for less than 3% and venture capital accounting for over 5%.[79]

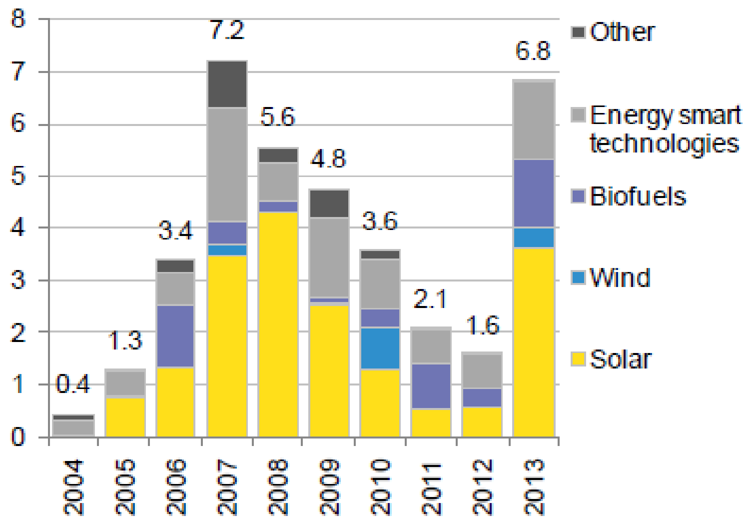
It is likely that the increased M&A activity is a result of attractive opportunities in the market where companies have proven their products and are now selling or seeking financing from strategic investors at attractive prices, in part because so little PE and VC capital was available. Strategic buyers remain active in many markets: already a consolidation in the solar industry is apparent, with SolarCity purchasing balance-of-system manufacturer, Zep Solar, in 2013 and acquiring manufacturer Silvio in 2014, and Direct Energy acquiring Astrum Solar in 2014, to cite a few examples. Rumors regarding further consolidation among installers continue to circulate.

Figure 10: Total New U.S. Investment in Clean Energy, 2004-2013 ($ billions)



Reproduced from Bloomberg New Energy Finance. *Sustainable Energy in America: 2014 Factbook*, February 2014.

Figure 11: U.S. Public Market Investment in Clean Energy by Sector, 2004-2013 ($ billions)



Reproduced from Bloomberg New Energy Finance. *Sustainable Energy in America: 2014 Factbook*, February 2014.

[79] Bloomberg New Energy Finance. *Sustainable Energy in America: 2014 Factbook*, February 2014.

III. The Six Angels of Environmental Markets

Considering the macro-forces discussed above helps contextualize and explain the already large, rapidly growing scale of the environmental industry sector, predict continued expansion of selected segments, and highlight opportunities for attractive returns to the specialized investor.

Against the backdrop of these macro-forces, the "Six Angels" of environmental markets represent particularly attractive aspects of the market, further supporting the case for investment. In particular, the Six Angels advantage the specialist investor who can leverage deep sector knowledge and management expertise to build a portfolio of companies that capitalize on resource inefficiencies in the broader market. Building on the Six Angels, private investors should be able to profitably deploy capital to provide superior economic returns as these companies gain from the tailwind benefits of market growth and concurrently provide societal co-benefits without having to trade-off against economic returns.

A. Already a Large, Developed Market

Environmental opportunities already constitute a large domestic market sector, representing approximately $382 billion in annual turnover in the U.S. market (2014 estimate). The overall market is growing rapidly, with some segments and sub-segments growing at much more rapid rates, as U.S. total annual energy consumption continues to decline (5% in 2013 from 2007 levels), thanks in part to advances in energy efficiency while the U.S. economy grew 6% over the same time period.[80] At the same time, renewables' role in the U.S. power sector continues to expand, with roughly 13% of electricity generation coming from renewables in 2013, up from 8% in 2007.[81]

Estimates from the EIA in 2014 show the average annual rate of U.S. energy consumption growing only 0.4% annually to 2040, down from a growth rate of 1.8% in 2005.[82] Also in 2014, the EIA projected that by 2040 energy use per capita will decline to 279 million Btu—a level not seen since 1965.[83] This reduction is anticipated to result directly from energy efficiency applications in end-use markets, federal and state policies (*e.g.,* U.S. standards for a range of consumer appliances that will lead to over 80 TWh of annual electricity savings by 2020[84], CAFÉ standards for vehicle fuel efficiency), and other likely technology advances.

[80] Energy consumption increased in 2013 by 1.4% after declining by 6.3% from 2007 to 2012. Bloomberg New Energy Finance. *Sustainable Energy in America: 2014 Factbook,* February 2014.
[81] Bloomberg New Energy Finance. *Sustainable Energy in America: 2014 Factbook,* February 2014.
[82] U.S. Energy Information Administration, "Market Trends: U.S. energy demand," *Annual Energy Outlook 2014,* May 7, 2014, http://www.eia.gov/forecasts/aeo/MT_energydemand.cfm.
[83] U.S. Energy Information Administration, "Market Trends: U.S. energy demand," *Annual Energy Outlook 2014,* May 7, 2014, http://www.eia.gov/forecasts/aeo/MT_energydemand.cfm.
[84] International Energy Agency, *Energy Efficiency Market Report 2013* (Paris, OECD/IEA, 2013).

Figure 12: Estimated Size and Growth Rates of Environmental Opportunities Segments and Selected Sub-segments

Industry Segment	**U.S. Industry Revenues ($billions) (2013E)**	**Annual Growth Forecast (2013E-2015E)**
Energy efficiency (a)—*e.g.,*	**62**	**7% - 9%**
• *High efficiency HVAC for data centers*	*–*	*13%*
• *Energy Recovery Ventilation (ERV)*	*0.9*	*15%*
• *CCHP distributed energy*	*–*	*–*
• *Green building materials*	*51.8*	*12%*
• *LED lighting*	*19.9*	*40%*
• *Demand Side Management*	*–*	*–*
Clean energy (b)—*e.g.,*	**89**	**12% – 14%**
• *Solar installations*	*13.7*	*26%*
• *Innovative project finance business models*	*–*	*–*
• *Roof-mounted solar innovations (Balance of System)*	*–*	*–*
Water Resources and Reclamation (c)—*e.g.,*	**59**	**3%-4%**
• *Wastewater network rehabilitation*	*5.5*	*15%*
• *Precision agriculture systems*	*–*	*–*
• *Water processing membranes*	*0.4*	*25%*
• *Water desalination*	*1.2*	*59%*
Waste-to-Value (d)—*e.g.,*	**88**	**3%-4%**
• *Waste-to-energy*	*9.8*	*11%*
• *Waste-to-materials*	*–*	*–*
• *Waste-to-fertilizer*	*–*	*–*
• *Waste stream management*	*–*	*–*
Environmental Services (e)—*e.g.,*	**61**	**3%-4%**
• *ESCOs*	*4.9*	*8%*
• *Environmental sensors and monitoring services*	*12.8*	*6%-7%*
• *Environmental remediation services*	*–*	*–*
• *Environmental consulting services*	*–*	*–*

Sources: Visiongain, Bloomberg New Energy Finance, WinterGreen Research, NewWorld calculations.

B. Continuing Rapid Market Growth

The environmental sector market in the U.S. is forecast to expand from $382 billion in 2014 to an estimated $580 billion by 2020. Recent estimates from the U.S. EIA in 2014 affirm fossil fuel's receding role in U.S. energy, suggesting strong progress in energy efficiency and the transition to clean energy.[85] In the near term, many growth forecasts predict that high-growth segments (at least 2x to 4x normalized GDP, with selected sub-segments growing much faster) will continue until at least 2020, advantaging many environmental opportunity firms by creating strong tail-wind market growth benefits.

[85] U.S. Energy Information Administration, "Market Trends: U.S. Energy Demand," *Annual Energy Outlook 2014*, May 7, 2014, http://www.eia.gov/forecasts/aeo/MT_energydemand.cfm.

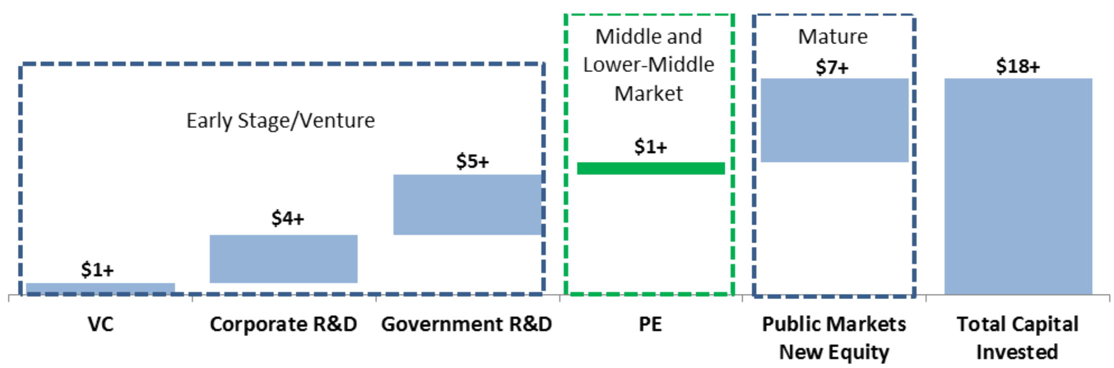
While many environmental segments are growing at multiples of normalized GDP, some market sub-segments are growing significantly faster. For example, solar installations are estimated to have grown at 26% in 2014 (10x real GDP).[86] Bloomberg New Energy Finance reports that overall investment in solar grew 100-fold from $0.8 billion in 2000 to $79 billion 2010. In part, this growth can be explained by the dramatic reduction in photovoltaic (PV) costs in combination with financing instruments that overcome end user's "first cost" bias. Other incentives, including tax incentives and feed-in tariffs, have also made solar installations attractive investment opportunities, as they help ensure a market premium.

C. An Undercapitalized Market

The middle and lower-middle environmental business market has been chronically undercapitalized, allowing invested equity to command a significant premium. In the environmental market segments of interest, there are many middle- and lower-middle market "attacker" companies that are offering innovative competitive products and services aimed at the energy and environmental markets developing in the U.S. and elsewhere. Many of these companies are in particular need of capital and management assistance to fuel their development and help them become a significant presence in their target markets.

Figure 13 illustrates the financing bottleneck in the middle and lower-middle market. Early stage financing was more than $10 billion in 2013, and financing for mature companies was more than $7 billion, but financing for the transitional growth stage in between was lacking, with only $1 billion in PE funding available for that market level and very little available debt. For true middle and lower-middle market companies, $1 billion is nowhere near a sufficient amount of capital to support growth. This undercapitalization should result in premium returns for investors who move to fill the gap.

Figure 13: Clean Energy Investment Types and Flows in the United States, 2013 ($ billions)



Source: Bloomberg New Energy Finance and the Business Council for Sustainable Energy

The private middle and lower-middle markets offer an attractive opportunity relative to public markets. While there may be some undervalued opportunities in public markets, many publicly-listed companies have already experienced their peak growth, and high value companies should

[86] "New Report: U.S. Solar Market Grows 41%, Has Record Year in 2013," Solar Energy Industries Association, March 4, 2014, http://www.seia.org/news/new-report-us-solar-market-grows-41-has-record-year-2013.

show relatively stable growth over the next few horizons. Additionally, younger companies often seek and benefit most from private capital that is "more than just money." These companies may be crossing or preparing to cross the commercialization gap, struggling to find investors willing to support their growth. Their track records may not be sufficiently long for bank debt and their capital needs may not be large enough to attract large private equity firms,[87] but they may need more capital to scale than traditional venture capitalists will likely provide. Thus, a significant opportunity exists for mid-scale private equity firms to capitalize on this gap in the market.

Relative to venture capital, private equity firms typically make larger investments. Venture capital markets in general deploy significantly less capital per opportunity because younger, venture-stage companies typically do not require substantial amounts of capital to grow. In 2013, the average private equity deal was $97.9 million while the average venture capital deal was just $7.9 million.[88] Further, venture capital is less likely to mitigate the risks of environmental markets, as evidenced by the cleantech venture bubble of the mid- to late-2000s.[89] Returns are proportionally discounted in the VC market as opposed to the premium that can be commanded by investing in middle and lower-middle market companies where there is significant undercapitalization.

Overall, the environmental opportunities sector is seriously undercapitalized. In particular, middle- and lower-middle market companies are often underfunded, clearly more so than other segments of the market. For that reason, there are highly attractive companies seeking investment at reasonable valuations and offering risk-mitigated, upside opportunities to investors with expertise in the space.

D. Innovation Everywhere

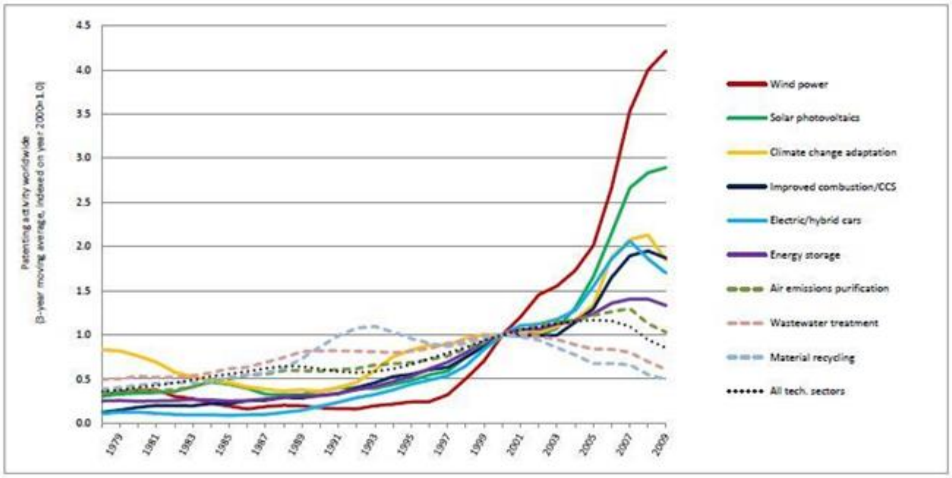
High rates of business and technology innovation in a market lead to less competitive intensity and more growth opportunities, thus allowing businesses to grow with less margin pressure. The late 1990s and early 2000s saw a surge in innovation in environmental markets specifically, as measured by relative global patenting. This trend has continued to the present, with clean energy patents reaching an all-time high in 2013.[90]

Younger, smaller companies act as the growth engine of the U.S. economy. According to a 2012 McKinsey study, they "account for almost two-thirds of all net new job creation" and "contribute disproportionately to innovation, generating 13 times as many patents per employee as large companies do."[91] A study published by MIT's *Review of Economics and Statistics* in 2013

[87] Note that an increasing portion of overall invested capital is going toward larger, mega-funds as pensions and other large institutional investors seek to pare down the number of GP relationships and consolidate into top performers. This macro-economic trend at the fund investor level trickles down to limit the capacity of such mega-funds to make middle- and lower-middle market investments (of $5 to $40mm) into rapidly growing smaller companies, thus improving the relative position of specialized middle market funds. For more detail on this trend, please refer to NewWorld's essay "The Pleasures and Perils of Private Company Investing" in the series *On Matters That Matter*.
[88] Preqin private equity research.
[89] See more recently, for example, "Google Buys Smart Home Startup Nest Labs for $3.2bn," Environmental Leader, January 14, 2014. http://www.environmentalleader.com/2014/01/14/google-buys-smart-home-startup-nest-labs-for-3-2b.
[90] Clean Energy Patent Growth Index, *2013 Year in Review*, April 23, 2014, http://www.cepgi.com/2014/04/clean-energy-patent-growth-index-2012-year-in-review.html.
[91] John Horn and Darren Pleasance, "Restarting the U.S. small-business growth engine," McKinsey & Company, November 2012, http://www.mckinsey.com/insights/growth/restarting_the_us_small-business_growth_engine.

highlighted the critical role that start-ups and young companies play in U.S. employment growth dynamics, finding also that growth is more rapid for younger firms.[92]

Figure 14: Global Patenting Activity in Environmental Markets



Reproduced from OECD Project on Environmental Policy and Technological Innovation, based on data extracted from the EPO Worldwide Patent Statistical Database (PATSTAT)

Moreover, companies moving across the Commercialization Gap in the middle and lower-middle markets have the benefit of providing innovation and job creation while also developing a track record of sales and often EBITDA. Investors can see if the new technology or innovation actually works and can invest based on the market validation as seen in a company's sales record, customer diversity and presence of repeat purchase customers. This is essential for mitigating technology risk and demonstrating profitability of innovative businesses and technologies.

E. Diversity as a Benefit

Companies in the environmental opportunities sector frequently benefit from diversification across a range of end-markets, allowing investors to build a diversified portfolio less prone to market cyclicality. Cyclicality is tempered because many environmental products and services sell into highly diversified end markets. A portfolio of assets across targeted segments in environmental markets, ideally with different value factors driving growth and diverse risk and cyclicality factors, can offer a way to mitigate cyclicality. This is because such a portfolio is built around less-correlated markets so that the value of the portfolio of assets does not move much with particular sub-segment, general economic, or public market trends. In addition, many of these environmental markets are growing rapidly, with strong factors driving growth, which further tends to blunt the effects of cyclicality.

Investing in environmental opportunities not highly dependent or correlated to hydrocarbon pricing also helps mitigate the risk of company cyclicality during periods of hydrocarbon price shocks like the one in fall 2014. In general, commodities markets (including hydrocarbon-based businesses) are more cyclical, heavily influenced by the macro environment, business cycles, and political

[92] John Haltiwanger, Ron S. Jarmin, and Javier Miranda, "Who Creates Jobs? Small Versus Large Versus Young," *Review of Economic and Statistics* 95, No. 2 (May 2013), 347-361.

decision-making. Prices of raw materials tend to move quickly with the health of the overall economy.

It is widely understood that a commodities super-cycle has been underway for a number of years, as supply and underinvestment were outpaced by demand (largely driven by emerging markets such as China) and increased prices. From the late-1990s until the Great Recession beginning in 2008, most commodities experienced annual real price growth in the double-digits: oil rose 1,062%, copper rose 487% and corn rose 240%, as examples.[93]

Hydrocarbon commodities (in particular, oil) also play a role in the macro environment; for example, oil price volatility has likely had some stagflationary effects on the macro economy.[94] Many segments of U.S. economy remain reliant on commodities; in particular, hydrocarbon energy commodities are obviously susceptible to hydrocarbon price shocks. Commodities-intensive industries, therefore, bear a certain amount of risk whereas some environmental opportunities markets should be viewed as less cyclical. Water businesses, for example, are less cyclical as there are no substitutes for water.[95] Companies whose products and services are applicable across multiple industry segments with different cyclicality dynamics or that can enter new less-cyclical market verticals may diversify revenue streams and increase their ability to ride out general economic slowdowns.

F. The Advantage of Complexity

Environmental markets are complex relative to many industries, as they involve science, technology, public policy, public interest, established power networks, emerging markets (underdeveloped, not foreign, market segments) and business strategy. Such complexities can lead to very attractive opportunities if the market dynamics are well understood, thus advantaging the specialist investor over the generalist investor. In addition, such markets are typically growing rapidly and changing, further advantaging the close-in investor.

Mid-sized and smaller investment firms with a specialization in environmental markets and strong strategic leadership have a material advantage over larger firms with more generalized investment strategies. Relative to generalist firms, specialized private equity firms have been found to have certain competitive advantages based on "a deeper knowledge of the competitive environment of acquired companies… and can, therefore, both select potentially superior performers and also provide more effective monitoring and advice…"[96]

A specialized firm should be comprised of a team that is deeply knowledgeable about the various driving forces, value drivers and risk factors shaping its target markets. Firms with specialized knowledge can better evaluate the validity of the technology that goes into complex products, and they can better interpret subsidies, regulations and practical implications of written laws and environmental agencies. In a complex market, such expertise is essential for maximizing investor

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[93] Nicholas J. Johnson and Greg E. Sharenow, "Is the Commodity Supercycle Dead?" PIMOC Viewpoints, September 2013, http://www.pimco.com/en/insights/pages/is-the-commodity-supercycle-dead.aspx.

[94] For an evaluation of the role of oil price volatility in contributing to stagflation, specifically in the 1970s, please see Lutz Kilian, "Oil Price Shocks, Monetary Policy, and Stagflation," in Renée Fry and Callum Jones & Christopher Kent (ed.), *Inflation in an Era of Relative Price Shocks*, Reserve Bank of Australia (2010), 60-84.

[95] Tina Byles Williams, Roger Keyon, and J. Womack, "Enhancing Alpha by Investing in Environmental Markets: Perspectives on Portfolio Allocation," FIS Group, Inc., June 2008,

[96] Robert Cressy, Federico Munari, and Alessandro Malipiero, "Playing to their strengths? Evidence that specialization in the Private Equity industry confers competitive advantage," *Journal of Corporate Finance* 13, no. 4 (September 2007), 647-669.

returns while minimizing downside risk. Non-specialized teams usually suffer from a lack of experience and knowledge gaps, which a complex market punishes.

The highly complex market favors theme investors and strategy-driven funds with a strong base strategy and no style drift. This makes investors more disciplined and protects them against common pitfalls. Strong and consistent strategy also allows a specialist firm to focus on the types of companies that truly fit its investment criteria and, thus, can further hone the firm's strategy and expertise through time.

IV. The Six Devils of Risk

While environmental markets offer substantial opportunities for investors to capitalize on macro-trends as well as the "Six Angels," there are also significant challenges that, if not carefully mitigated, can result in sub-par returns: the "Six Devils".

Some of these challenges correlate with the strengths of the market as well; when appropriately considered, these challenges advantage prepared investors with expertise in environmental markets. For example, market complexity is an advantage to investors who understand how to move through the "weeds" but is a challenge to non-specialized investors who are less familiar with the particular technology, regulatory environment, and competitive landscape.

A. Technology Risk

Technology risk is the most pervasive risk in environmental markets. The failures of cleantech past, from fuel cells to Solyndra, have attracted much media attention and the market is well aware of the risk of unproven technologies.

Technology risk may appear in several stages of a company's development. Notably, some disruptive environmental technologies simply will not work at the very early stages of development or may not scale cost-effectively. Investing at conceptual or pilot stages inherently assumes much of this technology risk without much downside protection. Any transition from pilot manufacturing to commercial scale manufacturing also contains technology risk because, for many environmental opportunities, manufacturing processes differ at various scales, and these changes may materially impact end-product functionality and unit delivered cost.

Many of the technologies and business approaches needed to address these challenges exist today and others will continue to be developed—and this secular industrial transformation will gather force in the years immediately ahead. This transformation will require large amounts of private capital, as government lacks the mandate and resources to provide the needed funding.

Mitigants. The initial step in understanding technology risk is to assess the underlying technology on its own merits and conduct a sound technology review by considering whether the product works according to the laws of physics and chemistry. On a scale of technology risk, investors could imagine an unexplained "black box" on one end of the spectrum, indicating great technology risk, and a services company with little product-based technology risk on the other end. Specialized knowledge is necessary for this evaluation, as most generalist investors are not trained to evaluate the technological aspects of an environmental business.

Assuming the target company passes the technology screen, technology risk can be assessed in the commercial scale context by looking for a significant revenue record. Repeat customer orders over a significant time horizon prove by proxy that the technology has been successfully demonstrated and sold in the field, thereby mitigating some of the risk. In the case of a ramp-up of product manufacturing, technology risk can be mitigated by ensuring that the ramp-up will not include any changes to the existing production mechanisms. These types of investment screens favor companies with existing manufacturing facilities or low-cost capital expansion plans, existing downstream distribution and delivery infrastructure, and proven track records of company sales and performance, and should enable specialized investors to sidestep technology risk.

B. Regulatory and Subsidy Risk

Regulatory and subsidy risk is not unique to environmental opportunities markets (fossil fuels are much more heavily subsidized than clean fuels and the subsidies are more powerfully protected), but regulations and subsidies have certainly assisted the development of the environmental industry while also deterring some investors who fear inconsistent policy development, enforcement and renewal.

Regulatory risk encompasses the risk of selling or providing services to a regulated market, the risk of unanticipated regulatory changes, and the risk of unenforced or minimally enforced policy. Inconsistencies between federal, state, and local regulations further complicate this risk. Some regulations to consider are the Clean Water Act, the Clean Air Act, CAFÉ Standards, and EPA's new greenhouse gas and pollution standards for power plants. A critical issue is regulatory enforcement, at not only the federal level but also at the individual state level.

Subsidy risk is another critical issue to consider in the environmental opportunities market space. Recent governmental support to renewable energy development include the Production Tax Credit (PTC), the ITC, and Treasury Grants (*e.g.,* 1603). Though fossil fuels are heavily subsidized, renewable energy subsidies need to be considered carefully in the context of long-term consistency or policy shifts (for example, the Wind PTC).[97]

Mitigants. Investors should avoid investing in companies that are highly reliant on government regulations or subsidies. While many companies can benefit from upside provided by government incentive programs and regulations, investors should not be entirely reliant on regulation to drive a company's growth as these regulations may not be budgeted for in a given year, may not receive the necessary legislative support for enforcement, or may simply expire. Investors should evaluate regulatory risks on a case-by-case basis and should not make investments based on anticipated policy or regulatory changes, such as an anticipated carbon tax. Investors should incorporate no improvement in current regulations or their levels of enforcement into investment cases. That said, any future regulations of carbon pricing or air/water quality would obviously advantage investments in environmental opportunities markets.

A business can take advantage of subsidies without being reliant on such subsidies. Never assume a future subsidy or increase in an existing subsidy in the base case of an investment analysis. As history is often not an indicator of future performance, historical subsidies must be evaluated on a case-by-case basis, and their long-term continuation cannot be assumed. Investors are inherently and unavoidably exposed to the downside risk of regulations and subsidies' being undermined. In

[97] Unlike other cycles of impending expiration and then extension, the wind PTC recently expired at the end of 2013 without being renewed by Congress. The uncertainly about the long-term status of the tax credit discourages investment.

the case of anticipated grants or tax credits, investors should always incorporate contingency plans and financings in case the subsidies fail to perform.

C. Hydrocarbon Pricing Risk

Hydrocarbon prices are inherently volatile, as seen in oil price movements in the fall of 2014. One factor is relatively inelastic supply, as new drilling and mining fields can take years to be developed. The increasing scarcity of easily accessible hydrocarbon sources has only exacerbated the problem, while geopolitics continue to play an important role. Oil prices have been rising since 2002, with natural gas rising in tandem until the recent shale gas boom brought natural gas prices down. Strong and sustained demand around the world has played a role in increasing prices. Substitution away from fossil fuels has also been discouraged due to subsidies that keep hydrocarbon prices artificially low without reflecting the true cost, particularly in the United States and the Middle East.

Companies may expose themselves to hydrocarbon pricing risk if any of the following apply: (i) profitability depends on beating out competitors who are tied to high hydrocarbon prices; (ii) hydrocarbons are a primary feedstock for the product, such that cost-competitiveness depends on low hydrocarbon prices; or (iii) profitability depends on low transportation or distribution costs, which are, in turn, dependent on low hydrocarbon prices. In all of these cases, sudden changes in hydrocarbon prices, as are increasingly common, may cause a target company to falter.

In theory, sustained periods of low hydrocarbon prices could compromise renewables' cost competitiveness and deter investment. However, as this essay has already noted, sustained periods of low hydrocarbon prices would also affect oil and gas production, likely stranding certain unconventional hydrocarbon projects (that require a certain price to breakeven) and restraining supply. To the extent that demand is inelastic, prices would rise to bring sufficient hydrocarbon supply back into balance with demand while also enhancing clean energy's position as a competitive substitute.

Mitigants. Many environmental opportunities are self-mitigated for hydrocarbon pricing risk because they tend to be less tied to hydrocarbons. In fact, the growth in energy efficiency and renewable energy is tied in part to business and consumer interest in reducing vulnerability to hydrocarbon price volatility. Investors should avoid companies whose value unduly depends on high hydrocarbon prices or low transportation and distribution costs, in favor of companies that are less reliant on hydrocarbon or related commodities.

In particular, it is also worth considering the U.S. power sector in the context of low hydrocarbon prices. Oil in the United States is overwhelmingly used for transportation (seven out of ten barrels is used for transportation), followed by industry (which uses another 2.5 barrels out of ten).[98] The sector that consumes more total energy than any other in the United States —electricity generation—uses only a tiny amount of oil.[99] As such, the U.S. power sector is only indirectly exposed—and affected—by oil prices, particularly now that U.S. natural gas prices are less linked to crude oil. Though developments in renewable electricity have been certainly aided by expensive crude over the last decade (which has helped the political case for investment and

[98] Jeffrey Ball, "Oil Prices Are Dropping. Will We Turn Into Gas-Guzzling, Energy Monsters Again?" *The New Republic*, October 22, 2014, http://www.newrepublic.com/article/119947/oil-prices-wont-hurt-green-gains.
[99] Jeffrey Ball, "Oil Prices Are Dropping. Will We Turn Into Gas-Guzzling, Energy Monsters Again?" *The New Republic*, October 22, 2014, http://www.newrepublic.com/article/119947/oil-prices-wont-hurt-green-gains.

production incentives), the main driver of their increasing competitiveness has been technological advancement, not high oil prices. Volatile or low oil prices are unlikely to directly affect the U.S. power sector, helping to mitigate the possibility of stranded assets in the renewable energy sector.

D. Capital Scale Risk

Capital Scale Risk is frequently found in the high "first costs" of environmental opportunities businesses and often coincides with technology risk. A company that requires financing for initial capital outlays—for example, to construct a first-of-a-kind, commercial-scale manufacturing plant—presents significantly more risk, especially because fixed assets are relatively illiquid. Companies that have already acquired and successfully used their fixed assets carry less risk for an investor, as the investor can be more confident that the company will be able to use investment dollars to increase working capital productivity.

Mitigants. Investors should generally avoid asset-intensive products or businesses (*e.g.*, developing utility-scale wind) that require substantial commitments of upfront capital or investing in maturing industry segments, rather than segments characterized by rapid growth. Asset-light strategies will support attractive rates of return without exposing undue amounts of capital to investment risk or regulatory or capital markets risk. The most attractive opportunities will typically be found upstream or downstream of capital-intensive segments (*e.g.,* distributed solar installation). Rather, invest in scalable platforms that do not require significant build-out of manufacturing lines during the timeline of an investment case, or in service-structured companies that need logistical infrastructure instead of capital-intensive physical infrastructure in order to scale.

E. Foreign Competitor Risk

Foreign competitor risk is a major challenge, especially in relation to U.S. manufacturing companies. Companies in rapidly developing countries (*e.g.,* China, India, South Korea) often benefit from significant market scale and government support, which can overwhelm smaller U.S.- or European-based manufacturers. Moreover, certain Chinese companies, for example, benefit from lower manufacturing burdens, lower costs of capital, early mover advantages, government subsidy support, a predictable and consistent policy regime, and national determination to win specific markets (*e.g.*, solar PV panel manufacturing). Foreign companies that already have scale or other advantages (such as lower cost labor) can compete more cost-effectively against newer U.S. "attacker" companies.

Mitigants. Investors should seek business opportunities not likely to be targeted by advantaged foreign competitors that may benefit from significant market scale, cost and regulatory-support advantages in sectors prioritized by their governments. Environmental businesses may be readily overtaken by advantaged international competitors if their technology may benefit from economies of massive scale in particular. The solar panel manufacturing market is a prime example. A general rule is that if a particular market is important to China and other large emerging market economics, an environmental investor should avoid it. In contrast, high-value businesses, such as customer-facing services opportunities that cannot be overtaken by international manufacturing are readily scalable, and often yield higher margins and returns.

If investors wish to focus on manufacturing companies, they may mitigate risk by looking at companies whose innovations are difficult for foreign companies to replicate. These companies are often small, nascent, or far under-the-radar-screen and may require substantial in-market knowledge, presence, or opportunity networks. Many environmental technologies that have mitigated technology risk also have sustainable differentiation and system designs that are trade secrets, which makes it easier for an international competitor to purchase the company (presumably at a premium) rather than attempt to replicate its technology. Other environmental technologies represent niche market opportunities where international competitors may not have an immediate interest but may still represent later take-out opportunities when the business has reached full scale.

F. Business Scaling/Executional Risk

Business scaling/executional risk is present predominantly in middle and lower-middle market environmental opportunities companies. Growing companies often face many challenges such as incomplete management teams, immature channels to market, uncertain customer adoption rates, or challenges of balancing investments in technology while maintaining attractive gross margins. Many recent companies do not have fully built-out management teams or the resources to scale the business necessary to minimize executional risk.

One challenge particular to environmental markets is the split-incentive structure of many end-customer purchasing decisions. Energy efficiency technologies are economically attractive to tenants, for example, who can save money on their utility bills. However, building management and those in charge of installing and financing energy efficiency measures have little incentive to cut utility costs because they pass these charges to the tenants.[100] Thus, while an energy efficiency product may offer proven technology, competent management teams, and minimal capital scaling risk, the challenges of bringing that product to the target market can be substantial.

Mitigants. The role of middle- and lower-middle market private equity is to be expert in business scaling; therefore, the expertise of the investment team often determines the amount of risk associated with scaling challenges. In contrast to technology risk, business scaling is largely controllable with proper guidance and planning, which are the responsibility of company management and active investors. Business scaling risk can be mitigated by thorough diligence on scaling challenges specific to the target company, controlling the company or having strong negative controls, insisting on a close, consultative relationship with company management, constructing a downside investment case in the event that the company gets stuck as a niche player, and identifying possible exit opportunities in case of limited business improvement success.

V. Opportunities in Environmental Business Markets

The environmental opportunities sector in North America is large and growing rapidly, propelled by macro-forces centered on rising and volatile commodity prices. The innovation, diversity, and complexity of environmental markets have resulted in a recent record of rapid growth and development.

[100] Data increasingly show that residential and commercial real estate in major cities such as New York can command premium prices and attract better quality tenants if they can claim environmental benefits (*e.g.*, energy efficiency, sustainable materials).

The private middle- and lower-middle markets in the environmental opportunities space are made even more attractive by opportunities to capitalize and help scale underfunded companies that are advantaged by sector growth trends. Both mature public company investing and early stage venture investing leave a "missing middle" opportunity for growth companies to ride the macroeconomic drivers to scale with less risk and higher returns for investors. The tendency of capital to flow into the early venture stage and late mature stage of this spectrum also contributes to the undercapitalization of high-opportunity commercialization-stage companies in the sector.

In these private middle and lower-middle markets, therefore, investors can find high value investments, support the growth of companies, and seek exits at attractive multiples. There are niche opportunities for specialized equity investors to achieve extra-normal returns by focusing on four types of opportunities: (i) less asset-intensive, more IP-based, and service plays already NPV positive; (ii) disruptive technologies where technology risk has been retired but where commercialization risk is apparent; (iii) undervalued assets with complex barriers to growth that the investor understands; and (iv) strong growth plays that are relatively capital intensive vs. what venture investors normally invest.

The following strategies in combination are essential to securing high economic returns in environmental markets:

- *Invest in market-validated companies.* The market indicates when risk is mitigated sufficiently to produce strong customer purchase decisions. Certain more fully developed companies that markets favor have, by that fact, retired many risks, usually including unproven technology and subsidy risk.

- *Invest in growing companies in growing markets*. Invest in rapidly growing companies in high-growth market sub-segments as a means of achieving high returns while limiting investment risk. Preferably invest in companies that are growing faster than the market itself is growing.

- *Invest in certain downside-protected companies or projects to achieve an overall risk-balanced portfolio.* As part of an overall investment portfolio, asset-light companies and projects offer protection against capital scale and business scaling risks, while pre-contracted offtake and feedstock agreements also mitigate risk.

- *Add value to companies beyond simply providing capital*. Providing growth capital and expertise along with control or high levels of management influence allows smart investors to actively help companies move across the Commercialization Gap, which is a major value creation event, resulting in higher returns for investors.

The favorable interplay of these trends—the macro-forces and the Six Angels—highlights several attractive market segments: energy efficiency, clean energy, water resources and reclamation, waste-to-value, and environmental services.

A. Energy Efficiency

Energy efficiency is an enormous opportunity for the American economy. The United States is among the least energy efficient of all developed nations, using 75% more electricity per capita than every major market except Canada.[101] The U.S. economy is composed of poorly insulated buildings that leak energy, inefficient commercial and home appliances that waste energy, and industrial processes that consume excessive energy. Average energy prices are increasing (U.S. energy prices have increased 43% over the past decade), and will continue to rise, driven by higher fossil energy costs, higher transmission and distribution costs, and creeping regulation.

Thanks in part to rising commodity costs, the U.S. energy efficiency market is already large—and rapidly growing: in 2013, it was a $62 billion-industry, with annual growth rates projected to be 7% to 9% to 2016 and likely beyond.[102] Some sub-segments are growing more rapidly, such as green building materials (12%) or LED lighting (40%).[103] Ratepayer-funded energy efficiency programs alone have scaled up in recent years, growing more than 20 percent annually from $2.6 billion in 2006 to nearly $7 billion in 2011.[104] Financing and investment in building, industrial, and supply-side energy efficiency doubled in 2012, reaching more than $15 billion.[105] Energy-efficiency-retrofits for buildings alone offer a $279 billion dollar investment opportunity, with energy savings that could total more than $1 trillion over ten years, as of 2012.[106] While overall construction declined from 2007 to 2012, demand for green building materials remained steady and is projected to grow 11% per year to $86.6 billion in 2017.[107]

The market breaks into three sub-segments: consumer, commercial, and industrial. The commercial and industrial sub-segments are increasingly "natural" markets, largely owing to real cost savings opportunities (energy costs today can reach 35% of product costs).[108] Energy efficiency enhancements include smart buildings and more energy-efficient appliances, energy management systems, distributed cogeneration, electricity and thermal storage, smart grid applications, and energy engineering for industrial applications. Existing technologies, such as efficient lighting, combined cooling heat and power (CCHP), and aggregation and control devices for demand response, can be deployed to save energy and yield significant returns when replacing older, less efficient systems.

An increased focus on energy efficiency is being seen in the "built environment," as evidenced by stricter building codes, higher appliance efficiency standards, government-supported financial incentives for building energy retrofits, energy efficiency standards for government buildings, and growing demand for energy efficient products and services.

The growth of the energy efficiency market is driven largely by direct cost savings and supplemented by government support through green building and smart grid initiatives and incentives (*e.g.*, the Energy Star program, AB32 in California, the American Recovery and Reinvestment Act's $30 billion in federal support) and by growing public and private sector support (utilities, municipalities, businesses, residential consumers). Consumer preferences also

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[101] World Bank Development Indicators.
[102] NewWorld calculations.
[103] NewWorld calculations.
[104] David Frankel, Stefan Heck, and Humayun Tai, *Using a consumer-segmentation approach to make energy-efficiency gains in the residential market*, Electric Power/Natural Gas (Americas), McKinsey & Company (November 2013).
[105] As described in Select USA, "The Energy Industry in the United States," http://selectusa.commerce.gov/industry-snapshots/energy-industry-united-states. Accessed October 2014.
[106] The Rockefeller Foundation and DB Climate Advisors, *U.S. Building Energy Efficiency Retrofits: Market Sizing and Financing Models*, March 2012.
[107] Freedonia Group, *Green Building Materials to 2013*, Report no. 2459, 2009.
[108] NewWorld estimate.

support market growth, though challenges remain as to how to effectively monetize energy efficiency.

Many public utilities are also now providing rebates to purchasers of energy efficient appliances (such as energy efficient commercial air conditioning) in order to reduce pressure to build new peak-demand power plants. An expanding range of financing models that can convert the up-front capital cost into a service (or operating) cost will push further growth by encouraging adoption of technologies such as smart grid software and hardware, energy information management and sensor controls, demand response, energy storage, energy efficient lighting, and more.[109]

The energy efficiency market is rife with derisked technologies. Rather, many energy efficiency technologies have roots in longstanding, proven, and resilient technologies, such as Internet-based applications to monitor and control residential energy use. In fact, technology facilitating the "Internet of Things" and machine-to-machine (M2M) communication has the potential to usher in a new era of continuous improvement in energy efficiency. Continuous data monitoring, control, and measurement due to better information exchange between the system control and facility operation level will wring efficiency out of existing supply chains and manufacturing processes. In particular, the M2M industry is projected to attain a 23% CAGR over the coming decade, growing from a $12 billion business today to almost a trillion in 2020.

Some of the most attractive sub-segments in the energy efficiency landscape are asset-light, growth plays with disruptive, but proven, technologies. These are commercial and industrial products that offer direct energy savings, increased product life, or have reused/recycled components. Other attractive opportunities are bolstered by energy efficiency financing opportunities.

Many companies are seeking energy efficiency gains, driven by the prospect of cost savings in not only energy consumption but also in production and operation. For example, for a major chain of supermarkets, efficiency improvements like LED lighting that cut energy costs by 10 percent could yield tens of millions of dollars in added profits by reducing operating costs.[110] Most investment (venture capital or private equity) invested to date in the U.S. energy efficiency sector has been in the lighting market. LED prices have been declining rapidly, due to production overcapacity and aggressive equipment subsidies in China, but are beginning to stabilize as prices approach their entitlement cost. Innovations in financing in this area are promoting growth: in 2013, Philips announced a "lighting-as-a-service" model that will allow the Washington Metropolitan Area Transit Authority to install 13,000 LEDs at no upfront cost, allowing the project to be paid through annual energy savings (of $2 million) and a 10-year maintenance contract.

Consider the energy recovery ventilation (ERV) sub-segment: HVAC equipment that uses the energy associated with a building's exhaust air to precondition the incoming fresh air has the result of reducing energy consumption while improving indoor air quality. Over one-third of total commercial energy consumption is used for space heating, ventilation, and cooling.[111] To the extent that the technology facilitates capturing and reusing waste heat as a substitute for costly purchased fuels or electricity, the ERV segment exhibits potential for rapid growth. In 2006, the size of the ERV market in the United States was estimated to be $324.6 million, and was expected

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[109] Charlotte Kim, Robert O'Connor, et al, *Innovations and Opportunities in Energy Efficiency Finance*, Wilson Sonsini Goodrich & Rosati, May 2012.
[110] ENERGY STAR® Building Manual, *Facility Type: Supermarkets and Grocery Stores*, January 2008.
[111] Frost & Sullivan, *North American Energy Recovery Ventilation Markets*.

to double in size by 2012.[112] The global ERV market in 2014 was $1.6 billion, and expected to double by 2020, reaching nearly $3 billion.[113]

Impact. Investing in energy efficiency technologies and businesses yields many positive co-benefits by reducing resource use, pollution, and the energy intensity of the U.S. economy more broadly. Improving energy efficiency also promotes energy cost savings for industry and consumers alike. Decreasing consumption of fossil fuels through energy efficiency improvements also decreases greenhouse gas emissions and other pollutants, improving atmospheric, human, and environmental health. Reduced oil use also means that the U.S. will send less money to foreign countries to pay for oil imports, while also reducing the U.S. economy's overall exposure to volatile hydrocarbon prices. Improving energy efficiency may also improve industrial efficiency and international competitiveness of the U.S. industry, resulting in improved economic bottom lines.

B. Clean Energy

The U.S. clean energy industry is large and growing rapidly, driven by high and unpredictable resource prices and shifting consumer behavior. In 2013, the size of the clean energy market was $89 billion, with annual growth rates of 12% to 14% projected to 2016.[114]

Despite the rise of new techniques for extracting unconventional fossil fuels like shale gas, the U.S. Energy Information Administration predicts that by 2016, renewables worldwide will account for more power generation than natural gas and twice as much as nuclear.[115] Renewable energy as a percentage of total U.S. electricity production is approximately 13% today[116], and is expected to account for 60% of new capacity and 65% of the $7.7 trillion power investment by 2030.[117]

The clean energy segment includes renewable electricity (solar thermal/photovoltaic, wind, hydro, geothermal, biomass, biogas) and renewable fuels (production facilities, distribution infrastructure, advanced biofuels). Within this segment, demand-side (as opposed to supply-side) asset-light opportunities, typically found upstream or downstream of the capital-intensive segments, are some of the most attractive spaces.

Examples of these attractive sub-segments include combined cooling, heating and power (CCHP); distributed solar installation services; roof-mounted solar innovations; wind services; and small hydropower. As the Case Study: The Rise of Residential Solar illustrates, many of these sub-segments exhibit attractive features of environmental markets (the Six Angels discussed above) while being favorably propelled by positive macro-forces. Related renewable energy services businesses—characterized by high levels of innovation, market fragmentation, low capital intensity, and less cyclicality—should also benefit from growth in clean energy adoption.

The infrastructure for energy delivery will be another key dynamic influencing change in the sector. Fossil fuel excavation projects are being developed further from existing grid networks,

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[112] Frost & Sullivan, *North American Energy Recovery Ventilation Markets*.
[113] Navigant Research, *Indoor Air Quality Monitoring and Management in Smart Buildings*, August 2014.
[114] NewWorld calculations.
[115] International Energy Agency, "Renewables to Surpass Gas by 2016 in the Global Power Mix." June 2013.
[116] U.S Energy Information Administration, "How much U.S. electricity is generated from renewable energy?" April 14, 2014, http://www.eia.gov/energy_in_brief/article/renewable_electricity.cfm; and U.S. Energy Information Administration, *Electrical Power Monthly*, February 2014.
[117] Bloomberg New Energy Finance, *2030 Market Outlook*, June 2014.

increasing costs for transmission and distribution (T&D). Meanwhile, a confluence of factors, including falling costs of distributed generation, improved renewable energy and storage technologies, rising interest in demand-side management, relatively low natural gas prices, and rising electricity prices in some areas, is pushing clean distributed electricity generation towards the center of grid networks.[118] Distributed generation is increasingly a force to be reckoned with, and there are already some utility responses in the form of corporate investment in clean energy projects and discussions of changing business models to charge customers nominal fees to continue supporting existing T&D infrastructure and backup power supplies.

Even though hydrocarbon energy may be presently less costly at the point of generation than renewable energy (and supported by significant government subsidies), clean energy (even with its modest subsidies) is becoming increasingly competitive against fully depreciated and grandfathered coal- and natural gas-fired facilities. It is worth repeating that residential solar compares favorably on a cost basis to retail electricity rates for a majority of the U.S. population.[119]

Impact. Investing in clean energy opportunities (such as renewable electricity generation or other demand-side clean energy services and businesses) benefits the environment and society alike by reducing fossil fuel consumption—thereby also reducing other negative side-effects associated with oil and gas extraction, production, and use. Notably, to the extent that fossil fuel usage is reduced, clean energy also reduces the amount of carbon emissions and other pollutants, slowing the accumulation of greenhouse gases in the atmosphere and contributing to climate change mitigation. Decreasing consumption of fossil fuels will yield cost savings in the long-term, and improve economic resiliency.

C. Water Resources and Reclamation

The U.S. faces major water challenges, the impacts of which are beginning to be felt across industries, including water scarcity, aging infrastructure, water quality issues and rising water-related energy risks—all of which are exacerbated by increasing demand and climate volatility. The U.S. water resources and reclamation market was estimated to be $59 billion in 2013, with an annual growth rate of 3% to 4% through 2015.[120] This market includes wastewater treatment and reclamation, water treatment/purification, desalination, supply/distribution, and precision irrigation.

This market broadly is expected to have strong and sustainable market growth, growing end-consumer demand, increasing government support, and a near-term need for improved efficiency, infrastructure management, and treatment for municipal, industrial, and agricultural users. Several trends, reflective of the macro-forces driving environmental markets in general, support this conclusion.

The U.S. passed domestic peak water supply back in the 1970s, and consumes more than 400 billion gallons of freshwater daily.[121] Due to inefficient practices, aging infrastructure, and other

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[118] 13D research (2013).
[119] See Case Study: The Rise of Residential Solar.
[120] NewWorld calculations.
[121] Peter Gleick, and Meena Palaniappan, "Peak Water and the Limits to Freshwater Withdrawal and Use," *Proceedings of the National Academy of Sciences* 107, no. 25 (June 22, 2010): 11155-62. Based on data for 2005; more recent data not readily available. Joan F. Kenny, et al, "Estimated Use of Water in the United States in 2005," U.S. Geological Survey, 2009.

factors, a large proportion of U.S. water is wasted. The U.S. water distribution infrastructure breaks about 540,000 times each year, leaking roughly 6 billion gallons of freshwater every day.[122] Freshwater is being used far faster than it is being regenerated, and water tables in major cities across America are falling rapidly (lower by 30% to 60% in some urban areas[123]). Nearly one in 10 watersheds in the United States is "stressed", with demand for water exceeding natural supply. Deutsche Bank estimated that the U.S. drought in 2012, which affected nearly two-thirds of the country's lower 48 states, would reduce GDP growth by approximately one percentage point.[124]

Power generation, agriculture, and industry account for large portions of freshwater use in the United States.[125] It takes 39,000 gallons of water to manufacture a car and 1,000 tons of water to produce a ton of steel. Between January 2011 and September 2012, more than 65.8 billion gallons of water was used for hydro-fracking, representing the annual water use of 2.5 million Americans. The organization Ceres found that nearly half (47%) of U.S. shale oil and gas wells were developed in water basins with high or extremely high water stress (meaning that over 80% of available water is already being withdrawn, whether for municipal, industrial, and agricultural uses).

Reflecting broader trends in environmental markets, water-risk management is shifting into the mainstream consciousness of business: over 90 signatories of the United Nations Global Compact's CEO Water Mandate have pledged to develop, implement, and report on water-sustainability policies and practices in their operations as well as their suppliers' processes.[126] Many companies are also beginning to calculate their "water footprint" and are increasingly viewing water resources as a strategic asset to be managed more efficiently.

Capitalizing on these trends, some of the most attractive spaces in the broader market are decentralized and asset-light, including reclamation and use, water processing, and provision and management. Financing services that sell water processing as a service, rather than as a capital cost, offer attractive opportunities. Several sub-segments of the water resources market will see rapid growth over the next few years: for example, desalination is expected to experience annual growth rates of 59% to at least 2016 while spending on water membranes is expected to increase 25% annually.[127]

Impact. Conserving water through better and more efficient practices will lead to many positive impacts for society and for the environment. For example, reducing water usage through technological improvements (particularly in industrial practices or in agriculture) will help conserve water for human consumption, while solutions and products that can encourage change in end-user and consumer practices will yield not only cost savings but also water savings. Improvements in treatment and re-use capability for wastewater will also help reduce stress on new water sources, particularly in water-short areas, while reducing the amount of untreated or polluted water that is discharged into the environment.

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[122] Tracey Schelmetic, "Water Infrastructure Upgrades: A $1 Trillion Market Opportunity Waiting to Happen," Thomas Net Industry Market Trends, June 19, 2013.
[123] 13D Research.
[124] As reported in Joe Richter, "U.S. Drought May Cut GDP by 1 Percentage Point, Deutsche Says," *Bloomberg,* November 11, 2012, http://www.bloomberg.com/news/2012-11-12/u-s-drought-may-cut-gdp-by-one-percentage-point-deutsche-says.html.
[125] 13D Research.
[126] Andrew Streer, "Water Risk on the Rise," World Resources Institute, September 20, 2013, http://www.wri.org/blog/2013/09/water-risk-rise.
[127] *Water Market USA 2011*; Global Water Market Intelligence, 2010.

D. Waste-To-Value

Waste generation in the United States has exploded in recent years without a corresponding increase in the ability to recover and dispose of the waste. This mismatch in the context of environmental concern yields great opportunities in the U.S. waste-to-value market. The waste-to-value market was estimated to be $88 billion in 2013, and is forecast to grow annually at 3% to 4% to 2016.[128] Per-capita waste generation is now 4.5 pounds per person per day, almost double the 1960 amount.[129] Today, 55% of waste generated in the United States still goes directly into landfills,[130] in many cases polluting the land and generating methane gas emissions while failing to recover valuable reusable materials. E-waste and other high-value industrial waste pose special problems of recovery. Growing waste generation, declining landfill capacity, increasing landfilling costs, and resistance to permitting new landfill sites are spurring increased innovation and adoption of waste-to-value solutions.

Reuse and recycling are emerging more prominently in the context of larger forces, particularly, for example, as resource prices rise, landfills expand and pollutants increase, and penalties on hard-to-dispose-of waste increases (*e.g.*, landfill gate fees). Total municipal solid waste (MSW) generation in the U.S. in 2011 was 250 million tons, and the recycling rate was 35%, equivalent to 87 million tons; 66 million tons were recovered, and 29 million tons were combusted. Though this represents big advances since the 1960s, there is much room for improvement.

The waste-to-value market segment captures the associated opportunities, and includes waste-to-energy, such as biodigestors/anaerobic digestion and landfill gas operations; waste-to-materials; fugitive emissions control; waste stream management; and waste-to-fertilizer. The sub-segments of particular interest span both the centralized and distributed market spaces, but are generally characterized as strong growth plays with low feedstock risk, low asset-intensity, and with retired technology risk.

Waste-to-energy is an example of a sub-segment that is poised to experience even stronger growth, with annual growth rates of over 10% to at least 2016, and a projected market size in 2016 of $29 billion.[131]

As commodity prices rise and natural resources are depleted, e-waste and other high-value industrial waste recovery services are becoming increasingly valuable. The U.S. electronics recycling industry has shown tremendous growth over the past decade: in 2012, it was estimated to be a $20 billion market (up from less than $1 billion in 2002). Of used electronics collected in U.S. each year, 83% are refurbished and sold domestically while 17% are exported, according to the U.S. International Trade Commission. The global volume of e-waste generated is expected to reach 93.5 million tons in 2016, up from 41.5 million tons in 2011, and the e-waste management market is expected to grow from $9.15 billion in 2011 to $20.25 billion in 2016 (a CAGR of over 17%).[132] Moreover, the U.S. scrap recycling market is $90 billion, with over 135 million tons of material processed annually. To the extent that waste continues to be produced, and to the extent

[128] NewWorld calculations.
[129] U.S. Environmental Protection Agency, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008," 2008.
[130] U.S. Environmental Protection Agency, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008," 2008.
[131] NewWorld calculations.
[132] Markets and Markets Research, *Global E-Waste Management Market (2011 – 2016)*, August 2011.

that consumers look to minimize their waste and associated costs, much opportunity lies within the waste-to-value space in North America.

Impact. Investing in waste-to-value yields substantial co-benefits to society by reducing the need for ever-increasing extraction of natural resources through recycling, reusing, and other waste recovery. Investing in waste-to-value efforts also reduces the volume of generated waste, slowing the growth of landfills and reducing accumulations in the oceans and other water sources. Reducing landfill growth also decreases leaching of toxins and other hazardous materials into the environment and water resources (such as groundwater), which helps to improves human well-being and overall environmental health. Waste-to-value efforts also may represent cost-savings for companies through improved resource management and use, thus increasing businesses' bottom lines while improving productivity and enhancing industrial competitiveness.

E. Environmental Services

In light of the many energy and environmental inefficiencies in the U.S. economy, environmental services companies can play a valuable role. This market includes environmental services companies, energy services companies (ESCOs), professional service providers, remediation services, and related engineering, design, and information services.

The U.S. market size of environmental services is large: in 2013, it was estimated at $61 billion, with annual growth rates of 3% to 4% to 2016.[133] Some sub-segments are projected to see even stronger expansion in the coming years (like ESCOs, with annual growth rates of 8%, or environmental sensors and monitoring services, with growth rates of 6% to 7%).[134] The environmental services market is also largely driven by private sector demand and end-market support, and is closely correlated with energy efficiency and clean energy investment. Aside from ESCOs, the environmental services segment is less incentivized by current regulation and legislation than other environmental segments.

The most attractive sub-segments are those with recurring revenues, such as companies offering optimization, efficiency, and logistics; information tracking/analysis; centralized monitoring; and utility services (including water processing, clean energy, and energy efficiency provision). Other spaces of interest are remediation, financing, and commissioning and installation (clean energy, water processing, reuse and reclamation).

ESCOs are natural service adjuncts to energy efficiency innovations and provide a market channel for those investments. These businesses feature stable, growing demand and the prospect of continued growth despite fluctuations in the market cycle. Though there are a few major players in this space, such as Johnson Controls, Honeywell, or Siemens, no company has a dominant market share in this industry, leading to a fragmented market and often regionally focused services. There is plenty of space for innovation and diversity without debilitating competition.

Take the remediation and environmental cleanup services sub-segment, which generated over $8 billion in revenues in 2012, as another example.[135] This same sub-segment in August 2014 was estimated to earn over $18 billion in revenues.[136] Due to market rebound and increasing need for

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[133] NewWorld calculations.
[134] NewWorld calculations.
[135] Environmental Business International Inc., *Remediation Market 2013*, EBJ 28, no. 4 (2013).
[136] IBISWorld, *Remediation & Environmental Cleanup Services Market Research Report*, NAICS 56291, August 2014.

remediation services, many firms (particularly in the construction market) are seeing revenue increases, particularly as remediation related to brownfield sites recovers from the real estate bubble. Liability disclosure (through financial disclosure requirements) is also a driver in remediation of contaminated sites, particularly in the power, oil and gas, mining, and manufacturing industries broadly, that are looking to clean up projects (and their balance sheets) in light of increased consumer and corporate concern. The need for water remediation and clean-up services in the oil and gas E&P industry is increasing, as freshwater costs rise and shale oil and gas production continues to expand by using fracking techniques. It is estimated that water services requirements in the U.S. oil and gas extraction & production space could reach up $100 billion.[137] This market is highly fragmented, as different regions have different water, fracking requirements, and regulations for water disposal or recycling.

Because environmental services companies encompass such a wide range of services, winning strategies also vary, but in general, companies that provide tangible efficiency improvements, possess an established and growing client base, or include performance contracting and infrastructure outsourcing opportunities are attractive. In terms of energy efficiency services, offerings outside the municipal, university, school, hospital (MUSH) and government markets need financing; commercial energy services agreements may be a vehicle for financing these services. Lighting and motor retrofits, as well as HVAC operating leases, are attractive. Compliance services are likely to continue to grow with increasing EPA, state, and local regulatory complexity and reach.

Impact. Similar to co-benefits that are associated with improvements in clean energy and energy efficiency, environmental services that drive more resource-efficient use and management should reduce resource use broadly. By doing so, accompanying waste, pollution, and energy intensity will also be reduced. Environmental services that improve energy efficiency while also increasing clean energy use may also improve industrial efficiency and international competitiveness of the U.S. industry, resulting in improved economic bottom lines. Reduced energy use overall, particularly fossil fuels, also reduces the amount of carbon emissions and other pollutants that are released into the atmosphere.

* * *

Each of these five target segments have developed mainly over the past ten to 15 years. They feature strong growth prospects, are in need of substantial investment capital and business-scaling support, are characterized by common or related value drivers and less-correlated risk factors, and exhibit operating characteristics that make investing in them attractive for a middle-market private investment firm.

A team of equity investors specialized in environmental markets should be able to avoid falling prey to the Six Devils by using their expertise to evaluate risk before making an investment decision. Risks can be turned into opportunities; certain sub-sectors of the market are undercapitalized because generalist investment teams lack the specialized knowledge necessary to evaluate and mitigate risks. A specialized team should, therefore, be able to command a premium in financing businesses in these business segments.

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[137] Tim Probert, "Shale Gas Fracking: Water Lessons from the US to Europe," Water World, http://www.waterworld.com/articles/wwi/print/volume-27/issue-2/regional-spotlight-europe/shale-gas-fracking.html.

With the right approach, environmental markets should offer investors that capitalize on resource inefficiency an opportunity to reap top-tier returns. Societal co-benefits are attractive to some investors, but regardless of their motivation, players in environmental markets do not have to compromise on returns. In many cases, the very factors that create environmental problems, such as inefficient resource use, also create opportunities for extra-normal profits. Today, technological innovations and business scaling have led many environmental products to become price- and cost-competitive, and corporations and consumers are increasingly paying attention.

Commodity prices will likely continue to remain high and volatile, in conjunction with increasing global demand and growing supply limitations. This trend is driving changing corporate considerations that favor increasing adoption of environmental technologies, and has driven historical federal investment by multiple countries, which has contributed to decreasing component costs of proven technologies and laid the foundation on which environmental businesses of today have grown. Furthermore, many talented, experienced leaders and professionals are moving into the environmental opportunities sector and are prepared to drive environmental businesses forward. Conditions increasingly favor specialized investors who will add value and use expertise to spot undercapitalized opportunities, mitigate risk, and navigate the market, resulting in top-tier economic returns.

This essay was prepared by Carter Bales, Silda Wall Spitzer, Danielle Joseph and Alexandra Mahler-Haug of NewWorld Capital Group, LLC.

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Profit in Moving Toward a Clean Economy

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