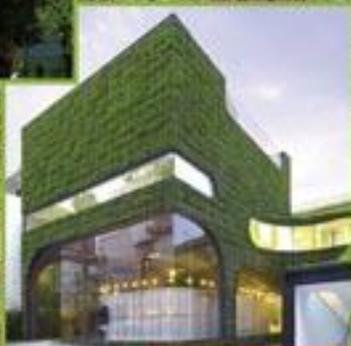




Green Transition Inflection Point

Green Transition Scoreboard® 2013 Report



 **Ethical Markets®**

Green Transition Inflection Point: Green Transition Scoreboard® 2013 Report

Cover: Green Construction – green cover over green tech
Cover design by Regine de Toledo, Graphics Ink Design Studio, St. Augustine, FL

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Reference suggestion:
Henderson, H., Sanquiche, R. and Nash, T. “Green Transition Inflection Point: Green Transition Scoreboard® 2013 Report,”
Ethical Markets Media, February 2013.

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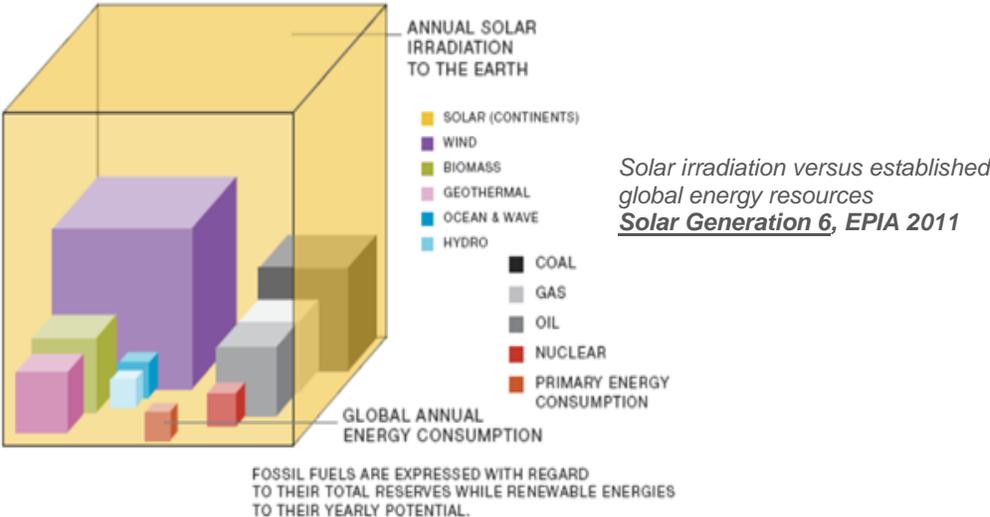
This report does not contain investment advice. For full disclosure: principals of Ethical Markets Media, LLC, are personal investors in green companies (see Appendix 2).

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Executive Summary

The year 2012 was an inflection point for the green transition worldwide, with \$4.1 trillion of private investments tracked in this report. Technology and innovation such as in electricity generation and transport began forcing structural changes and rethinking of business models, urban design and development toward integrated systemic approaches – still unreported in mainstream media. Global policy makers, businesses and civic society began realizing that environmental, social and human capital must be assessed and integrated into financial markets in order to achieve equitable and sustainable forms of development. The output of Rio+20 was an unprecedented reintegration of human knowledge resulting in new global shared goals and paths transitioning 191 member countries toward low-carbon, cleaner, greener, information-rich economies. Awareness grew of localization is a key principle for redesigning industrial methods, agriculture, infrastructure, sustainable communities as developed by our partner company, Biomimicry 3.8 and our joint Principles of Ethical Biomimicry Finance™.

As the green and biomimicry innovation revolution gathers speed, the year 2013 promises further shifts away from the fossil-fueled Industrial Era as illuminated by our Green Transition Scoreboard® (GTS) which tracks private investments growing the green economy worldwide since 2007, totaling in Q4 of 2012 this \$4.1 trillion. The Green Transition Scoreboard® tracks five sectors: Renewable Energy; Green Construction, Energy Efficiency; Corporate R&D and Cleantech, representing broad areas of investment in green technologies, many overlapping. Each covers an area of substantial capital investment in technologies which Hazel Henderson's years of research as a science advisor and which the [Ethical Markets Advisory Board](#) expertise indicate have contributed and are contributing to a sustainable future.

While some governments and institutional investors are increasing their focus on growing greener economies, they are not included in this report. Our recommendations that investing at least 10% of institutional portfolios directly in companies driving the global Green Transition, provide a way to

INVESTMENTS IN GREEN TRANSITION 2007-2012	
Sector	US \$
Renewable Energy	\$2,281,347,792,080
Green Construction	\$837,620,000,000
Energy Efficiency	\$526,921,247,320
Corporate R&D	\$254,800,000,000
Cleantech	\$224,601,088,873
TOTAL	\$4,125,290,128,273

update strategic asset allocation models both as opportunities and as risk mitigation. Such shifts in investments will solidify the Green Transition worldwide. Many studies, computer models and reports confirm our view of investing \$1 trillion annually until 2020 in material and energy efficiencies, wind, solar, geothermal and other renewable energy, sustainable land-use and forestry, smart infrastructure, transport, building and urban re-design.

This transition strategy is now on track (see our barometer) and recognized in the 2012 report by Mercer which suggested 40% of portfolios should be in Green Transition sectors. This consensus validates models indicating that investing \$1 trillion annually until 2020 can scale these innovations and reduce their costs. This updated Green Transition Scoreboard® 2013 report finding of over \$4.1 trillion puts investors and countries growing green sectors globally on track to reach \$10 trillion in investments by 2020.

The March 2013 GTS report demonstrates that many other private investors are following our recommended avenue for institutional investors to shift to green sectors. Fossilized sectors are becoming increasingly stranded assets as their perverse subsidies are targeted and as low-carbon regulations are implemented and oil, coal and gas reserves become harder to exploit. Green technologies and systems investments are simply the next evolution of human societies as we learn more from the earth systems sciences and the satellites tracking the conditions on planet Earth.

Our definition of 'green' is quite strict, omitting areas such as nuclear, clean coal, carbon capture & sequestration, and biofuels from feedstock other than sea-grown algae. We are also looking closely at nanotech, genetic engineering, artificial life-forms and 3D printing, determining their green contribution on a case by case basis. For example, genetically modified microbes to produce fuels – dubious propositions for long-term sustainability. Research indicates that increasing production of crops, even inedible grasses, still require water and land better suited for range or agriculture food production.

GTS data sources include the highly respected Cleantech, Bloomberg, Yahoo Finance, Reuters and many new UN and other international studies, NASA and individual company reports. Companies, organizations and the sources of financial data included in the GTS are screened by rigorous social, environment and ethical auditing standards. They can be found in indexes such as Calvert, Domini and Pax World, the PowerShares Cleantech Portfolio, Dow Jones Sustainability Indexes, London's FTSE4GOOD, NASDAQ OMX Green Economy Global Benchmark Index, ASPI Eurozone, the many newsletters from around the world we post daily at www.ethicalmarkets.com and others.

Renewable Energy - Important to this rapidly expanding sector is the growth of renewable energy in developing countries.

Green Construction - This is the most conservatively under-reported sector of this report. We are only counting green construction materials, not including labor.

Energy Efficiency - Investments include conservation efforts and initiatives and products focused on lowering energy needs or using less energy than a comparable product, as companies now recognize efficiency investments' rapid payback periods.

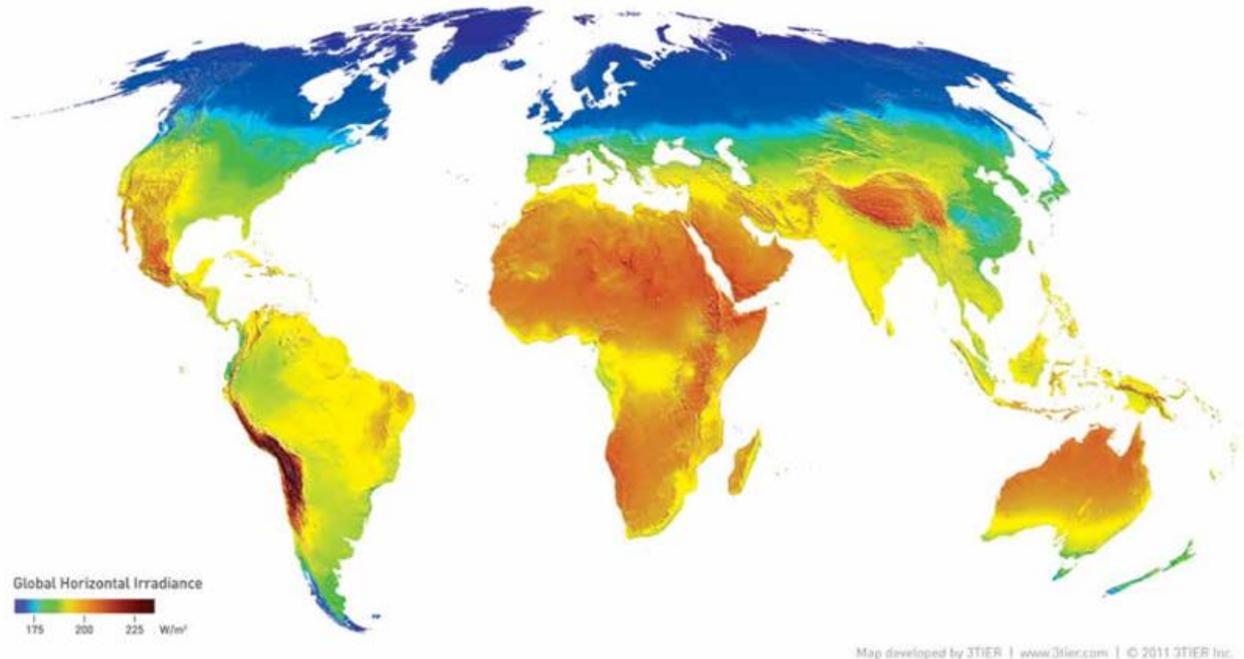
Green R&D - Significant company investments show sustainability is integrated into its core strategy, serving as a strong indicator for investors. This data helps identify innovative companies ahead of the curve in responding to heightening environmental risks and regulations.

Cleantech - As Cleantech grows, energy storage increases in importance, at the level of power plants and grid electricity and at retail and local levels with improvements in batteries, fuel cells, flywheels, ultra capacitors, flow batteries, compressed air as well as metering of use at all levels.

Part One



Global Mean Solar Irradiance



Introduction and Overview By Hazel Henderson

Green Transition Driving Paradigm Shifts

The year 2012 was an inflection point in many ways, particularly for global energy policy. Technology and innovation in two key fields: electricity generation and transport began forcing structural changes and rethinking of business models, urban design and development toward integrated systemic approaches – still unreported in mainstream media. Even the US National Intelligence Council's report on Global Trends 2030 noted "game-changers" in the rise of cities and emerging countries, erosion of soils and water-shortages, while seeing technology and markets having a more important impact in reducing carbon emissions than an updated Kyoto-style agreement. We agree!¹

First the bad news: Anthropogenic climate change was evidenced in all the actual droughts, heat waves, floods, tornadoes and hurricanes that augured a different future for humans.² In spite of all the

denials, the billions in advertising, lobbying and funding of front groups by the incumbent fossil energy and transport industries, even mainstream media in the USA began covering the issues of climate change. Culminating in the devastations of Hurricane Sandy and the \$60 billion relief passed by the US Congress in 2013, the public debate began, albeit still backing into the future looking through the rearview mirror: how to adapt to rising sea levels; how to capture and sequester CO₂ from fossil fuel burning; how to strengthen levees, build floodgates and protect infrastructure and food supplies; how to compensate for losses, deal with insurance issues, and so on. The thornier issues of relocating people living in the vulnerable coastal areas and floodplains, restoring protective wetlands, heeding planetary boundary conditions³ and reforming finance, economic models and their metrics has barely begun.

Paradigms shifted in the electric utility sector as the legacy, centralized large-scale, base-load

¹ "Global Trends 2030: Alternative Worlds," National Intelligence Council, December 2012.

² NOAA News, www.noaa.gov.

³ See for example, Wijkman, Anders and Rockstrom, Johan. *Bankrupting Nature*, Routledge, UK, 2012; Speth, Gus. *America The Possible*, Yale University Press, 2012.

generating national grid structures were increasingly bypassed by decentralized local renewable micro-grids, rooftop solar PV (set to reach parity with grids by 2016), municipality and cooperatively owned wind generators, demand-management firms and new technologies in storage and transport.⁴ These shifts challenged conventional financial “big project” power generation models for nuclear and coal plants, eroding their profitability. A technical group at the University of Delaware’s computer model of energy in 13 states shows that wind and solar electricity paired with storage could power their grid 99.9% of the time more cheaply than the current system.⁵ Big power-generating companies have resisted solar and wind, as “intermittent,” “unreliable” and “niche” providers since these renewable sources often generate electricity difficult to integrate into base-load plants and their big grids. These assumptions force the debate into finding better big-storage beyond pumped water, compressed air, and problems of how to even out new supplies. The earlier problems of evening out demand have been routinely handled for decades.

By 2012, these assumptions and issues were upended. The new paradigm involved how to expand use of micro-grids, smaller plants and local generation. In turn, the new focus is on redesigning systems, business models and finance for the ever-increasing supplies of wind, solar and other renewables together with efficiency, changing demand and electrification of transport. Cities are leading this paradigm shift in pragmatic ways: energy efficient retrofitting buildings, LED public lighting, pedestrian malls, bike-sharing, charging stations for electric and hydrogen fuel cell vehicles, better recycling, water re-use and enacting local standards for energy efficiency and renewables, a market worth \$20.2 billion annually by 2020.⁶ Systemic approaches to energy efficiency in commercial and residential building, optimization of industrial processes and motivation of consumers are the next generation frontiers.⁷

Meanwhile, the attacks on renewable energy alternatives continued in the USA. Familiar “subsidies wars” raged with renewed efforts by fossil

fuel lobbies to turn back state legislation for renewable portfolio standards and other energy efficiency measures. Efforts to defund or abolish the EPA continued, demonizing the DOE’s ARPA-E program and ridiculing renewable energy technologies and start-ups. Globally, adaptation and mitigation efforts to protect or relocate vulnerable populations in small island states became more urgent, along with curbing deforestation and other unsustainable practices. As risky, long-range schemes for geo-engineering and new kinds of nuclear power were trotted out, even the world’s most popular beverage source – Arabica coffee trees – joined the growing list of endangered species.

The deeper issue is how quickly human societies can expand our awareness and understanding of the planetary biosphere of which we are a part. Can we reintegrate our knowledge and become systems thinkers – now a necessity as we face the planetary whole-system shifts our growing population, economic systems and technologies have engendered? Can we redesign our cities, buildings, transport, factories, production methods, energy and resource systems to operate within the tolerances of our natural biosphere’s life-support systems?

Now for some more good news!

We have begun to “connect the dots” as three global summits in 2012 illustrate. The Declaration of the G-20 nations in their Mexico Summit calls for deployment of energy efficiency and clean technologies, promoting sustainable agriculture, food security and examining price spikes related to commodity markets and speculation.⁸ The United Nations’ Millennium Development Goals (MDGs) have morphed into Sustainable Development Goals (SDGs), signaling a deep paradigm shift. The UN produced detailed reports on major aspects of this shift in its “A Guidebook to the Green Economy.”⁹ The Declaration of the United Nations’ Rio+20 Summit signals more paradigm shifts in environmental and climate policy since the UN Copenhagen Climate Summit of 2009, as well as outlining the reforms of models needed in global finance since the crises of 2008. The World Economic Forum’s Green Investment Report 2013 estimates investments required for water, agriculture,

⁴ See for example, “Renewables Global Futures Report,” Ren21, Jan. 2013; Farrell, John, “Commercial Rooftop Revolution,” ILSR Institute for Local Self-Reliance, www.ilsr.org, December 2012 which includes an interactive [US Solar Grid Parity Map](#).

⁵ “Wind and Solar Power Paired with Storage Could Power Grid 99.9 Percent of the Time,” *Science Daily*, Dec. 10, 2012.

⁶ “Smart City Tracker 1Q13,” Pike Research, Feb. 2013.

⁷ York, Dan, et al. “Frontiers of Energy Efficiency: Next Generation Programs Reach for High Energy Savings,” Research Report U131, ACEEE, Washington, DC, Jan. 2013; “The Benefits of Energy Efficiency – Why Wait?” ECOFYS and Phillips, for the UN Climate Change Conference in Doha, Qatar, Nov. 2012.

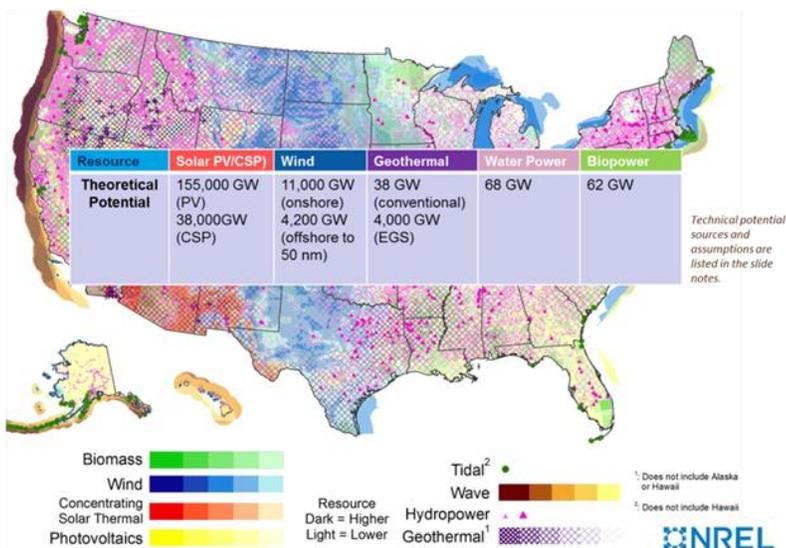
⁸ “Tracking Progress on the G20 Development Commitments.” Draft Report, Munk School of Global Affairs, University of Toronto, International Organizations Research Institute, National Research University, Jan. 2013. For final report, contact drafting organizations.

⁹ Allen, Cameron. “A guidebook to the Green Economy,” UN Division for Sustainable Development, Nov. 2012.

telecoms, power, transport, building, industrial and forestry sectors at \$5 trillion per year to 2020.¹⁰

By 2012, it became clearer to global policy makers, businesses and civic society that environmental, social and human capital must be assessed and integrated into financial markets in order to achieve equitable and sustainable forms of development and the UN's Millennium and Sustainable Development Goals. Thus, the output of Rio+20 was an unprecedented reintegration of human knowledge resulting in new global shared goals and paths transitioning 191 member countries toward low-carbon, cleaner, greener, information-richer economies.¹¹ Over 50,000 groups attended, many others were represented by the Green Economy Coalition, of which Ethical Markets is a member, the largest global coalition and publisher of "The Green Economy Pocketbook: the case for action."¹² The National Renewable Energy Laboratory (NREL) estimates US renewable energy potential for the major technologies (solar PV and CSP, wind, hydro, geothermal) at 481,800 terawatt hours, compared with 2010 usage at merely 3,754 terawatt hours.¹³ This confirms our view reported in our [Green Transition Scoreboard 2012](#) report that these

U.S. Renewable Resources



¹⁰ "The Green Investment Report," World Economic Forum, Geneva, 2013.

¹¹ See for example, Dodds, Felix and Nayar Anita, "Rio+20: A New Beginning" describes directives to merge the UN Millennium Development Goals with the new Sustainable Development Goals and other synergies which emerged from the "People's Summit" and the ten Sustainable Development Stakeholders Dialogues initiated and hosted by the Brazilian Government (*Perspectives*, Issue 8, UNEP, 2012).

¹² "The Green Economy Pocketbook," Green Economy Coalition, www.greeneconomycoalition.org, 2012.

¹³ "NREL, July 2012.

renewable resources greatly exceed any needs for growing human populations in the foreseeable future. Indeed, we see the green transition as humanity's [next technological evolution](#). The contrast between the new thinking at the G-20 and the creativity at Rio+20 and official forecasts versus the dispirited Doha Climate Summit of COP 19-CMP8, December 2012, was stark. Doha focused on efforts to salvage the Kyoto Protocol and reforming its fraud-plagued carbon trading regime; the missed targets for CO₂ caps, clashes between Tier I developed countries versus Tier II developing countries and backsliding on finance for mitigation and adaptation. This rearview mirror focus ended with a "far from adequate" reauthorizing of Kyoto even though the Protocol now only covers 12% of global emissions.¹⁴

The significance of this multifaceted 2012 global paradigm shift remains unexamined by mainstream media. Policies for implementation, technologies and financial strategies are still being formulated and debated.

The Fossil Fuel Sector vs Renewables

The "elephant" blocking more rapid progress has been clearly identified: the powerful, incumbent fossil fuel sectors which finance ten major US "think tanks" in their media campaigns against green energy.¹⁵ Fossil fuels are resurgent in shale-based natural gas and oil, Canada's tar sands, as well as claims of the nuclear industry (even after Fukushima-Daichi). Japan announced it will replace the Fukushima nuclear site with the world's largest wind farm to produce 1 gigawatt of electricity.¹⁶ Nuclear and fossil fuels all still enjoy outside subsidies from most governments. The resulting incorrect pricing is feeding the shale fossil fuel boom and leading to mis-investing in new coal plants in Europe which are unjustified on both economic and environmental grounds.¹⁷ In the Rio+20 Declaration (www.uncsd2012.org), these subsidies were identified as the key barriers to the

level playing field required to fully utilize existing renewable energy technologies and speed the transition to green economies. In addition are the growing external costs of fossil fuels in health threats,

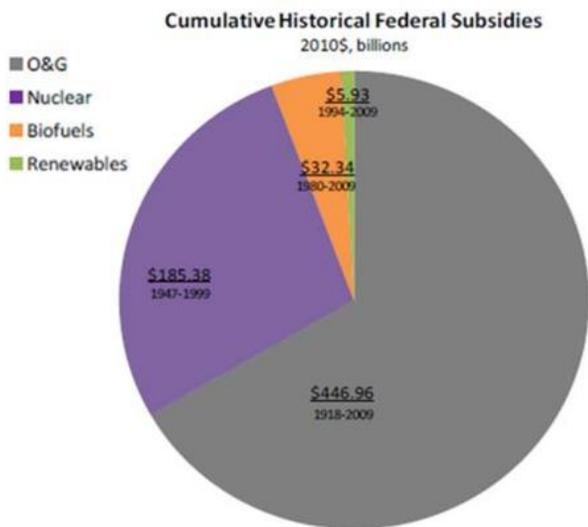
¹⁴ *Earth Negotiations Bulletin*, IISD, December 2012.

¹⁵ "Fossil Fuel Front Groups on the Front Page," www.checksandbalancesproject.org, December 2012.

¹⁶ "Japan to replace nuclear plant with world's largest wind farm," *physorg.com*, Jan. 18, 2013.

¹⁷ "Europe's Dirty Secret," Briefing: Coal in the rich world, *The Economist*, Jan. 5, 2013, pp. 54-56.

pollution and other uncounted damage.¹⁸ Pledges to reduce subsidies, as well as shift government tax policies and procurement budgets to greener technologies, at Rio+20 were accompanied by commitments to reform finance and its conventional metrics, correct national accounts by reformulating GDP indicators (www.ethicalmarkets.com [Beyond GDP](#)) and internalize formerly externalized costs at all levels including corporate balance sheets and accounting practices.



(from DBL Investors' *What Would Jefferson Do?*)

The Sustainability Accounting Standards Board and UK-based Institute for Chartered Accountants of England & Wales (ICAEW) are pioneering such changes.¹⁹ A Novethic survey found that nearly one third of institutional investors managing €4.5 billion use environmental, social and governance (ESG) metrics for long-term risk management.²⁰ A group of seasoned cleantech asset managers now see 2013 as an inflection point for the rise of the green economy.²¹ Wind energy, leading in

renewables, will have its own label in 2013: "WindMade," developed by WWF, the Global Wind Energy Council (GWEC), the UN Global Compact and Vestas with 50 global corporations adopting the label, including Motorola, Deutsche Bank, Bloomberg, Widex and Becton Dickinson (BD).²²

Thus in 2012, the battles that I foresaw in 1981 in my *Politics of the Solar Age* were joined. While acceptance of earth systems science²³ grew to understand the full abundance of free solar energy, wind, geothermal and see the redesign of human production systems, cities and societies became viewed as opportunities as we do in the Green Transition Scoreboard® (GTS). The fossil-fueled Industrial Era giants fought back. Their weapons are ever-larger political donations, lobbying and funding more research by intellectual mercenaries, advertising campaigns and media propagandists. They proclaim the USA as the new "Saudi Arabia" of oil and gas, promoting the International Energy Agency's *World Energy Outlook* which more cautiously cited water shortages and noted that to limit global warming to 2°C, only one third of already proven reserves can be burned, citing massive investments needed in low-carbon and energy efficiency technologies.²⁴

All this cast additional confusion on the scientific consensus on climate change and global warming developed since the 1970s, reflected in opinion polls on environmental issues.²⁵ Such survey



questions focused on environmental threats in the abstract predictably polled lower than threats to jobs, economic insecurity, budget cuts as people faced austerity policies and uncertainty. Polls

focusing on green energy and specific choices continued to show majorities.²⁶ Clearly this transition

¹⁸ Weiss, Daniel J. "The Effects of Rising Energy Costs on American Families and Employers," testimony before the Energy Policy, Healthcare, and Entitlements Subcommittee, Committee on Oversight and Government Reform, US Congress, Feb. 14, 2013.

¹⁹ Sustainability Accounting Standards Board, www.sasb.org; Institute of Chartered Accountants of England and Wales, www.icaew.com. ICAEW published Capra, Fritjof and Hazel Henderson, "Qualitative Growth," 2009, and Henderson, Hazel, "Transitioning to the Solar Age: From Economism to Earth Systems Science," forthcoming 2013.

²⁰ "Asset owners using ESG for long-term risk management," IPE, Dec. 11, 2012.

²¹ Konrad, Tom. "A Clean Energy Inflection Point in 2013?" AltEnergyStocks.com, Jan. 6, 2013. Jabush, Garvin. "2013: Green Economy Inflection Point," AltEnergyStocks.com, Jan. 6, 2013.

²² Font, Vince. "WindMade Label to Expand to Other Renewables," RenewableEnergyWorld.com, Dec. 4, 2012.

²³ Earth Systems Science was initiated in the mid-1980s by NASA when the late astronaut Sally Ride called for this "Mission to Planet Earth."

²⁴ "World Energy Outlook 2012," International Energy Agency, Paris, Nov. 12, 2012.

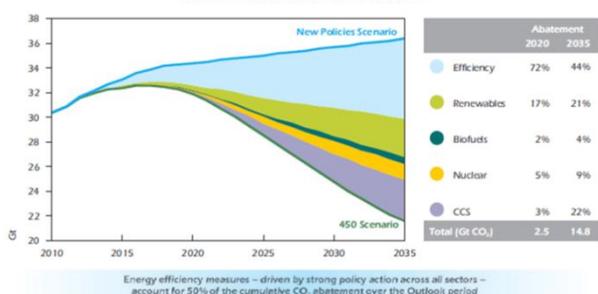
²⁵ "Environmental Concerns 'At Record Lows': Global Poll," [GlobeScan](http://GlobeScan.com), London, Feb. 25, 2013.

²⁶ "Energy & Environment Consumer Survey," Pike Research, Q4, 2012. Goad, Jessica, et al. "The Vast Potential for Renewable Energy," [Center for American Progress](http://CenterforAmericanProgress.org), Aug. 6, 2012.

to the green economy already underway will be highly disruptive to the massive global apparatus of the fossil fuel and nuclear era. Many companies based on 19th and 20th century technologies will go under and jobs will be lost.²⁷ The National Solar Jobs Consensus 2012 finds 8,500 jobs in installations adding to the 57,177 already employed with more growth expected in 2013.²⁸ Bridging strategies using natural gas are already highly contested due to the huge water-use, polluted residues, methane release and other problems.²⁹ Fossil fuels are also faced with carbon and pollution taxes, such as the \$30 per ton of CO₂ equivalent in Canada's British Columbia province and the carbon tax enacted in China in February 2013.³⁰ Carbon taxes and on all externalized pollution are the market-based solution we prefer to cap and trading emissions schemes.³¹ US secretary of State John Kerry, a longtime supporter of the green economy, says, "This \$6 trillion market is worth millions of American jobs...and we had better go after it."³²

The IEA in ACTION: PROMOTING energy TECHNOLOGIES to BRIDGE the FUTURE

World energy-related CO₂ emissions abatement in the 450 Scenario relative to the New Policies Scenario



(from the IEA's *Worldwide Enaqaement for Sustainable Energy Strategiees...*)

The International Energy Agency aims to improve the rate of reduction of energy-intensity.³³ The \$4.1 trillion of private investments since 2007 tracked in this latest update of our Ethical Markets'

Green Transition Scoreboard® attests to the huge shifts now in the pipeline. While renewable energy stocks and start-ups have taken a beating and the falling costs and prices are driving the shake-out process familiar in all previous technological revolutions, savvy contrarians are stepping in.

The consensus at Rio+20 and that of the G-20 in Mexico, the OECD's Global Green Growth Institute and [Knowledge Platform](#) has emerged.³⁴ For example, 86 global companies and 50 countries affirmed commitments to using natural resources in their capital accounting. The US Commission on National Energy Policy sees energy efficiency doubling US productivity by 2030.³⁵

Finance in the Green Transition

US investor Warren Buffet's Mid-America Renewables investments reached \$13.6 trillion³⁶ and the US Department of Defense is now the single most important driver of the cleantech revolution in the USA.³⁷ The US Army now has the world's largest solar photovoltaic facility located at the White Sands Missile Range in New Mexico.³⁸ Solar City and Honda established a \$65 million fund offering discounts on rooftop solar systems to car buyers, following Ford and Sun Power's offer to Ford electric car buyers.³⁹ In 2012, seven new geothermal plants came online in the USA, enough to meet the residential need of mid-size cities.⁴⁰ The fuel cell and hydrogen industries had sharp increases in residential sales and overall revenues of over \$1 billion.⁴¹

The rapid green transition in South Korea is covered in a new report on financial performance.⁴²

In 2011 and 2012, nature provided ample evidence of the massive CO₂ emissions' daily trapping heat equivalent to many Hiroshima-size nuclear bombs in Earth's atmosphere. The effect of this in driving unprecedented weather conditions worldwide: floods, droughts, fires, tornadoes, heat

²⁷ In the USA, coal employs a total of 136,000 people (National Mining Association, Washington, DC), while green jobs employed in 2010 total 2,675,545 ("Sizing the Clean Economy: A National and Regional Green Jobs Assessment," Brookings Institution, Washington, DC, 2011).

²⁸ "National Solar Jobs Census 2012 Finds Installers Leading the Way," The Solar Foundation, Nov. 14, 2012.

²⁹ Siegel, Jeff. "This will Devastate Our Economy," Energy and Capital, Dec. 17, 2012.

³⁰ "China to introduce carbon tax: official," <http://www.xinhuanet.com/english/> Feb. 19, 2013.

³¹ Henderson, Hazel. "From Rigged Carbon Markets to Investing In Green Growth," Real World Economics Review, Issue 57, 2011.

³² "John Kerry on the \$6 Trillion Energy Market," cleantechnica.com, Feb. 3, 2013.

³³ "Setting the stage for energy efficiency investment," *Environmental Finance*, Jan. 9, 2013.

³⁴ www.ggkp.org

³⁵ Friedrich, Kat. "Commission Report Features Financing Recommendations to Double U.S. Energy Efficiency," www.renewableenergyworld.com, Feb. 21, 2013.

³⁶ Gladman, Kimberly. "Responsible Investment at \$13.6 Trillion," GMIRatings, Jan. 31, 2013.

³⁷ Konrad and Jarbush, op. cit.

³⁸ Kelly-Detwiler, Peter. "US Army Dedicates World's Largest Low-Concentration PV Facility," *Forbes*, Jan. 16, 2013.

³⁹ Martin, Christopher and Justin Doom. "SolarCity, Honda Establish \$65 Million Project Investment Fund," *Bloomberg* and www.renewableenergyworld.com, Feb. 20, 2013.

⁴⁰ "Geothermal Industry Ends 2012 on a High Note," Geothermal Energy Association, Dec. 18, 2012.

⁴¹ "The Fuel Cell and Hydrogen Industries: Ten Trends to Watch in 2013 and Beyond," Pike Research, 1Q, 2013.

⁴² "Corporate Sustainability 2013 Korea," SolAbility, Feb. 2013.

waves, is causing huge losses and insurance costs.⁴³ This planetary awareness is now challenging our cultural beliefs about money, wealth, scarcity, abundance and transcending financial models derived from obsolete economics. The new multi-disciplinary models and metrics I describe reassure us that in moving beyond economics and GDP, we will not be flying blind but moving to the many systems models and more accurate data from many scientific fields.⁴⁴ Thus, in addition to our Green Transition Scoreboard®, Ethical Markets is launching with our partner company Biomimicry 3.8 our program for Transforming Finance Based on Ethics and Life's Principles and our manual for asset managers and investors, *Principles of Ethical Biomimicry Finance*™.

This paradigm shift in economics and its financial models is proving highly disruptive to traditional capital asset pricing, modern portfolio theory, value-at-risk, discount rates and their assumptions, particularly in electric power, fossil fuel and nuclear industry finance. The deepest paradigm shift is in the popular movements worldwide to defrock conventional finance. From right-wing US Republican followers of Congressman Ron Paul, Tea Party and fundamentalist “gold bugs” to the Occupy Wall Street and democracy movements, the veils of mystery around money-creation and credit-allocation have been torn away by the financial crises of 2008. Britain’s senior financial regulator, Lord Adair Turner broke ranks and called for an end to allowing private banks to create the nation’s money at interest, but to turn this power back to the government’s public treasury so as to create new money interest free.⁴⁵ This is not as radical as it sounds since the American Monetary Institute’s bill in Congress shows how such a change could be made, using a systemic model of such a transition (www.monetary.org).⁴⁶

The excesses of high-frequency trading and derivatives are visible (now at an astronomical \$1.2 quadrillion global notional value) while global GDP remains in the \$60 trillion range.⁴⁷ All this, together with insider trading scandals, LIBOR interest rate-fixing drives away retail investors now fleeing stock markets, by-passing Wall Street. Many are moving

⁴³ *State of the Climate in 2011*, National Oceanic and Atmospheric Administration Bulletin of the American Meteorological Society, July 2012.

⁴⁴ Henderson, Hazel, “Transitioning to the Solar Age: From Economism to Earth Systems Science,” ICAEW and Tomorrow’s Company, London, forthcoming 2013.

⁴⁵ Turner, Adair. “Debt, Money and Mephistopheles – How do we get out of this mess?” Lecture at Cass Business School, Feb. 6, 2013.

⁴⁶ Yamaguchi, Kaoru, “Workings of a Public Money System of Open Macroeconomies – Modeling the American Monetary Act Completed,” Doshisha University, October 2011.

⁴⁷ Cohan, Peter. “Big Risk: \$1.2 Quadrillion Derivatives Market Dwarfs World GDP,” *Daily Finance*, June 9, 2010.

back to local banking and businesses, peer-to-peer lending, moving off-grid, and using crowdfunding such as MOSAIC, the local rooftop solar PV provider which financed three recent cooperative projects in 24 hours.⁴⁸ Students, egged on by Bill McKibben’s 350.org and former US Vice President Al Gore (*The Future*, 2013), demand 250 universities and their colleges’ endowments divest from fossil fuel companies. While Harvard resisted, several colleges are complying and some mutual funds, including Portfolio 21 Global Equity Fund and Green Century Balanced Fund, offer fossil-fuel free portfolios. Independent research from Aperio shows little effect on the performance of such funds in simulation models and back-casting.⁴⁹ Seattle’s Mayor Mike McGinn requested the city’s two chief pension funds “to refrain from future investments in fossil fuel companies and begin the process of divesting”.⁵⁰ The Green Growth Alliance, tasked by the G-20 and chaired by former Mexican President Felipe Calderon calls for \$700 billion for sustainable infrastructure investments annually.⁵¹

Green R&D Accelerating

As we reported in the GTS August 2012 update, R&D into greener technologies is accelerating but difficult to fully document due to proprietary and competitive considerations, as well as our \$100 million threshold for inclusion in Green R&D

Thus, many exciting advances I reported in my earlier GTS overview were from smaller companies, many still privately held. This trend has continued, whether in more-efficiently designed products such as the upcycled vehicle tires of Lehigh Technologies or others leading the green chemistry revolution: Seventh Generation, Bioamber, Amyris, Kior, Renmatix, Pantheon, Natcore and others, to newly designed LED lighting without heavy metals.

Green chemistry, pioneered by Biomimicry, Warner Babcock, and the ACS Green Chemistry Institute is revolutionizing traditional industries in many countries, e.g., Brazil-based Natura and in the USA where the Congress is taking notice with Senator Frank Lautenberg’s (D-NJ) reintroduced Safe Chemicals Act, with support from the American Sustainable Business Council.⁵² Organically designed solar cells at Northwestern University; thin-film solar cells based on organic photovoltaic (OPV) technology

⁴⁸ Woody, Todd. “Startup Launches Online Platform to Let Individuals Invest in Solar Projects,” *Forbes*, Jan. 7, 2013.

⁴⁹ Gunther, Marc. “Deep green investing: A closer look,” *GreenBiz.com*, Feb. 4, 2013.

⁵⁰ Jabush, Garvin. “2013: Green Economy Inflection Point,” *AltEnergyStocks.com*, Jan. 6, 2013.

⁵¹ Berthon, Bruno. “A call for \$700 billion in sustainable infrastructure investments,” *GreenBiz.com*, Jan. 23, 2013.

⁵² Safer Chemicals Campaign, www.asbc.org.

from Global Photonic Energy Corporation (GPEC) and the University of Michigan⁵³; Natcore's non-toxic coating for any kind of solar panel to increase energy efficiency; V3 Solar's spinning solar cells, all are driving down costs and leading to forecasts that 100% renewable energy is becoming the new normal, with many cities setting such goals as mentioned earlier, as well as companies including Google, IKEA and Whole Foods.⁵⁴

Estonia is the first country to build a national electric vehicle charging network of 165 stations.⁵⁵ Cities are following suit with London's 300 diesel/electric buses with a further 600 on delivery in 2013 and 1000 electric charging stations. The C-40 group of 63 cities led by New York's Mayor Michael Bloomberg is accelerating such changes in partnership with the William J. Clinton Foundation.⁵⁶ All this green progress is tracked in the USA by the US Metro CleanTech Index.⁵⁷ The UK's new Green Investment Bank will be based in Edinburgh, Scotland, and in London. One of its trustees is Tessa Tennant, green investment pioneer, founder of ASRIA and member of Ethical Markets Advisory Board.

Water in the Mix

Water and looming shortages are becoming a major focus since energy generation from fossil fuels, nuclear and shale fracturing use enormous quantities of water.⁵⁸ Electric power plants in the USA account for 39% of all fresh water withdrawals – about the same amount as agriculture – or 136 billion gallons daily.⁵⁹ Desalination of seawater is expensive and energy-intensive. China's \$4.1 billion facility in Tanjin began generating electricity in 2009 and by 2010 produced China's first large-scale, main-supplied desalinated water. Yangzi River water diversion of 700 miles to Tanjin and

⁵³ Casey, Tina. "Grid Parity in Sight for New Low-Cost Solar Cell," www.cleantechnica.com, Dec. 8, 2012

⁵⁴ Moss, Diane, "100% Renewable Energy: Becoming the New Normal?" www.cleantechnica.com, Feb. 22, 2013.

⁵⁵ "1st Nationwide EV Fast Charging Network – In Estonia," www.evobsession.com, Feb. 23, 2013.

⁵⁶ www.C40cities.org

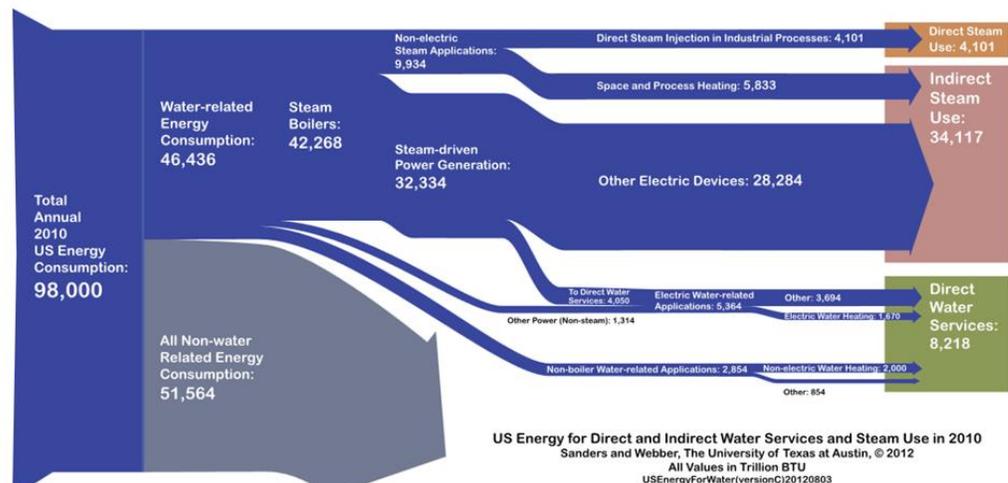
⁵⁷ US Metro CleanTech Index, Clean Edge, October 2012.

⁵⁸ Sanders, Kelly T. and Michael E. Webber. "Evaluating the energy consumed for water use in the United States," *Environmental Research Letters*, 7 (2012) 034034 (11pp).

⁵⁹ "Water Footprint of Electricity," www.rivernetwork.org.

Beijing has cost \$34 billion so far and is to be completed by late 2014, after the removal of 330,000 people!⁶⁰ A renewable energy powered desalination plant in Masdar, Abu Dabi, which aims to be commercially viable by 2020 is a better way.⁶¹ Water wars in the US are possible.⁶² In 2013, Lakes Michigan and Huron hit their lowest levels on record with urban demand clashing with the needs of agriculture and navigation. The Mississippi River became too low for some ship traffic – and record droughts may continue. Conservation and smart-use seem the best answers along with pollution prevention, recycling and re-use, as in California where recycled sewage is now cleaned to drinking water standards.

Cutting water use may not be enough. It may be necessary to radically change the "flush and forget" plumbing and sewage-treatment systems industrial societies consider as "progress." Environmental scientist and consultant Fred Pearce explores returning to age-old methods used in the developing world – collecting human wastes and



spreading them on farm land.⁶³ Collecting "night soil" is still practiced, for example in India and many other countries pumping out septic tanks and pit latrines in African countries, and in Mexico where sewage is still used in farming. The city of Milwaukee pioneered in selling Milorganite, a fertilizer made from its citizens' sewage. Pearce says, "realization is growing that our faeces and urine... are a valuable resource." He adds that each human produces some 500 liters of

⁶⁰ "Desalination: Costly Drops," *The Economist*, Feb. 9, 2013.

⁶¹ "Could Massive Solar Powered Desalination Plants Help Cancel Out Rising Sea Levels?" www.cleantechnica.com, Jan. 19, 2013.

⁶² Reardon, Sara and Hal Hodson. "Water wars loom as US runs dry," *New Scientist*, Feb. 16, 2013.

⁶³ Pearce, Fred. "Flushed with success," *New Scientist*, Feb. 16, 2013, pp. 49-51.

urine and 50 kilograms of feces annually (10 kilograms of phosphorus, nitrogen and potassium compounds). These are the three main nutrients in roughly correct proportions that plants need to grow and sufficient to produce more than 200 kilograms of cereals.⁶⁴ Permaculturalist Bill Mollison demonstrated how sewage can be used safely to restore land.⁶⁵

In the 1970s and 1980s, many “back-to-the-land” groups in North America, Australia, Europe and Japan turned to permaculture methods of food production and showed how using human-produced phosphorus, nitrogen and potassium can produce bumper crops safely. Others experimented with composting toilets, such as the Clivus Multrum still available from Swedish inventor Rikard Lindstrom. Rural development models include many water-saving and recycling improvements, such as several of the finalist in the global innovation KATERVA Awards of 2012.⁶⁶ Companies are also re-designing processes for dyeing textiles without using water, by substituting CO₂, as GTS reported in 2012 and in Sweden’s H&M, a big user of textiles adopting water-saving methods advised by WWF.⁶⁷

Batteries, Super Capacitors and More

New approaches to storage are producing many innovations from passive green off-grid buildings which store solar energy⁶⁸ to super capacitors which store electricity differently from batteries – used in electric and hybrid cars to store braking energy.⁶⁹ Giant batteries are in development for Texas wind farms by Xtreme Power.⁷⁰ The future of storage, batteries, super capacitors and flywheels will be different from the past massive pumped storage of water for power-plants and huge dams and hydro-electric plants. Flexible and smaller-scale storage seems the new focus, with the advent of electrical transport, where every vehicle is also a storage “battery.” Ethical Markets TV Series explored

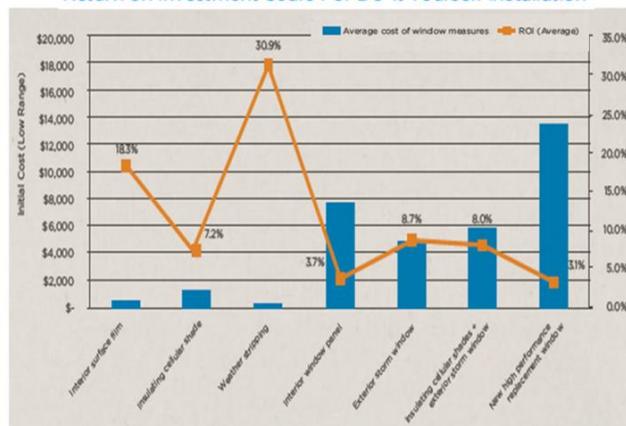
such scenarios in its “[Green Building and Design](#)” and “[Renewable Energy](#)” programs.⁷¹

New materials are being researched at MIT, Chicago’s Joint Center for Energy Storage Research (JCESR) and Argonne National Laboratory.⁷² Perhaps the most unusual research on new storage for solar energy comes from a 1975 experiment at the University of Texas at Austin on the storage capacity of rust, i.e., iron oxide, which is non-toxic, abundant and cheap. New research at Imperial College London finds that iron oxide can convert solar energy to hydrogen, and others at Denison University, Ohio; Technion University, Haifa, Israel; and the Swiss Federal Institute of Technology at Lausanne (EPFL) are pursuing these storage models.⁷³

Bringing Green Markets Home

Transitioning to decentralized and local green markets continues beyond energy and such shifts as those in Boulder, Colorado, reported in the GTS. Their municipal electric utility was bought from Xcel Energy and now is focused on phasing in renewable energy which will reduce costs as well as lowering emissions by 50%.⁷⁴ The CLEAN LA Solar Program allows local businesses, residents and organizations to install renewable energy projects and sell power they produce to the utility, bringing 100 MW of local solar online in the LA service area.⁷⁵

Return on Investment Soars For Do-it-Yourself Installation



(from Preservation Green Lab’s study on efficiency from wind retrofits and replacements)

⁶⁴ Ibid.

⁶⁵ Mollison, Bill and David Holmgren. *Perma~Culture One*, Tagari, Australia, 1978,1981.

⁶⁶ Adams, Susan. “The World’s Best Sustainability Ideas,” *Forbes*, www.katerva.org, Jan. 30, 2013. Hazel Henderson serves as one of the global judges for KATERVA, along with Janine Benyus, founder of Ethical Markets Media partner company Biomimicry 3.8.

⁶⁷ Stevens, Harry. “Inside H&M’s design for a new water management strategy,” www.greenbiz.com, Feb. 14, 2013.

⁶⁸ “Green Building Outlook Strong for Both Non-Residential & Residential Sectors Despite Soft Economy,” www.construction.com, Nov. 12, 2012.

⁶⁹ “Exploring Super Capacitors to Improve Their Structure,” www.sciencedaily.com, Feb. 18, 2013.

⁷⁰ “Greening the grid,” *New Scientist*, Feb. 2, 2013.

⁷¹ www.ethicalmarkets.tv. The series is available for college use at www.films.com.

⁷² “The future of energy: Batteries included?” *The Economist*, Feb. 2, 2013.

⁷³ Lubick, Naomi. “Midnight Sun,” *New Scientist*, Jan. 26, 2013.

⁷⁴ Minott, Christopher. “Boulder steps closer to creating clean energy-based municipal utility,”

www.renewableenergyworld.com, Feb. 25, 2013.

⁷⁵ Bernhardt, John. “A Bright Future for the CLEAN LA Solar Program,” www.renewableenergyworld.com, Feb. 22, 2013.

US shoppers are choosing local with 66% saying they prefer local food, even over organics, according to a survey by A. T. Kearney, and another by Whole Foods Market found 47% of the 22,274 adults they polled would pay more for locally grown foods.⁷⁶

In St. Augustine, Florida, home of Ethical Markets Media and our Henderson-Kay-Schumacher Library, a local renewable energy company, Solar Stik, supplies on-site, small-scale wind and solar packs for use on boats and for military bases off-grid, employing 25 local workers.⁷⁷

guide to the leading edge of the global green transition.

A key example concerns how to sequester carbon, which we have reported can be best achieved by restoring soils, rangelands and forest, as in the biomimicry research of our Advisory Board members, along with Janine Benyus; Wes Jackson, the Land Institute; Allan Savory and partner John Fullerton in the Grasslands Project in South Dakota; John Todd, University of Vermont; Gunter Pauli, author of *The Blue Economy* (2010); Martin Ping, Hawthorne Valley Farm, NY, and others. Now soil scientist Kenneth Olson of the University of Illinois has developed a new measure for soil CO₂ sequestration, SOC, which can compare different tillage and restoration methods and monitor results.⁷⁹ Allan Savory's earlier research indicates that properly managed agriculture, rangelands and forests can absorb past and current CO₂ emissions worldwide cheaply and effectively – rather than coal plant sequestration and other costly, unproven schemes.⁸⁰

Biomimicry designs run the gamut from enhancing computer models (GTS, August 2012), advanced engineering software by Ansys, Dassault Systèmes and LMS International, a Siemens subsidiary, now selling pricey biomimicry-inspired software packages.⁸¹ Biomimicry is redesigning aircraft and speedboats to the array of bio-based chemicals and plastics we describe in this report. While these bioplastics cut use of fossil fuel feedstocks and produce up to 60% less greenhouse gasses, we and many other biomimicry specialists worry about over-use of biomass for wasteful or non-essential products or in plastic packaging mixed with more toxic feedstock, as well as new toxic chemicals from biomass such as benzene and toluene.⁸² The ramp-up of land-based biofuel production in the USA is destroying grasslands as well as competing with food, and encouraging further deforestation worldwide.⁸³ To avoid such new dangers requires more sustainable forms of consumption and steering the global \$500 billion annual advertising industry toward healthier lifestyles as we do with our [EthicMark® Awards](#), partnering with the World Business Academy and ESPM in Brazil. Genuine

⁷⁹ "New Protocol Recommendations for Measuring Soil Organic Carbon Sequestration," www.SciencDaily.com, Feb. 1, 2013.

⁸⁰ Savory, Allan. "Holistic resource management: a conceptual framework for ecologically sound economic modeling," *Ecological Economics*, 3 (1991) 181-191; available at www.ethicalmarkets.com.

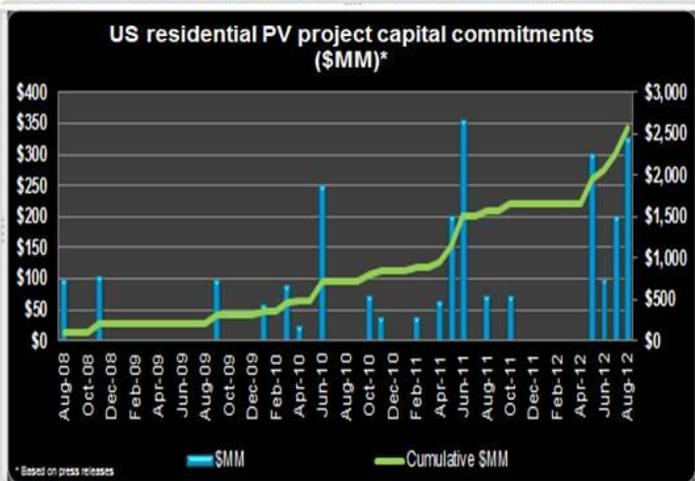
⁸¹ Konrad, Alex. "The Evolution of Everyday Things," *Forbes*, March 4, 2013.

⁸² Belliveau, Mike. "Bio-based chemicals: When green is toxic," www.greenbiz.com, Feb. 1, 2013.

⁸³ Spross, Jeff. "Biofuels Policy Helping Destroy U.S. Grasslands at Fastest Rate Since 1930s, Boosting Threat of Dust-Bowlification," ThinkProgress.org, Feb. 25, 2013.

INVESTORS ARE COMMITTING Clean Power Finance
BILLIONS TO DISTRIBUTED SOLAR FINANCING

Distributed solar delivers investors 'credit card returns at AAA bond risk'



Applying Biomimicry

Localization is a key principle for redesigning industrial methods, agriculture, infrastructure, sustainable communities as developed by our partner company, Biomimicry 3.8 and our joint Principles of Ethical Biomimicry Finance™. For example, with the guidance of Janine Benyus and Biomimicry 3.8, the city of Lavasa is rising in India, 60 miles south of Mumbai, as a set of villages of between 30,000 and 50,000 people, using their "Genius of Place" ecological designs with the architectural firm HOK.⁷⁸ We at Ethical Markets focus on biomimicry and Life's Principles which have guided successful evolution of the 30 million species on Earth for 3.8 billion years. Thus, GTS tracks biomimicry innovations as our best

⁷⁶ Blomberg, Lindsey. "Shoppers Choose Local," www.emagazine.com, Feb. 25, 2013.

⁷⁷ Jordan, Douglas. "Portable Power Needs Fuel Business," *St. Augustine Record*, Feb. 25, 2013.

⁷⁸ Berg, Nate. "Inspired Infrastructure," *ensia Environmental Solutions in Action*, Spring 2013, p.10.

biomimicry uses only green chemistry from the lightest elements in the Periodic table at room temperature, using water as solvents rather than untested nanotechnology, genetic modification, artificial life-forms or earlier, obsolete industrial methods which Janine Benyus calls “heat, beat and treat.”

As the biomimicry innovation revolution gathers speed, as in our co-sponsorship of the conference on Biomimicry Innovation and Finance, Zurich, August 2012, we will scan this exploding field for those technologies and companies that truly keep to Life’s Principles, such as the resurgence of seawater-based farming on desert lands, using the thousands of salt-loving plants researched by our Advisory Board member Dr. Mae-wan Ho⁸⁴ and NASA’s chief scientist Dr. Dennis Bushnell.⁸⁵ Dr. Carl Hodges pioneered such experiments in Mexico in the 1970s and later in Egypt, the Middle East and Africa with his Seawater Foundation and Advanced Biofuels production of plants for food and oils.⁸⁶

The year 2013 promises further shifts away from the fossil-fueled Industrial Era, as we track additional private investments into the exciting opportunities in cleaner, knowledge-rich sectors of the worldwide green economy transition.

⁸⁴ Ho, Dr. Mae-Wan and Prof. Joe Cummins. “Saline Agriculture to Feed and Fuel the World,” www.i-sis.org.uk, Feb. 18, 2013.

⁸⁵ Bushnell, Dennis. “Seawater/Saline Agriculture for Energy, Water, Land, Food and Warming,” ed. Gad-el-Hak, Mohamed, *Large-Scale Disasters: Prediction, Control and Mitigation*, Cambridge University Press, 2008, p. 212.

⁸⁶ “Launch of Commercial Scale Seawater-Based Biofuels Project in Egypt,” press release, Energy Allied International and the Seawater Foundation, March 29, 2010.

Part Two – Sectors Data

Sectors Covered

The Green Transition Scoreboard® (GTS) tracks private investments growing the green economy worldwide since 2007, totaling in Q4 of 2012 \$4.1 trillion. Governments and some institutional investors are increasing their focus on growing greener economies since Rio+20 in 2012 but are not included in this report. We recommend investing at least 10% of institutional portfolios directly in companies driving the global Green Transition which provides a way to update strategic asset allocation models both as opportunities and as risk mitigation. This transition strategy is now recognized in the 2012 report by Mercer which suggested 40% of portfolios should be in Green Transition sectors.⁸⁷ This consensus validates models indicating that investing \$1 trillion annually until 2020 can scale wind, solar and other renewables, efficient energy and material, green construction, cleantech, R&D, sustainable land-use, smart infrastructure, transport and urban re-design to accelerate the Green Transition globally, scale these innovations and reduce their costs.

The Green Transition Scoreboard® tracks five sectors: Renewable Energy; Green Construction, Energy Efficiency; Corporate R&D and Cleantech.

INVESTMENTS IN GREEN TRANSITION	
2007-2012	
Sector	US \$
RENEWABLE ENERGY	\$2,281,347,792,080
GREEN CONSTRUCTION	\$837,620,000,000
ENERGY EFFICIENCY	\$526,921,247,320
CORPORATE R&D	\$251,504,462,815
CLEANTECH	\$224,601,088,873
TOTAL	\$4,121,994,591,088

The February 2013 GTS report shows over \$4.1 trillion in private investments in the green economy, demonstrating our recommended avenue for institutional investors to shift from fossilized sectors—increasingly stranded assets as low-carbon regulations are implemented and oil, coal and gas reserves become harder to exploit.

⁸⁷ "Through the Looking Glass: how investors are applying the results of the climate change scenario study," Mercer, LLC, New York, 2012.

Our definition of 'green' is quite strict, omitting areas such as clean coal, carbon capture & sequestration, and biofuels from feedstocks other than sea-grown algae. We are also looking closely at nanotech, genetic engineering, artificial life-forms and 3D printing, determining their green contribution on a case by case basis.

Please note that international investments are reported in US dollars and are subject to fluctuating exchange rates.

What's Included

These Green Transition Scoreboard® five sectors: Renewable Energy; Green Construction, Energy Efficiency; Corporate R&D and Cleantech represent broad areas of investment in green technologies, many overlapping. Each covers an area of substantial capital investment in technologies which Hazel Henderson's years of research as a science advisor and which the [Ethical Markets Advisory Board](#) expertise indicate have contributed and are contributing to a sustainable future.

GTS data sources include the highly respected Cleantech, Bloomberg, Yahoo Finance, Reuters and many new UN and other international studies and individual company reports. Companies, organizations and the sources of financial data included in the GTS are screened by rigorous social, environment and ethical auditing standards. They can be found in indexes such as Calvert, Domini and Pax World, the PowerShares Cleantech Portfolio, Dow Jones Sustainability Indexes, London's FTSE4GOOD, NASDAQ OMX Green Economy Global Benchmark Index, ASPI Eurozone, the many newsletters from around the world we post daily at www.ethicalmarkets.com and others.

What's Omitted

The GTS focuses on private sector investments, thus government funded projects and initiatives are purposefully omitted. Sustainable technologies suffer from the misperception that they cannot stand alone, reinforced by campaigns by fossil fuel companies that miscast the percentage of subsidies to renewable energy, which in reality go to fossil fuels, e.g., \$500 billion worldwide in 2012, up from \$409 billion in 2011.^{88,89} To bypass the

⁸⁸ *Renewables Global Futures Report*, REN 21, Paris 2013.

continuing political debate over the allocation of subsidies, the GTS purposefully omits government funded projects and initiatives. When government funding is part of a larger project, the research team has removed, in as far as is transparent, the portion of investments from government funds. With these omissions, the GTS still exceeds \$4.1 trillion, proving that green technologies are competing and are already cheaper than nuclear power,⁹⁰ as well as coal and oil when their external costs are included.

Certain sectors and technologies are omitted. Despite arguments made that nuclear energy is a sustainable option, EROI from mining, enrichment, processing, transportation, and waste disposal and decommissioning costs are infrequently counted. Nuclear has enormous taxpayer subsidies in the US, and the Price-Anderson government insurance provision⁹¹ because no private insurer will take on the risk, showing that nuclear is neither environmentally sound or sustainable. China still hopes to become a global exporter of new designs, but its experimental projects introduce new concerns. Construction on a pebble-bed model reactor must go beyond Germany's abandoned pebble-bed prototype which cost \$7.3 billion to decontaminate.⁹² China's efforts in clean energy should capitalize on the country's lead in solar cell production.

We omit coal carbon sequestration (CCS) due to its major government subsidies and huge costs, according to an MIT CCS study which projects costs would rise from the current 5 cents a Kwh to 8 cents (not including coal subsidies and externalities) from conventional energy sources.^{93, 94} Still unproven, CCS would reduce the efficiency of coal-fired plants by as much as 40%.^{95, 96} The rush to

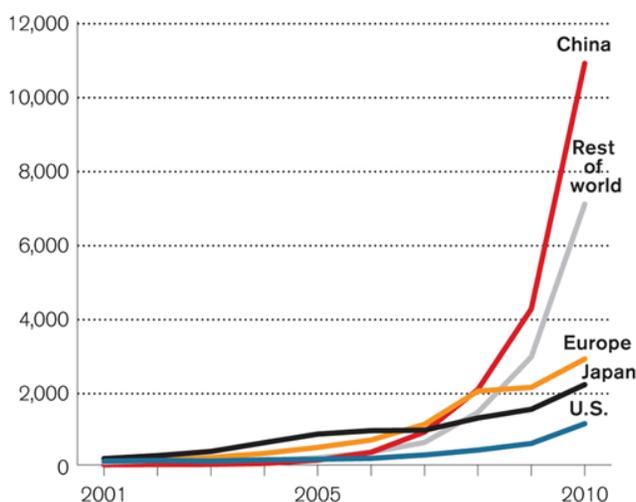
shale-fractured natural gas in the USA can reduce use of coal since its burning emits 50% less CO₂, but these shale-gas deposits incur risks to water supplies and incur methane releases that increase their CO₂ emissions.

Biofuels are omitted even though their use worldwide is growing. While local use of biomass recycled sustainably on small farms and other traditional uses in developing countries will continue, too much is invested in industrial-scale facilities, as

FAR AHEAD

China's production of solar cells is far outpacing everyone else's.

Annual solar-cell production (megawatts)



Source: GTM Research

well as in genetically modified microbes to produce fuels – dubious propositions for long-term sustainability. Research indicates that increasing production of crops, even inedible grasses, still require water and land better suited for range or agriculture food production. Many corn-based ethanol plants have closed and the some \$50 billion of US subsidies will be reduced and should be phased out. Mandates for 10% ethanol in US gasoline still are in place and also need to be phased out, since the future of transport is more likely to be electrically powered, as discussed in **Batteries, Super Capacitors and More.**

Exceptions are made for biofuels from algae grown on seawater, halophyte plants or other organic matter which do not take from the essential lifecycle of returning nutrients to the soil. Even so, this is still a point of debate as ecological design shows that all phases of plant growth and decay are essential to

⁸⁹ Sills, Ben. "Fossil Fuel Subsidies Six Times More than Renewable Energy," Bloomberg News, Nov. 9, 2011.

⁹⁰ Blackburn, John (former chancellor of Duke University). "Solar and Nuclear Costs – the Historic Crossover," NC WARN, July 2010.

⁹¹ "Price-Anderson Nuclear Industries Indemnity Act," Title 42 U.S. Code, Ch. 23.A.XIII (2006).

⁹² "China's Nuclear Muscle," *Bloomberg Businessweek*, Feb. 25-March 3, 2013, p. 11.

⁹³ Hamilton, Michael, Howard Herzog and John Parsons. "Cost and U.S. public policy for new coal power plants with carbon capture and sequestration," *Energy Procedia* 1 pp. 4487-4494, 2009.

⁹⁴ "Dig Deep." *The Economist*, June 21, 2008.

⁹⁵ Hamilton, Michael, et al. Op. cit.

⁹⁶ US Budget FY 2012

ensure the most nutrient rich lifecycle of any given biota.

Several subsectors have been purposefully omitted either because of controversy or lack of consensus that they will make a long-term contribution to sustainability. For example, nanotechnology may be appropriate in particular projects if further research concludes it is sustainable, without detrimental effect to life. Particularly worrying are the nanotech particles already present and untested in our food supply, cosmetics and household products.⁹⁷ The research team was approached to include nanotechnology as a solution to stave off future crisis in agriculture and manufacturing. The team chose to address nanotech on a case by case basis after convening a working group with David Rejeski, Director of the Woodrow Wilson Center Science and Technology Innovation Program, and others researching the field, as we do in our Principles of Ethical Biomimicry Finance™, jointly developed with our partner Biomimicry 3.8.

⁹⁷ Belli, Brita. "Eating Nano," *E-The Environmental Magazine*, vol. XXIII, no. 6, December 2012.

Renewable Energy

Investments in **Renewable Energy** include private technology development, equipment manufacturing, project finance and M&A activity. The sector is divided into current investments by year of funding and future commitments.

RENEWABLE ENERGY	
Year	Amount (USD)
2007	\$ 162,200,000,000
2008	\$ 205,500,000,000
2009	\$ 209,500,000,000
2010	\$ 266,700,000,000
2011	\$ 310,800,000,000
2012	\$ 286,400,000,000
Commitments	\$ 840,247,792,080
Total	\$ 2,281,347,792,080

Important to the Renewable Energy sector is the growth of renewable energy in developing countries. Investments used to be heavily concentrated in Europe and the US – 76% of clean energy investment in 2001 but down to 61% in 2011.⁹⁸ Supporting the growth trend, we are seeing a huge number of renewable energy auctions in various countries and regions such as Brazil, South Africa, Japan, the Caribbean and the Middle East, where a country will commit to a certain capacity, say 200MW of offshore wind, and accept the most competitive bid.⁹⁹

Another trend is the amount in commitments from big US banks. Bank of America, Goldman Sach and Wells Fargo have committed \$50, \$40 and \$30 billion respectively.¹⁰⁰

The majority of the current investment numbers are based on global trends reporting by Bloomberg New Energy Finance under contract with UNEP¹⁰¹ as well as other international studies.

⁹⁸ "Renewable energy country attractiveness indices," Ernst & Young, Nov. 2012, Issue 35.

⁹⁹ See for example, Nielsen, Stephan. "Jamaica Gets 85 Inquires for Renewable Energy Auction," Bloomberg.com, Jan. 18, 2013.

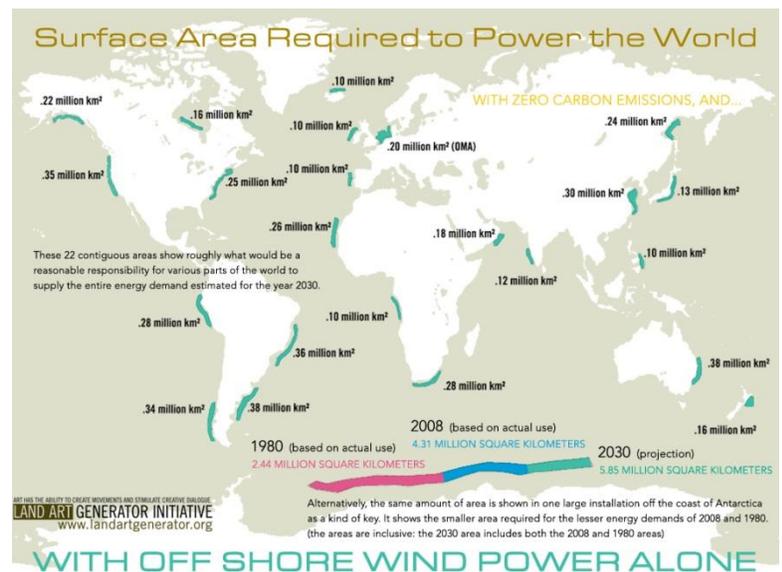
¹⁰⁰ "Bank of America Announces New \$50 Billion Environmental Business Initiative," Bank of America Newsroom, June 11, 2012; "Goldman set \$40 bln clean energy investment plan," *Reuters*, May 23, 2012; "Wells Fargo: \$30 Billion in Green Economy Loans by 2020," *SustainableBusiness.com News*, April 23, 2012.

¹⁰¹ McCrone, Angus, Eric Usher, Virginia Sonntag-O'Brien, Ulf Moslener, Jan G. Andreas and Christine

Commitment numbers have been compiled project by project from daily monitoring by Hazel Henderson, online research and other sources, posted at www.ethicalmarkets.com on our Green Prosperity, Energy Efficiency, GreenTech, Trendspotting and Earth Systems Science pages. The \$542 billion Desertec project (a Club of Rome initiative to provide 15% of energy needs to the European Union from the Sahara) is included in the commitments section even as work is now proceeding in Saudi Arabia, Morocco and Tunisia, and the "Asian Supergrid" promoted by Japan. The Desertec commitment figure will be modified as projects come to fruition.

Government R&D is omitted in our practice of removing public investments. As a rule, Corporate R&D is omitted here and reported Green R&D to avoid double-counting.

Biofuels are omitted, as mentioned in **What's Omitted**, because biofuel production competes with food production and because studies, such as that from Cornell and Berkeley, show that biofuels have a negative EROI.¹⁰² However, amounts for 2010, 2011 and Commitments (see **Appendix 1 – Investment Totals**) are aggregates from industry and company press releases, limiting our ability to remove all Corporate R&D or biofuels.



Grüning. "Global Trends in Renewable Energy Investment 2011," United Nations Environment Programme, Frankfurt School UNEP Collaborating Center and Bloomberg, 2011.

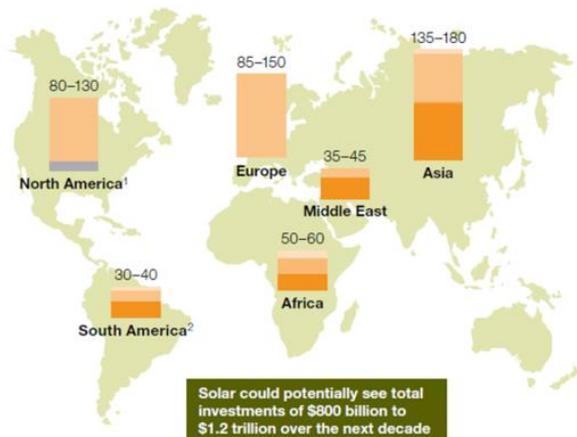
¹⁰² Pimentel, David and Patzek, Tad W. "Ethanol Production Using Corn, Switchgrass and Wood; Biodiesel Production Using Soybean and Sunflower." *Natural Resources Research*, vol. 14, no. 1, March 2005.

As mentioned in the **Introduction and Overview**, mal-investments in coal and gas continue, due to unaccounted externalities and subsidies to fossil fuels, which actually increased in 2012. The tremendous waste of capital due to theory-induced blindness will continue until pollution and carbon taxes take hold in China and other countries and other external costs are fully reflected in financial models, corporate balance sheets and national accounts. Luckily, as we report, these metrics are slowly changing at all levels and more science-based research is replacing theoretical models based on outdated economic assumptions. Asset managers, particularly at pension funds are being stressed by labor unions and student movements to redeploy their portfolios from big fossil-fuel and nuclear projects to renewable energy companies. Retraining for such portfolio managers in ESG and “triple bottom line” analyses is now offered at Scotland’s St. Andrews University and other courses.¹⁰³

Growth in solar PV may transform power markets.

Cumulative capacity additions, 2012–20, gigawatts

Off-grid Residential and commercial Isolated grids Peak capacity Large-scale power plants³



(from McKinsey & Co’s report on solar)

A Look at Geothermal

A Look at Wave Energy

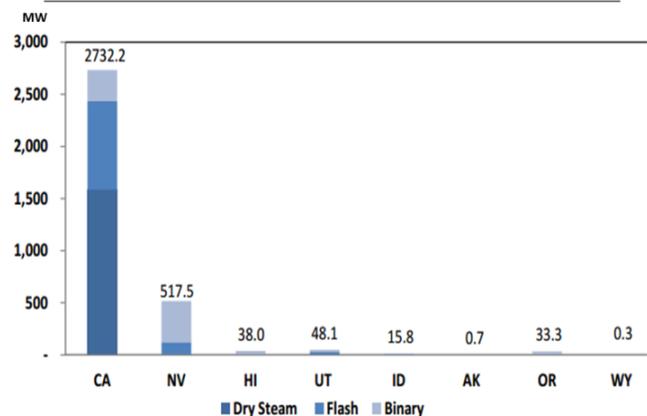
Summary of resource estimates for offshore and nearshore wave energy farms

	Offshore		Nearshore	
	Annual energy [TWh/y]	Mean power [GW]	Annual energy [TWh/y]	Mean power [GW]
Total	230	26	230	26
Theoretical	146	18	133	15
Technical	95	11	10	1
Practical	70	8	5.7	0.6

(from the UK Carbon Trust’s study of the UK wave resource)

A Look at Solar PV

February 2013, US Geothermal Installed Capacity by State (MW)



(from GEA’s 2013 Annual US Geothermal Power Production and Development Report)

¹⁰³ Henderson, Hazel, “Transitioning to the Solar Age: From Economism to Earth Systems Science,” forthcoming 2013.

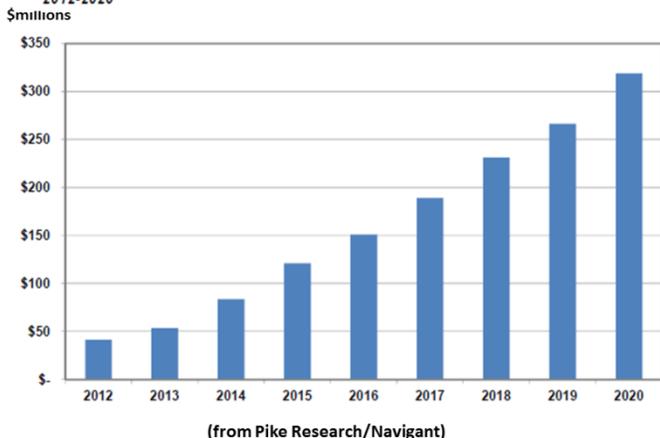
Green Construction

Investments in **Green Construction** include new building construction and existing building retrofits. The sector is divided into current investments by year of funding.

GREEN CONSTRUCTION	
Year	Amount (USD)
2007 (USA only)	\$ 33,460,000,000
2008 (USA only)	\$ 42,500,000,000
2009 (Global)	\$ 103,200,000,000
2010 (Global)	\$ 197,400,000,000
2011(e) (Global)	\$ 218,719,200,000
2012(e) (Global)	\$ 242,340,800,000
Total	\$ 837,620,000,000

This is the most conservatively under-reported sector of this report. We are only counting green construction materials, not including labor. For example, the US Bureau of Labor Statics emphasizes the importance of design occupations such as architects, civil, mechanical and electrical engineers, landscape architects and urban planners, all required to be continuously open to innovation. McGraw Hill Construction News reported 661,000 jobs in green design and construction with 35% of architects, engineers and contractors reporting having green jobs in 2011.¹⁰⁴ The USGBC predicts that green construction will support over 7 million jobs by the end of 2013.¹⁰⁵

Building Energy Management Systems for Utility Customers Spending, World Markets: 2012-2020



¹⁰⁴ "Greenbuild: Growing Green Building Market Supports 661,000 Jobs in the U.S.," press release, McGraw Hill Construction, Oct. 4, 2011.

¹⁰⁵ "Green Jobs Study," Booz Allen Hamilton and USGBC, 2009.

While this sector has been the most challenging to quantify, it is expected to explode, with the green buildings material market projected to reach \$406 billion a year by 2015.¹⁰⁶ The most innovative buildings now produce their own energy onsite, while advanced designs make buildings producing enough energy to feed into grids or local areas.¹⁰⁷

Amounts are calculated using the value of the green construction market, defined as construction built to LEED standards or that incorporate multiple green building elements. Since public-sector information is not recorded, the total includes some government buildings.

Figures for 2007 and 2008 are based on estimates from McGraw Hill that were published in the US Green Building Council 2009 Green Jobs Study.¹⁰⁸ Figures for 2009 are found in the "Diamonds in the Rough: Uncovering Opportunities in the \$277 Billion Green Buildings Market" report by Lux Research.¹⁰⁹ It compiles revenues from "any function, equipment, or material that improves the energy efficiency or reduces net material consumption of a building over and above that of the standard used at the time of original construction." The broad categories are: **Services**, including green engineering and design companies; **Equipment**, including lighting, HVAC, and water heating systems; and **Materials**, including insulation, windows and some structural materials that double as thermal insulators.

Figures for 2010 and 2011 are based on research conducted by Green Market Research, conveyed to the GTS research team by personal correspondence. Given their accounting includes government spending, the research team chose to conservatively discount Green Market Research figures by 30% to account for government buildings.

The estimate for 2012 is based on Green Building Materials and Services Market Research

¹⁰⁶ "Green Building Materials 6 a Global Strategic Business Report," Global Industry Analysts, Inc., 2010.

¹⁰⁷ Makower, Joel. "State of Green Business 2012," GreenBiz Group, 2012, p. 49.

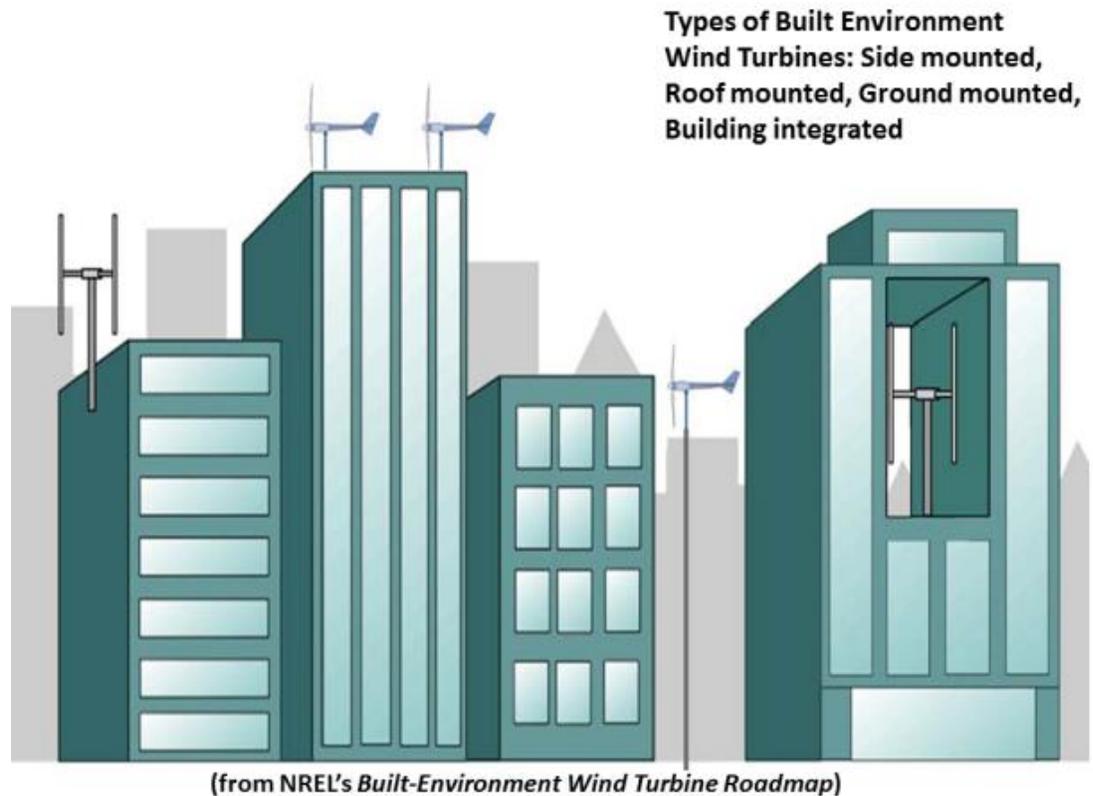
¹⁰⁸ Green Jobs Study. US. Green Building Council, Booz/Allen/Hamilton, 2009.

¹⁰⁹ Diamonds in the Rough: Uncovering Opportunities in the \$277 Billion Green Buildings Market. State of the Market Report, Lux Research, March 2010.

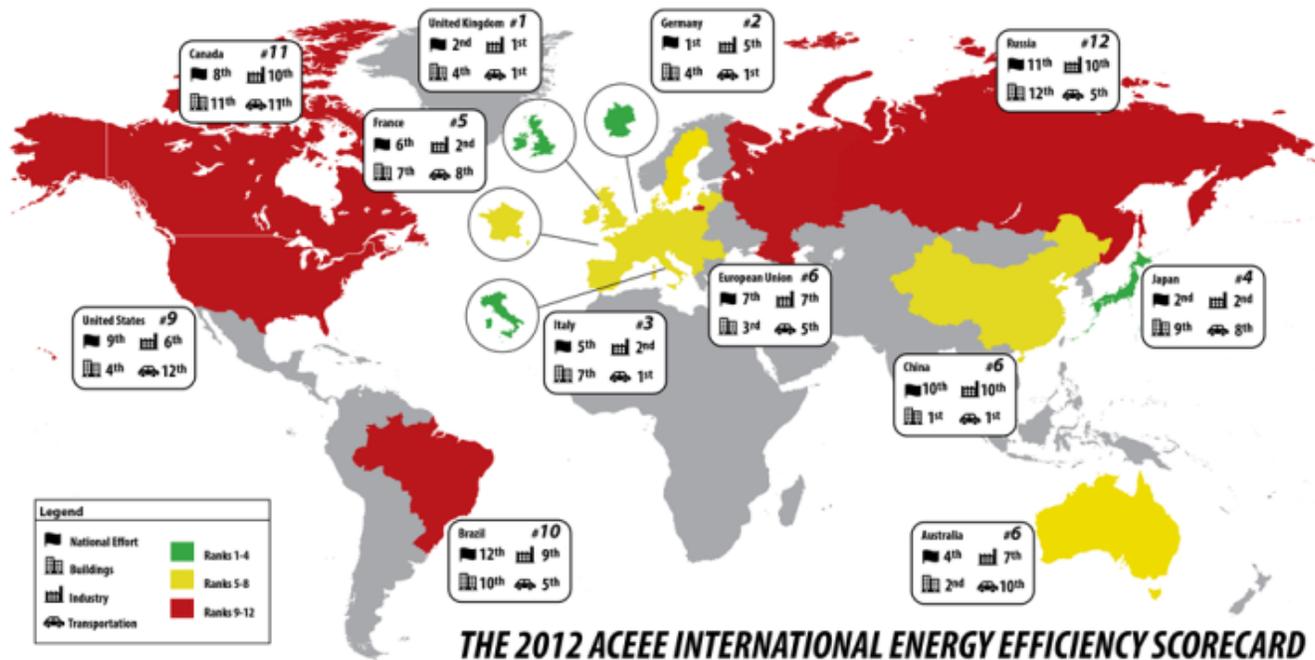
Report and assigns an annually compounded growth rate (CAGR) of 10.8%.

We subtracted figures for government buildings, energy generation equipment and energy monitoring services and hardware (smart meters, etc.) to avoid public investments and double-counting with Smart Grid which is included in Energy Efficiency.

Green Construction figures are taken from revenues of larger equipment and material providers in OECD countries. Similar data for other countries has been a challenge to compile (to provide country-specific sources on green construction and efficiency not included here, please contact our [research team](#)).



Energy Efficiency



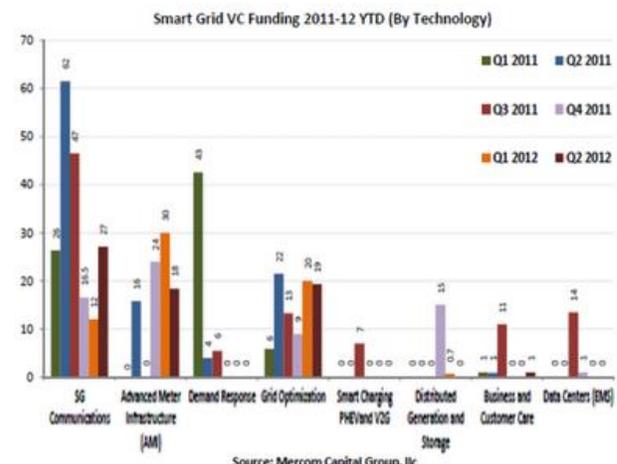
Investments in **Energy Efficiency** include conservation efforts and initiatives and products focused on lowering energy needs or using less energy than a comparable product. Investments in efficiency are more than \$837 billion or nearly 13% of total Green Transition investments.

central to all economic activity, saving nearly £4 trillion a year through reduced costs. Conservation efforts and initiatives are wide ranging and reported using a myriad of terms. As Amory Lovins of the Rocky Mountain Institute has long held, a foundation of sustainability is conservation.

ENERGY EFFICIENCY	
Year	Amount (USD)
2007	\$ 29,706,000,000
2008	\$ 32,703,000,000
2009	\$ 35,597,000,000
2010(e)	\$ 40,545,000,000
2011(e)	\$ 46,181,000,000
Efficiency Financing (2011)	\$ 20,000,000,000
2012(e)	\$ 52,600,000,000
SmartGrid	\$ 269,589,247,320
Total	\$ 526,921,247,320

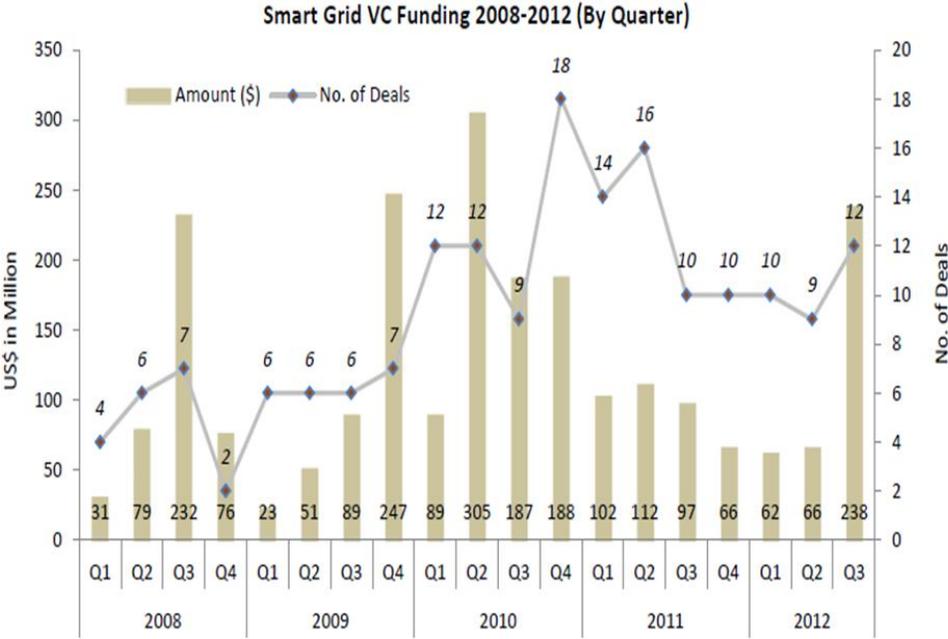
Companies now recognize efficiency investments' rapid payback periods from 12-24 months with revenues for pure-play energy efficiency companies seen as expanding by 13% annually through 2020.¹¹⁰ According to WWF and ECOFYS, by 2050, maximum energy efficiency will become

Smart grid technologies are included here in Energy Efficiency and largely refer to electrical components and equipment. Although it is possible that Smart Grids are serving industrial-era utilities rather than the green economy, the GTS continues to count investments which include smart meters and 2-way power transmission (crucial for large-scale deployment of renewable energy) from firms such as Itron, Hitachi and Legrand.



¹¹⁰ "A Bright Outlook for Energy Efficiency Plays," Bloomberg Businessweek, p. 53, Feb. 7, 2011.

Net-metering by large electric utilities and new programs like CLEAN LA allowing customers to sell their excess power into grids are expanding as reported in **Bringing Green Markets Home**.



Source: Mercom Capital Group, llc*

This sector also includes investments in batteries for electric vehicles and charging infrastructure, while other new storage technologies are discussed in **Batteries, Super Capacitors and More**.

Green R&D

Of the sectors tracked by GTS: Renewable Energy, Green Construction, Energy Efficiency, Cleantech and R&D, the \$251.5 billion invested in R&D accounts for 6.2% of the total GTS, greater than Cleantech.

GREEN R&D	
Year	Amount (USD)
2007	\$ 20,000,000,000
2008	\$ 21,900,000,000
2009	\$ 23,300,000,000
2010	\$ 26,300,000,000
2011	\$ 32,000,000,000
2012 (partial)	\$ 31,500,000,000
Commitments	\$ 98,900,000,000
Total	\$ 254,800,000,000

Significant investments in green R&D show that a company has integrated sustainability into its core strategy, serving as a strong indicator for investors betting on increasing consumer demand for green products. Additionally, this data helps identify innovative companies who are ahead of the curve in responding to heightening environmental risks and regulations.¹¹¹

The data collected for the GTS is the most comprehensive assessment of corporate green R&D performed to date. Our research team scours press releases, sustainability reports, and financial statements. We have identified the 165 companies responsible for more than \$241 billion in green R&D. We believe this amount understates by half actual global Green R&D, considering how much goes unreported for competitive reasons. International companies' R&D does not make it into the media. Companies are not required to report, and tens of thousands of middle-market and smaller companies have R&D budgets below our reporting thresholds of \$100 million.

Also, the data for 2012 is not a full representation of global Green R&D because many companies have not released 2012 financials or sustainability reports. It is encouraging to note that

¹¹¹ See for example, "Through the Looking Glass: how investors are applying the results of the climate change scenario study," Mercer, LLC, New York, 2012; Deutsche Bank, "Sustainable Investing: Establishing Long-Term Value and Performance," DB Climate Change Advisors, June 2012.

even without a full Green R&D inventory, figures for 2012 are approximate to all of 2011. We anticipate the mid-year update of the Green Transition Scoreboard® will note a significant increase.

Country Data

German firms are leading the way when it comes to green R&D, in large part due to automotive manufacturers such as Volkswagen, Robert Bosch, and BMW, all investing heavily into electric cars. Japan is home to leading-edge automotive companies like Toyota and Mitsubishi, and Japanese electronics firms like Panasonic, Sharp and NEC are recognizing the huge potential of green products and investing heavily in this area.

The USA is the official domicile of a large number of innovative firms, even though some of their R&D is conducted in other countries. Large USA-domiciled corporations such as GE and IBM are shifting their strategy in a more sustainable direction. Additionally, the USA hosts dozens of smaller pure-play green companies, such as Cree Inc. and Maxwell Technologies, who are betting solely on rising demand for green products.

Sector Data

As seen in the country data, the automotive industry is the largest investor in green R&D. The auto sector is more research intensive than other sectors, with many companies spending more than 5% of revenues on R&D.¹¹² Toyota, now in second place in worldwide sales, was the earliest adopter, spending billions developing their Prius line of hybrids. The Renault / Nissan alliance announced a [€4 billion push towards zero-emission mobility](#) that started with the Nissan Leaf.¹¹³ Volkswagen announced that they will [invest upwards of €76.4 billion](#) on R&D of efficient vehicles and greening their production sites by 2016.¹¹⁴ The sector total of \$133.5 billion does not capture the entire global investment. Many automobile companies, such as GM and Daimler, do not publicly disclose how much of their R&D is directed towards hybrid and/or electric vehicles.

The semiconductor sector is the next largest investor in green R&D as small-cap solar panel

¹¹² Deutsche Bank Research. "Capital Markets Reward R&D," June 30, 2011.

¹¹³ Squatriglia, Chuck. "Renault-Nissan CEO Pledges \$5.6 Billion for EVs," *Wired*, June 16, 2011.

¹¹⁴ "New Sustainability Objectives," Volkswagen Sustainability Report, 2011.

manufacturers reduce costs and increase efficiency as reported in the **Introduction and Overview**. The industry reached the monumental goal of developing silicon modules at a cost of [\\$1 per watt](#) of capacity.¹¹⁵

Meanwhile, large firms such as Samsung are [investing billions](#) in developing organic light emitting diodes (OLEDs),¹¹⁶ and many small companies investing in developing non-toxic coatings like Natcore Technology for solar panels and Pantheon Chemical, which spends 3-5% of revenue on R&D,¹¹⁷ for aircraft have products yet to come to market.

Research in large-scale storage and better batteries are discussed in **Batteries, Super Capacitors and More**. Investments in these are included in our Cleantech and Energy Efficiency sections.

For more depth on Green R&D, see the August 2012 GTS update focused on Corporate R&D.

¹¹⁵ Roston, Eric. "Solar Silicon Price Drop Brings Renewable Power Closer," Bloomberg.com, March 13, 2012.

¹¹⁶ "LEDs Without Heavy Metals, Silicon Nanocrystal Multicolor LEDs Created," www.cleantechnica.com, Feb. 23, 2013.

¹¹⁷ Lehan, Brad. CFO, Pantheon Enterprises, personal communication, Aug. 27, 2012.

Cleantech

Cleantech is a broad sector and includes companies in the following areas: agriculture; air quality and environment; energy efficiency, lighting, infrastructure and storage; materials; recycling and waste; transportation; and water/wastewater.

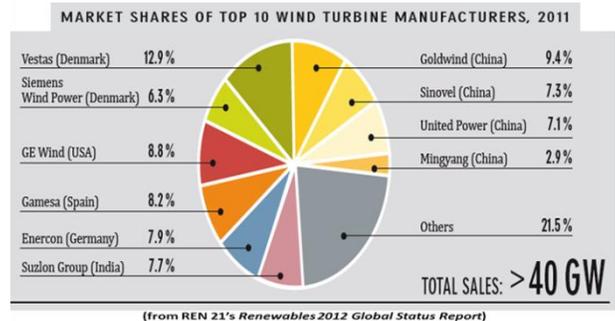
Cleantech	
Venture Capital (2007 - 2012)	\$ 33,616,825,940
Initial Public Offerings (2007 - 2012)	\$ 23,503,429,284
Mergers & Acquisitions (2007 - 2012)	\$167,480,833,649
Total	\$ 224,601,088,873

Cleantech figures are derived in cooperation with The Cleantech Group, LLC, based on their quarterly reporting. For this report, Cleantech Group removes those investment categories which we have chosen not to include in the GTS such as biofuels, clean coal and carbon offsets.

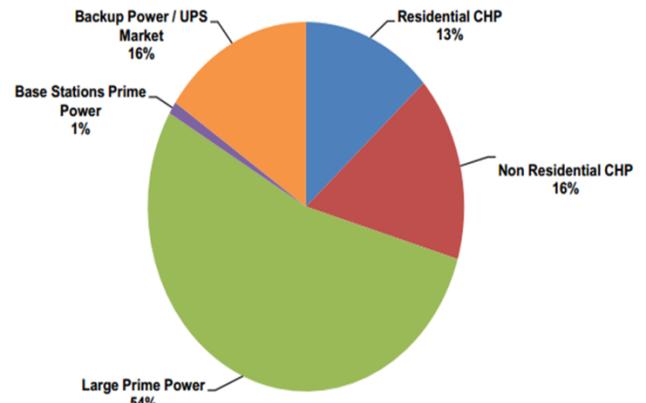
The burst of activity in the Mergers & Acquisitions is largely due to companies that have been hoarding cash since the 2009 credit crunch. They are slowly deploying capital and expanding into the green space. In addition to developing R&D in-house, firms like Google, DuPont, and Toshiba are acquiring small and medium-sized cleantech companies. Breakdown of investments by value chain, sector and geography are available from the Cleantech Group (research.cleantech.com).

As Cleantech grows, energy storage will continue to increase in importance, both at the level of power plants and grid electricity and at retail and local levels with improvements in batteries, fuel cells, flywheels, ultra capacitors, flow batteries, compressed air as well as metering of use at all levels, as discussed in **Batteries, Super Capacitors and More** and the GTS August 2012 update.

Growth in the number of deals reported daily on www.ethicalmarkets.com, for example in wind turbine manufacturers, shows they are rising substantially.

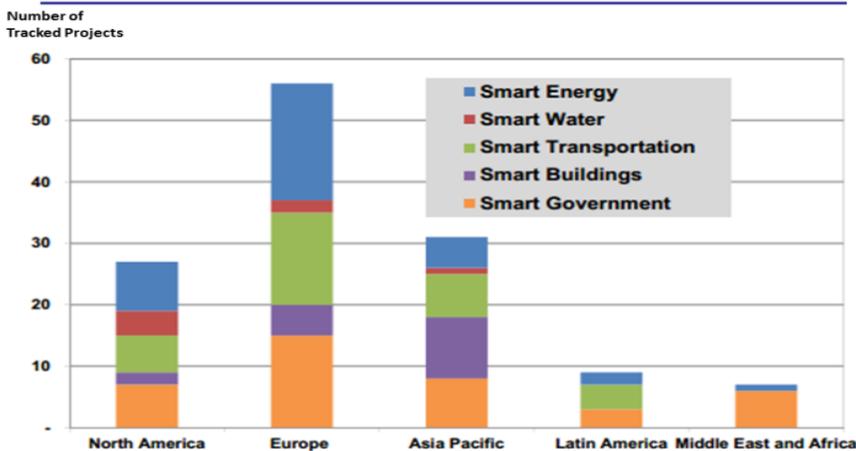


Fuel Cell Systems MW Shipped by Application, World Markets: 2013



(from the Pike Research white paper on 2013 trends in hydrogen and fuel cells)

Smart City Projects by Region and Primary Industry Sector, World Markets: 1Q 2013



(from Pike Research/Navigant)

Because this sector is divided into Venture Capital, Initial Public Offerings and Mergers & Acquisitions, there is no overlap with the Green Construction and Energy Efficiency sections that only count revenues. Where these kinds of investments are included in the Renewable Energy category, they are omitted here.

We also omitted investments in clean coal, as they are a palliative fix for fossil fuel consumption and do not contribute to the green transition. The cost of carbon sequestration of coal emissions price coal out of many markets.¹¹⁸ As national legislation, global agreements and increased cost come into play, coal as well as oil and other fossil fuels will become stranded assets and will need to be written down.

Carbon is best sequestered naturally in soils and forests. We are re-learning land-management methods such as the biochar, the “terra prieta” used in Latin America for centuries, and the sustainable management of grasslands using biomimicry principles (www.biomimicry.net) such as Allan Savory’s Holistic Management restoring scrubland in Africa, Australia and the Grasslands project in South Dakota, USA.^{119, 120} There is renewed interest in seawater farming for food and animal feed using halophyte (salt-loving) plants, all further discussed in **Water in the Mix** and **Applying Biomimicry**.

Similar approaches from The Rodale Institute, Emmaus, Pennsylvania, has shown that organically-grown food production can compete with industrial agriculture while preserving soils. The Land Institute in Salina, Kansas, restores perennial prairie grasses, following the research of ecologist Wes Jackson. Janine Benyus, author of *Biomimicry* (1997), has grown a network of expert consultants worldwide. Our Ethical Markets joint research with Biomimicry 3.8 has produced our Principles of Ethical Biomimicry Finance™, a turnkey manual for licensing to asset managers.

¹¹⁸ "Carbon Capture and Storage: Trouble in store." *The Economist*, March 5, 2009.

¹¹⁹ Ibid.

¹²⁰ "Field Study No. 1: The Grasslands Story," *Field Guide to Investing in a Resilient Economy*, Capital Institute, 2010.

Conclusion

The Green Transition is accelerating and reaching an inflection point, across sectors and countries, because of the work of decades-long pioneering, the energy of new entrepreneurs and the unfortunate climate crises which no longer allow us to ignore the consequences of our fossil-fuel addiction. The proliferation of conferences, whether local, national or global, are connecting all the players in the transition. International consensus at major summits such as Rio+20, the G-20 and others reported in the **Introduction and Overview** ensure global attention to greener ways going forward. Multinational corporations are responding to consumer demand as with the increasing production of hybrid and EV vehicles. Wall Street and City players such as Warren Buffet are investing in green technologies and following the many green indexes appearing on DOW, NASDAQ, FTSE and other exchanges. We are acknowledging and creating metrics for well-being that will show the way to where green investments are most needed and valued.

There is much good news that sustainability is winning and much more is in the works. The GTS team is constantly reviewing the newest technologies, assessing the next silver bullets, knowing they may in fact be dross. To our watch of nanotechnologies, artificial intelligence and bio-synthetics, we are also monitoring 3D printing.

Looking to the future, we hope to expand the GTS report to include organic agriculture, fisheries management, food distribution, seawater farming and the myriad of investments focused on feeding the more than seven billion people on our planet, whether growing food for the table or wisely managing livestock to enhance, rather than deplete, the natural biota. These projects are in the works. The Rodale Institute, Emmaus, Pennsylvania, has shown that organically-grown food production can compete with industrial agriculture while preserving soils. Allan Savory's work shows there is a natural rhythm to rangelands which we can emulate. Seawater farming of halophytes can produce food and animal feed. We will be following these trends.

The Green Transition Scoreboard® was created as a public service to help grow the green economy and reform market metrics and improve due diligence worldwide. We have added Ethical Biomimicry Finance™ in partnership with Biomimicry 3.8 to specifically address and upgrade the metrics of due diligence in finance.

Gathering this data is also a service to developing countries where green technologies and

their "leapfrog" strategies are of paramount importance. Green technologies often draw on available local resources in a more cost effective, time effective manner than fossil-fueled era, dated technologies. The GTS is an ongoing program of research made available to those UN agencies spearheading the UN's [Green Economy Initiative](#) and to advising organizations of Rio+20 of which we were a part, as members of the [Green Economy Coalition](#).

The report is a collaborative effort from colleagues in all sectors of the global green economy, drawing on Ethical Markets Media's daily collating and evaluating of green economy news from worldwide sources reporting on the green transition, including:

- Australia: Climate Risk Pty
- Brazil: Mercado Etico, Instituto Ethos
- Canada: Cleantech
- China: CSR China, Syntao, ASRIA
- European Union: Green Economy Coalition, Network for Sustainable Financial Markets, REN 21, HELIO International
- UK: Climate Bonds Initiative, Forum on the Future, Institute for Chartered Accountants in England and Wales, Green Economic Institute, New Economics Foundation, Responsible Investor, Tomorrow's Company, *New Scientist*
- USA: ACORE, American Council for an Energy-Efficient Economy, American Sustainable Business Council, Calvert, CERES, CSRWire, GreenBusiness, Greentech Media, New Economics Institute, New Energy News,¹²¹ New World Energy News, World Business Academy

¹²¹ A special thank you to Herman Trabish, editor and lead reporter for New Energy News, for his thorough coverage of energy news, leading the research team to hundreds of reports and many of the graphics used in this report.

Appendices

Appendix 1 – Investment Totals

INVESTMENTS IN GREEN TRANSITION 2007-2012	
Sector	Amount (USD)
Renewable Energy	\$ 2,281,347,792,080
Green Construction	\$ 837,620,000,000
Energy Efficiency	\$ 526,921,247,320
Corporate R&D	\$254,800,000,000
Cleantech	\$224,601,088,873
TOTAL	\$4,125,290,128,273

RENEWABLE ENERGY	
Year	Amount (USD)
2007	\$ 162,200,000,000
2008	\$ 205,500,000,000
2009	\$ 209,500,000,000
2010	\$ 266,700,000,000
2011	\$ 310,800,000,000
2012	\$ 286,400,000,000
Commitments	\$ 840,247,792,080
Total	\$ 2,281,347,792,080

GREEN CONSTRUCTION	
Year	Amount (USD)
2007 (USA only)	\$ 33,460,000,000
2008 (USA only)	\$ 42,500,000,000
2009 (Global)	\$ 103,200,000,000
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2007	\$ 29,706,000,000
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2012(e)	\$ 52,600,000,000
SmartGrid	\$ 269,589,247,320
Total	\$ 526,921,247,320

CLEANTECH	
Venture Capital (2007 - 2012)	\$ 33,616,825,940
Initial Public Offerings (2007 - 2012)	\$ 23,503,429,284
Mergers & Acquisitions (2007 - 2012)	\$ 167,480,833,649
Total	\$ 224,601,088,873

Appendix 2 – Positions Held by Ethical Markets Media Principals

For full disclosure: members of the GTS research team and other principals of Ethical Markets Media, LLC, are invested in companies supporting the green transition, most of which are privately held, early stage, pre-IPO companies.

As of January 31, 2013

3D Systems Corp	Lindsay Corporation
Acuity Brands	NASDAQ OMX CleanEdge Smart Grid
Autodesk	Infrastructure Index
Comverge	Natcore Technology
CREE	Nevada Geothermal
Domini Social Investment Fund	Ormat
Enernoc	Pax World Fund
Entech Solar	PowerShares Cleantech Portfolio
EnvisionSolar	Seimens
Equal Exchange	Solaria
FirstSolar	Suntech
GrainPro	Tesla Motors
Green Garmento	US Geothermal
Google	Waterfurnace Renewable Energy
Innergex Renewable Energy	Whole Foods
Johnson Control	ZBB Energy
LightPath Technologies	

Appendix 3 – Research Team

HAZEL HENDERSON, D.Sc.Hon., FRSA, created the Green Transition Scoreboard®. She is founder of [Ethical Markets Media](#), is author of award-winning *Ethical Markets: Growing the Green Economy* and eight other books. Her editorials are syndicated by InterPress Service, with articles in [Harvard Business Review](#), [New York Times](#) and many international journals. She leads the [Transforming Finance](#) initiative and developed with Calvert Group the widely emulated alternative to GNP, the [Calvert-Henderson Quality of Life Indicators](#), soon to be renamed the Ethical Markets Quality of Life Indicators.

Henderson lectures worldwide, holds many honorary degrees and serves as editorial advisor/board member of *Futures*, Elsevier UK; *Foresight* and *State of the Future* reports; Instituto Ethos de Empresas e Responsabilidade Social (Brazil) and World Affairs (India). She is an honorary member of the Club of Rome, an honorary advisor to the International Technology and Economy Institute, Beijing, China, and served as Advisor to the U.S. Congress Office of Technology Assessment, the National Science Foundation and the National Academy of Engineering, tracking disruptive technologies since the 1970s. Henderson provided overall guidance for this report with real-time analysis and synthesis of studies on the green transition.

ROSALINDA SANQUICHE, MA, Environmental and Resource Policy, George Washington University, is the executive director of Ethical Markets Media, co-author and editor of this

report. She began her environmental career working for the American Wind Energy Association in Washington, DC, in research and communications. She has written on the construction industry for [Builder/Architect](#) and on the environment for various outlets. She has taught environmental policy and team-taught field classes combining ecology and policy in Florida and Belize. She is treasurer of the Northeast Florida Green Chamber and continues as a speaker on environmental issues.

TIMOTHY JACK NASH, MSc, Strategic Leadership Towards Sustainability, Blekinge Institute of Technology, Sweden, is a senior advisor for Ethical Markets Media, and, as director of sustainability research, lead researcher for this report. He is the principal of SSI – Strategic Sustainable Investments in Toronto, Canada.

LESLIE DANZIGER, Ethical Markets Media Advisory Board, is a pioneer entrepreneur, co-founder and former chairman of Solaria Corporation, advanced solar modules and systems solutions, and co-founder and former chairman and CEO of LightPath Technologies, optical technologies developer and manufacturer she took public. Featured in *Business Week* and the *Wall Street Journal*, she holds two patents and was named New Mexico Inventor of the Year. She serves on the advisory boards of Equal Access and WorldBlu and is a member of Solar Circle and the American Solar Energy Society.

Our Green Transition Scoreboard® and icon are trademarked by the US Patent and Trademark Office. We license selected non-profit groups to carry our icon for information to their members.

Our turnkey manual, *Principles of Ethical Biomimicry Finance*™ - co-developed with our partner, Biomimicry 3.8, is available for licensing to socially responsible asset managers.

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