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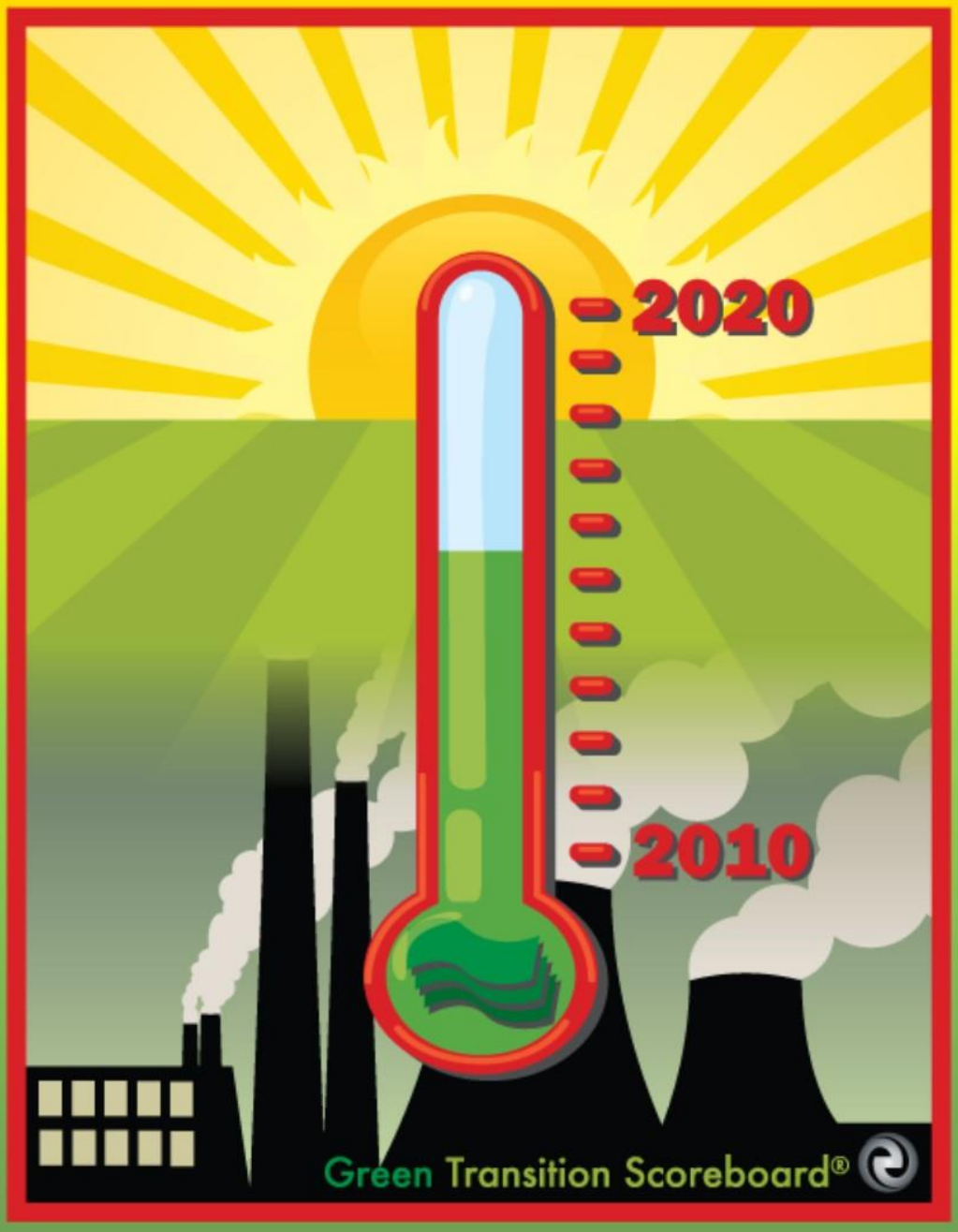
2016 Green Transition Scoreboard® Report



Ending Externalities: Full-Spectrum Accounting Clarifies Transition Management

2016 Green Transition Scoreboard® Report: “Ending Externalities: Full-Spectrum Accounting Clarifies Transition Management”

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Executive Summary

For 2015, the Green Transition Scoreboard® (GTS) focuses on transition management's top priority: "externalities" which amount to $7.3 trillion worldwide. Since 2007, companies tracked by the GTS are those avoiding negative externalities and focused on transition management in the context of the UN sustainability goals, SDGs, and COP21. For 2015, the GTS totals $7,130,521,000,000 in non-government investments and commitments in the green transition.

2016 Sector Totals

Sector	Amount US$	
Renewable Energy	$	3,167,439,374,995
Energy Efficiency	$	1,698,230,838,007
Life Systems	$	1,030,740,404,335
Green Construction	$	745,227,254,757
Corporate Green R&D	$	488,883,488,787
Grand Total	**$**	**7,130,521,360,881**

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The GTS tracks Renewable Energy, Energy Efficiency, Life Systems, Green Construction and Corporate Green R&D, representing broad areas of investment in green technologies. Each sector 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 are continuing to contribute to the growing green economy. Life Systems gained a new category for Fintech for sustainability, including peer-to-peer lending and crowdfunding, in addition to other subsectors tracking the system-wide interconnections among information and digitization, water, food, education and health.

The upward trend in investments since 2007 aligns with our recommendation to invest at least 10% of institutional portfolios directly in companies driving the global Green Transition, updating strategic asset allocation models both as opportunities and as risk mitigation. Excluding government investments to the extent possible, the $7.13 trillion in private investments and commitments as of 2015 puts private investors on track to reach $10 trillion in green sectors investments by 2020.

We strictly define 'green' by omitting technologies such as nuclear, clean coal and most biofuels while carefully assessing rapidly advancing technologies such as nanotech and IoT (Internet of Things). Sources of financial data are screened by rigorous social, environment and ethical auditing standards.

Renewable Energy – Growing strongly as fossil fuel becomes less appealing in light of cost parity of renewables, limiting carbon emissions and driving evolution to sustainable societies.

Energy Efficiency – Widespread ripple effects positively impact jobs creation, manufacturing and other metrics tracked by traditional GDP and integral to transition management, quality of life metrics reported in Life Systems.

Life Systems – This encompasses broad areas systemically linked, including water, remediation, waste and recycling, green infrastructure and info-structure, education, community investing and the myriad of digitization opportunities and obstacles, investments often overlooked as too small, such as the Fintech 100, 2015.

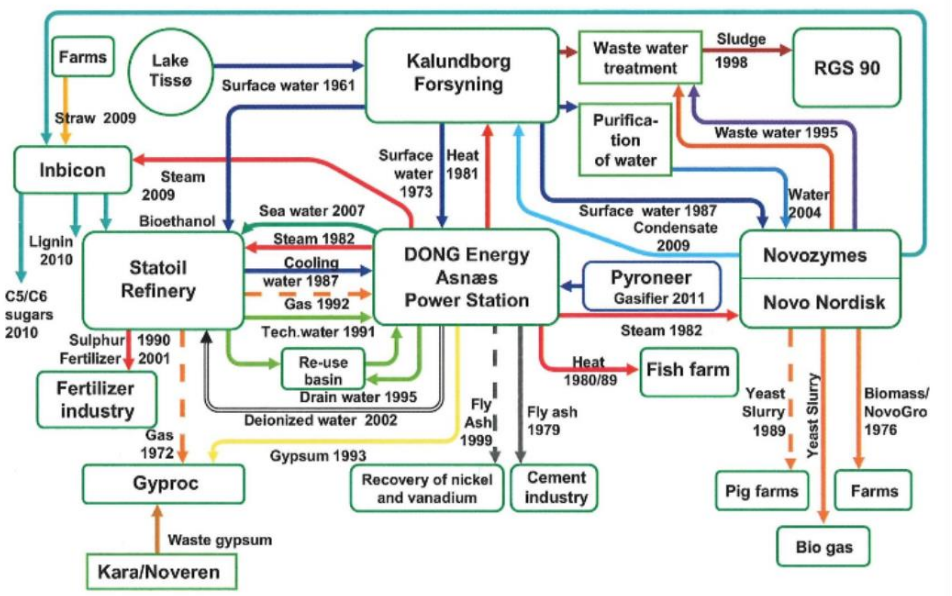
Green Construction – This sector ranges from “low-tech” passive solar buildings to “high-tech” flow 3D printing. For consistency, we omit labor, thus undercounting a form of capital which intrinsically increases the value of green construction.

Corporate Green R&D – Powered by the automotive industry, this sector is also heavily weighted in favor of energy generation, conservation and distribution with a precipitous decline in fossil fuels P&E.

Overview

By Hazel Henderson

Since 2015, the watershed agreements between the 195 member countries of the United Nations are now accelerating the global transition from the fossil-fueled Industrial Era to the Solar Age. As we have emphasized since our Green Transition Scoreboard® (GTS) launched in 2009, this global transition is the next stage of human socio-technical evolution. Examples of these transitions are now underway from local to global, as we described. Some pioneer macro-projects such as the Club of Rome's DESERTEC Industrial Initiative (Dii) launched in 2009 encountered roadblocks, including the financial crisis of 2008 (see Renewable Energy). Others, such as the energy efficient "Industrial Ecology" model pioneered by the City of Kalundborg in Denmark (see *Building a Win-Win World*, Henderson, H., 1996) are now working models of macro-efficiency. Even deeper transition management is that of Janine Benyus and her Biomimicry Institute and B 3.8 consulting firm helping companies redesign their products and processes since the 1990s and now showcased in Businessweek.[1]



Kalundborg Symbiosis, Denmark, DanishWaterForum.dk

Global Transition Management

The new term "transition management" sums up the decision-making challenges to both public and private sectors as they are confronted with demands from their publics and the increasingly powerful

[1] Scanlon, J. "Janine Benyus Looks to Nature for Design Inspiration". *Bloomberg Businessweek*, April 7, 2016. For full disclosure: Hazel Henderson is a lead investor in B 3.8.

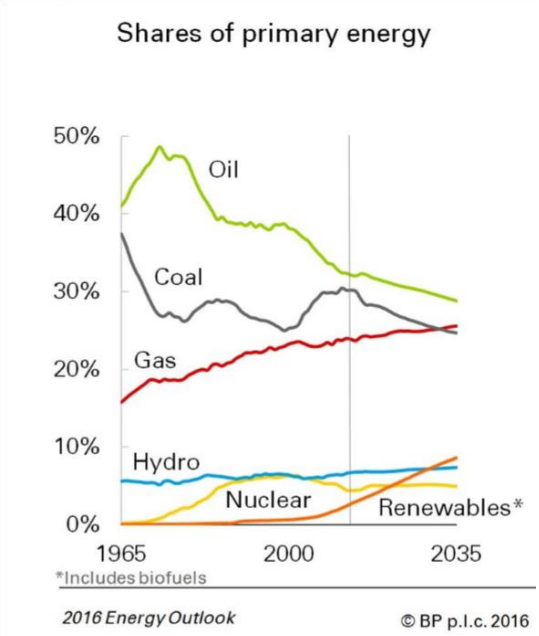
third sector: civic, non-profit organizations, public opinion and social media worldwide. Indeed, founder of survey research firm Globescan Doug Miller calls public opinion "the new global superpower" in *Can the World Be Wrong?* [2] Incumbent industries and finance are being forced to reevaluate their business models and assets after Carbon Tracker's reports on the extent of their reserves that are now un-burnable, including their latest report on Shale and the Price Roller Coaster.[3] Popular uprisings worldwide challenge elites and their policies subsidizing 19th and 20th century fossilized sectors, corporations and the enabling financial system. Politicians responded in 2015 by ratifying the broadly grassroots agenda codified in the 17 Sustainable Development Goals (SDGs) building on the earlier Millennium Development Goals.

As far back as 2000, OPEC was exploring alternatives to oil, as in their seminars and reports on New World Trends and the Future of Oil, co-chaired by Venezuela's former ambassador to India Dr. Frank Bracho and Ethical Markets founder Hazel Henderson, which explored the transition from fossil fuels to renewable solar-based energy.[4] Fast forward to the game-changing failure of the Doha meeting and announcement by Saudi Arabia's Deputy Crown Prince Mohammed bin Salman that oil giant Aramco will transform itself by 2018 from an oil producer to a $2 trillion diversified sovereign wealth fund investing

[2] Miller, D. *Can The World Be Wrong? Where Global Public Opinion Says We're Headed*. Greenleaf Publishing, Sheffield, UK, 2016.

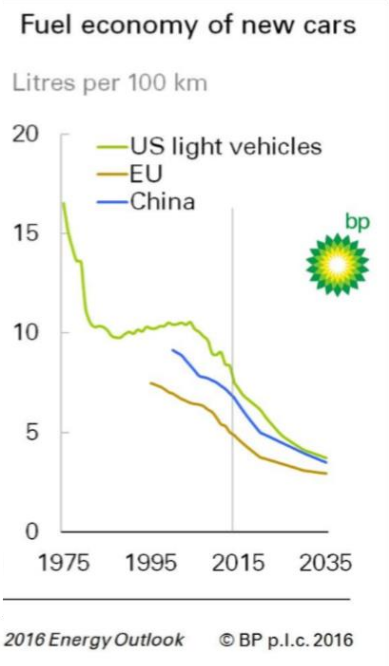
[3] Beyond the Shale: Aboard the Price Rollercoaster. Carbon Tracker Initiative, April 2016.

[4] Statement on New World Trends and the Future of Oil & Energy. Center for OPEC Studies and Presidential Preparatory Commission for II OPEC Summit, Venezuela, and Blue Energy Canada and Venture Resources, Canada. May and June 2000. www.FutureOfOil.com. For full disclosure: Frank Bracho is an Ethical Markets Advisory Board member.



in non-oil industrial development.[5] Even oil major BP forecasts a decline in oil as a share of the world's primary energy mix from its high of almost 50% down to 30% by 2035, replaced primarily by renewables, hydro and gas.[6]

Global financial players began responding, beginning to acknowledge their over-investments in fossil fuels and fossilized sectors: legacy central power-generation electric utilities, coal mining, industrial food production and other fossil-reliant industries, now being forced to disclose their carbon-footprints. Cheap debt fueled the US boom in shale now with $112 billion in junk bonds as cheap oil turned into today's bust.[7] In 2015, 26 shale drillers went bankrupt with more to follow in 2016 and expected to rise to 73 in 2017.[8] Fracking-related earthquakes in Oklahoma caused by injection of wastewater led to new regulations on its 4,000 disposal wells.[9] Led by Ceres, the UN Inquiry: Design of a Sustainable Financial System, UNPRI, SASB, GRI and others shifting to successful fossil-free portfolios, mainstream finance is beginning to catch up, as we describe herein.[10] ShareAction's March 20, 2016, report Transforming Our World Through Investment surveyed 52 institutional investors worldwide with £4 trillion AUM on their response to the UN's SDGs with 95% of respondents planning to engage with investee companies; 84% will allocate capital to investments supporting regulatory reforms.[11] Money Morning's Nick O'Connor called the transition "The Age of the Sun Guzzler" correctly linking oil's decline to the electric vehicle revolution,[12]



[5] Micklethwait, J. "Saudi Arabia Plans $2 Trillion Megafund for Post-Oil Era". Bloomberg, April 1, 2016.

[6] BP Energy Outlook 2016 Edition: Outlook to 2035. BP, 2016. www.bp.com/energyoutlook

[7] Loder, A. "Gone with the Boom". *Bloomberg Businessweek*, March 14, 2016.

[8] "Fracking companies: DUC and cover". *The Economist*, March 12, 2016.

[9] "Fracking: Regulations Dry Up Wastewater Wells". *Bloomberg Businessweek*, March 12, 2016.

[10] "Ceres' Response to the Task Force on Climate-related Financial Disclosures Scoping Report." Press release, Ceres, April 1, 2016.

[11] "Investors can play a central role in achieving the SDGs". Press release, ShareAction, March 21, 2016.

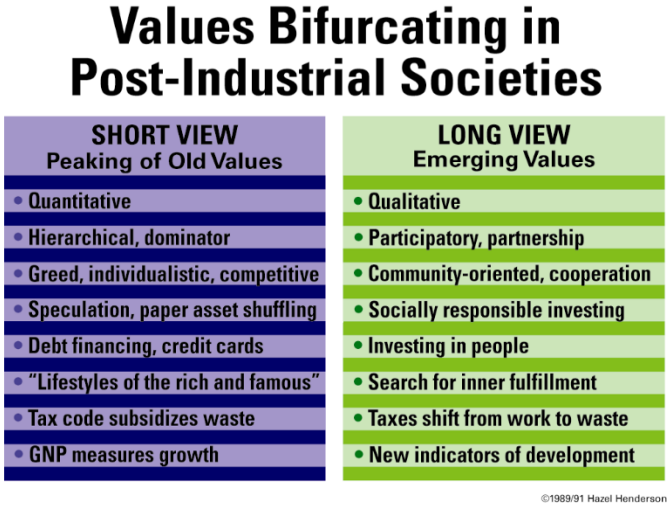
[12] O'Connor, N. "The Age of the Sun Guzzler". Money Morning, April 13, 2016.

Investopedia reported that the jump in oil stocks in response to oil's price rebound was "Another Case of Too Fast Too Soon" – we agree.[13] And the largest global sustainability NGO, the Green Economy Coalition, announced its launch of its State of the Global Transition communications product (which will feature this GTS report).[14] The current fintech disruption of finance will accelerate this transition.

Global Civic Society Empowered

The release in April 2016 of the Panama Papers accelerated the OECD's naming and shaming of companies and elites using tax shelters, estimated at $7.6 trillion worldwide by Gabriel Zucman in *The Hidden Wealth of Nations* (2015).[15] A group of NGOs led by Global Witness announced their Global Beneficial Ownership Register to illuminate tax avoiders and their shelters,[16] including in the USA where anonymous corporations register in Delaware, Nevada, South Dakota and Wyoming.

Global civic networks also succeeded in challenging the status quo economic models of GDP-growth and the defenders' claim that "there is no alternative" (TINA) to their "austerity": cuts in public services, safety nets, pension and jobs, following the 2008 financial meltdown and taxpayer bailouts of Wall Street. Values were bifurcating in many countries, seemingly favoring long-term versus current short-termism in stock markets. The global grassroots visions of many alternatives for prosperity based on inclusive sustainable forms of cleaner, healthier, greener, knowledge-rich societies broke through in 2015. All this disruption of existing norms and models culminated in December, 2015, with 195 countries agreeing at COP21 in Paris to accelerate the global transition to low-carbon, solar and renewably resourced green economies. The pledges made by 189 countries to accelerate shifts to low-carbon strategies was codified in their Intended Nationally Determined Contributions (INDCs).[17] The UN called for an international tax on carbon and a .005% levy on financial



[13] Saintvilus, R. "Oil Stocks Jump on Promised Production Freeze". Investopedia, April 13, 2016.

[14] Benson, E. Personal communication, Green Economy Coalition, March 30, 2016.

[15] Zucman, G. *The Hidden Wealth of Nations*. University of Chicago Press, 2015.

[16] "New Global Register to Shine Light on Anonymous Companies". Press release, Global Witness, April 4, 2016.

[17] Carbon Brief, December 24, 2015. http://tinyurl.com/ozmpa4z

trading, while earmarking a portion of the proposed European Union's financial transaction taxes so as to raise $400 billion for financing these investments.[18] Trading in financial markets is increasingly seen as excessive and a form of addiction similar to gambling. As reported by neuroscientist John Coates in his DNA sampling of traders' saliva, their elevated testosterone levels and endocrine imbalances indicate that these traders are in fact a clinical population.[19] Male dominance of finance persists as documented by Marto Capital.[20]

Bill Gates and other investors announced a multi-billion dollar fund for clean energy technologies – the Breakthrough Energy Coalition.[21] Many institutional investors and banks attended the Ceres Conference at the UN, January 2016, and joined in pledges to shift to green development, and our GTS goal of $1 trillion annually was adopted by many. A report was released, Mapping the Gap: the Road from Paris, which provides a roadmap.[22] Further pledges by 117 global companies set emissions reduction targets; 52 companies pledged to work toward use of 100% renewable energy. Another 156 companies pledged "Positive Action" on climate while 400 cities pledged similar action.[23] A recent survey by GreenBiz indicated that 75% of global businesses with $10 billion or more in sales do not think a price on carbon would affect them significantly while 39% think it would help them.[24]

Values and Paradigms Bifurcating

This millennial shift has ushered in the paradigm shift in economic and financial models augured in *Politics of the Solar Age* (Henderson, H., 1981) and tracked in the paper "Politics of the Solar Age: 1975-2015".[25] The UN Principles for Responsible Investment signatory pension funds have grown to $56 trillion under management. UNPRI Managing Director Fiona Reynolds makes the business case for

[18] World Economic and Social Survey 2012: In Search of New Development Finance. United Nations Department of Economic and Social Affairs, New York, 2012. http://tinyurl.com/9gzx66e

[19] Coates, J. *The Hour Between Dog and Wolf: Risk-taking, Gut Feelings and the Biology of Boom and Bust*. Penguin, NY, 2012.

[20] Stefanova, K., Teten, D. and Beardsley, B. "Who Will Disrupt Asset Management and How", DisruptInvesting.com, April 2016.

[21] Nussbaum, A., Talev, M., and Morales, A. "Gates to Announce Multibillion Dollar Clean-Energy Fund". *Bloomberg Businessweek*, November 29, 2015.

[22] Zindler, E. and Locklin, K. "Mapping the Gap: The Road from Paris". Bloomberg New Energy Finance and Ceres, January 27, 2016.

[23] Strassner, K. "The Paris Climate Agreement: Implications for Business". Presenation, AHC Group, Ballston Spa, NY, December 2015.

[24] State of Green Business Report 2016, GreenBiz and Trucost. http://tinyurl.com/ze8ojoa

[25] Henderson, H. "Politics of the Solar Age: 1975-2015". *Cadmus Journal*, October 13, 2015; SAGE *World Future Review*, November 2015.

ethical investing as practical not political.[26] The 2015 report of the UN Inquiry: Design of a Sustainable Financial System includes Ethical Markets' report "Perspectives on Reforming Electronic Markets and Trading."[27] Beyond traditional money-denominated GDP-measured economic growth, models initiated in the European Union (www.beyond-gdp.eu), and the new inclusive sustainable development models are based on new metrics measuring 6 forms of capital: finance, built, intellectual, social, human and natural capital.

These new auditing standards (SASB, IIRC, CDSB, GRI) all use multi-disciplinary research and incorporating statistics measuring progress in health, education, human rights, gender equality, poverty reduction, environmental protection and regeneration. New certification for accountants based on Global Management Accounting Principles® of the Chartered Institute of Management Accountants (CIMA) and the American Institute of CPAs (AICPA) embrace these new values, focusing their journal beyond cost accounting to Financial Management on integrative thinking and metrics for intangible assets: intellectual property, brands and reputation.[28] The Global Initiative for Sustainability Ratings (GISR) provides a broad overview of this expanding field.[29] In our GTS report "Green Bonds Growing Green Infrastructure", we cover the expansion of this important public sector and the global issuance of green bonds led by China. The importance of physical indicators beyond money-based abstraction is the global tracking of oil tankers which signal oil gluts in advance of financial models.[30] Visuals highlight key issues, such as the cover of *Bloomberg Businessweek*, February 15, 2016.

[26] Reynolds, F. "Fiona Reynolds: Looking at ESG is practical not political". Investment & Pensions Europe, February 17, 2016.

[27] Henderson, H. "Perspectives on Reforming Electronic Markets and Trading." UNEP Inquiry: Design of a Sustainable Financial System, November 2015.

[28] Joining the Dots: Decision Making for a New Era. *Financial Management*, CIMA and AICPA, February 2016.

[29] GISR Insight, March 2016.

[30] "Energy: The Art and Science of Tanker Tracking". *Bloomberg Businessweek*, March 4, 2016.

Thus, the new global focus on transition management leaves behind obsolete, myopic, economic textbooks and such misleading terms as "externalities". This terminology is now revealed as an accounting strategy used by companies to ignore those social and environmental costs imposed on others: taxpayers, the public, future generations and the environment. A recent study commissioned by the UN found that if these costs had been internalized and properly accounted on company balance sheets, they amounted to $7.3 trillion worldwide and reduced or eliminated stated corporate profits to shareholders.[31] Those companies which support the Paris climate agreement now will demand that other companies relying on business models based on "externalizing" costs disclose their carbon emissions. Former US Chair of the SEC Mary Schapiro is leading this disclosure initiative for the Financial Stability Task Force on Climate-Related Financial Disclosures.[32] The 2° Investing Initiative, CDP and other research and NGO groups will be monitoring these disclosures and the pledges on INDC promises by those 189 countries at COP21. The IMF estimates the annual cost to governments and consumers of "externalities", subsidies and social impacts at $5.3 trillion annually.[33]

The confusing concepts and terminology of "externalities" are still ubiquitous in economic analyses, textbooks, company accounting, government policies and public debates. Even the OECD's Policy Challenges for the Next 50 Years contains only one reference to greenhouse gas emissions, and its entire analysis is based on GDP-measured economic growth models.[34] While the vast majority of so-called "externalities" are negative and impact human health, safety and the environment, corporate-friendly economists point to "positive externalities", i.e., jobs, company training programs, benefits and charitable contributions. The time has clearly come to clarify these claims by finally closing the books on this confusing historic term: externalities. The American Sustainable Business Council (ASBC) is focusing on how US Congress members, their corporate supporters and conservative think tanks rely on these obsolete assumptions, terms and analyses.[35]

Full-Spectrum Accounting Tracking Global Transition Goals

Going forward we can focus instead on the goals and outcomes we want: the SDGs and the COP21 outcome. Both are accelerating the global transition now underway and the opportunities they present for a more equitable cleaner, greener future for all. This requires organizations and all government agencies and national accounts to adopt genuine full spectrum accounting, as we have

[31] Natural Capital At Risk: the Top 100 Externalities of Business. Trucost and TEEB, 2013.

[32] "Phase I Report." Task Force on Climate-Related Financial Disclosures". March 31, 2016. https://www.fsb-tcfd.org/

[33] "Counting the Cost of Energy Subsidies". *IMF Survey Magazine*, July 17, 2015.

[34] "Policy Challenges for the Next 50 Years". Economic Policy Papers, No. 9, OECD, 2014.

[35] Lawton, R. and Lederer, R. "Freeing the Market: Accounting for the True Cost (and Benefit) of Doing Business". ASBC, January 21, 2016.

advocated for decades (see for example in our suite of financial standards: Green Transition Scoreboard®, Ethical Biomimicry Finance®, EthicMark® Awards for Advertising, EthicMark® GEMS, Transforming Finance initiative and TV series, Ethical Money Directory and TCR® (developed by our colleague Frank Dixon of Global System Change).[36] Some accounting firms claim to perform full-spectrum accounting – but within the traditional accounting profession frameworks. The State of Green Business 2016 states that this year provides the best time for companies to position their business models to capitalize on sustainable growth opportunities.[37] The Circular Economy 100 created by the Ellen MacArthur Foundation reached similar conclusions in its research, partnered with the World Economic Forum and McKinsey & Company. The *Financial Times* reported in January 2016 that ETFs tracking social responsible investing (SRI) indices outperformed their benchmarks over the past 5 years.[38]

Externalities - accounting strategy companies use to ignore those social and environmental costs imposed on others: taxpayers, the public, future generations and the environment.

Meanwhile, climate scientists warn that the COP21 goals may already have been breached by underestimating planetary feedback loops that increase ocean temperatures and by melting in Antarctica such that sea levels will rise faster than anticipated.[39] Thus, the historic dodging of responsibility to society by carbon and other pollution emitters permitted by such narrow economic models is now at an end. Their doctrine of "externalities" has been challenged by many other reformers for decades. The pioneering report "Clocks and Lenses" by IISD and UNEP documents the extent that externalities in the form of subsidies to powerful favored interests had distorted full-cost accounting by fossil fueled industrial economies across the globe.[40] Today, many of these interest groups are colliding with the new realities. The Extractive Industries Transparency Initiative (EITI) global conference in Lima, Peru, was boycotted by NGOs as mining externalities continue.[41] The shift away from national grids and central electricity to local and distributed generation and micro-grids set old utilities against new sources and their own customers.[42] The report "Nation's Top Utility Companies Take Varied Approaches to Business Risk Posed By Climate Change" offers details.[43] For example, the fight

[36] Dixon, F. "TCR: Leading-Edge Corporate and Financial Sector Sustainability Strategies". Ethical Markets Review, December 1, 2015.

[37] State of Green Business Report 2016, op. cit.

[38] Faurschou, J. "SRI indices outperform over past five years". *Financial Times Adviser*, January 29, 2016.

[39] "Catastrophic Antarctic melting". *New Scientist*, April 2, 2016; Gillis, J., "Climate Model Predicts West Antarctic Ice Sheet Could Melt Rapidly". *New York Times*, March 30, 2016.

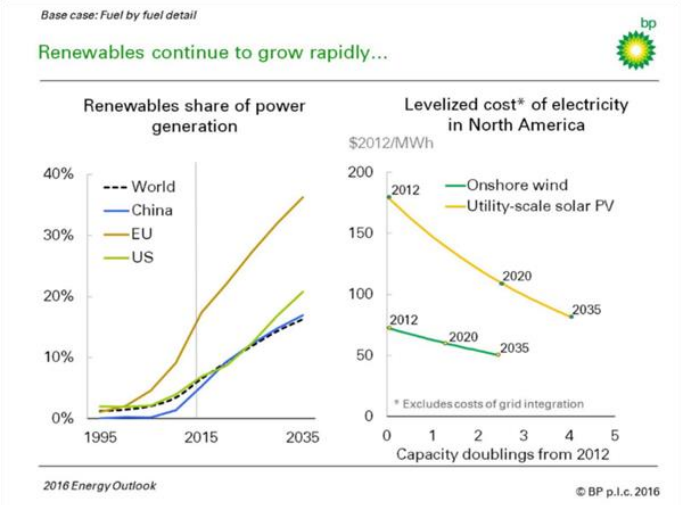
[40] Clements- Hunt, P. "Lenses and Clocks." IISD, June 2012.

[41] "Natural Resources: Flare-up". *The Economist*, February 27, 2016.

[42] Energy Democracy Initiative, ILSR, March 2016. http://tinyurl.com/zrvnxes

[43] Nation's Top Utility Companies Take Varied Approaches to Business Risk Posed By Climate Change. Press release, IRRC Institute, April 14, 2016.

between Elon Musk and Warren Buffett in Nevada pits the local utility owned by Berkshire Hathaway against Solar City and Nevada's solar consumers.[44] Utilities fight back through state legislatures and by urging the wider use of electric vehicles, i.e., those using their fossil-fuel generated electricity to substitute for lost consumers.[45] Other disciplines and scientific research document pollution, resource depletion, climate change, health effects on urban and rural populations, toxic wastes, earthquakes, mountain-top removal, mining injuries and fatalities. This broader research has now invalidated most of the core tenets of conventional economics as I document in Mapping the Global Transition to the Solar Age.[46] As mentioned, the latest estimation of these costs to societies of fossil fuel subsidies by the IMF is a staggering $5.3 trillion annually.[47]



The historic drop in oil prices presents opportunities to cut these wasteful subsidies – without any visible effects on consumers, and major progress has been made in Indonesia and other countries. The drive to put prices on carbon or enact pollution taxes illuminates the absurdity of simultaneously both subsidizing and taxing carbon! Once prices reflect these social and environmental costs formerly "externalized", the public can see that renewables win.

Fossil fuel divestments in 2015 grew to 2,476 institutions and individuals representing $2.6 trillion in assets, according to Trucost.[48] Globally as of 2014, more than $21 trillion in assets were invested under ESG principles, up from $13 trillion in 2013.[49] However, global greenhouse gas emissions increased by 5% from US and global firms.[50]

Developing Countries "Leapfrog"

[44] Buhayar, N. "Who Owns the Sun?" *Bloomberg Businessweek*, January 28, 2016.

[45] EVs & the Grid Summit: Transport Meets Power. Infocast, April 19-21, 2016.

[46] Henderson, H. *Mapping the Global Transition to the Solar Age*. ICAEW and Tomorrow's Company, 2014.

[47] Coady, D., Parry, I., Sears, L. and Shang, B. "How Large Are Global Energy Subsidies?" IMF Working Paper, Fiscal Affairs Department, May 2015.

[48] State of Green Business Report 2016, Trucost, op. cit.

[49] Ibid

[50] Ibid

Even in this still tilted playing field, solar and wind are now competitive with nuclear and coal for electricity generation. As subsidies to fossilized sectors are cut further and genuine full spectrum accounting illuminates real costs, the green transition will continue accelerating, particularly in developing countries. In my many visits to China in the 1980s and 1990s, I emphasized how developing countries could bypass the costly wasteful infrastructure and technologies of the earlier Industrial Era and leapfrog directly to the Solar Age. This "leapfrog" strategy is now the mantra in many developing and emerging economies in Asia, Latin America and Africa, summarized in "The Developing World Can Leapfrog Dirty Coal and Go Straight to Clean Energy".[51] Professor Daniel Kammen, director of the Renewable and Appropriate Energy Laboratory (RAEL) at UC Berkeley, a member of our Advisory Board, applies these "leapfrog" strategies in African and other developing economies, described in "The Energy To Change the World".[52] Such strategies in India are best exemplified by Development Alternatives, operating in thousands of Indian villages since 1983 and facilitating sustainable livelihoods for 12.4 million people.[53] This pioneering enterprise is headed, for full disclosure, by our Advisory Board member Dr. Ashok Khosla. Ending energy poverty is one of the worldwide goals of the SDGs, as examined by *The Economist*.[54]

Africa Rising

The "leapfrog" to renewable-resourced, democratized, distributed forms of development is now a major focus, particularly after the COP21 agreements in Paris. The 54 countries in the continent of Africa have been largely overlooked by investors except as a source of raw materials. In *The Next Africa* (2015), authors Jake Bright and Aubrey Hruby focus on how conventional Western models of economic growth relied too heavily on macro-statistics that ignored the informal unpaid and barter sectors which, as I have pointed out for decades (Henderson 1981, 1990, 1996) is a "Grossly Distorted Picture". In the 54 countries in Africa, informal productive activities are basic and account for roughly 55% of sub-Saharan African (SSA) countries' economic activity and 80% of its labor force. Bright and Hruby cite three important themes in Africa's contemporary growth story:

- Increased formalization of Africa's informal economies. This shows that statisticians have been missing large amounts of economic activity. Today, GDP revisions are underway to overhaul outdated practices.
- Efforts to quantify all the new business activity alongside existing commerce.

[51] Jacobson, M. "The Developing World Can Leapfrog Dirty Coal and Go Straight to Clean Energy". Fast Company, February 4, 2016. http://tinyurl.com/h4occ3d

[52] Kammen, D. "The Energy To Change the World". *Imagine*, June 2015. http://tinyurl.com/z2n33oc

[53] "A Business Eco-system for the Rural Indian Economy." TARA Enterprises Pvt Ltd, 2015.

[54] "Power to the powerless". *The Economist*, February 27, 2016.

- The constraints of (obsolete) GDP measurements still determining which countries are moving forward and delivering dividends to their people.

Thus, the authors are scanning formerly overlooked economic progress and seeing African economies with new eyes and better lenses. Their chapter on Kenya describes how its new M-Pesa (SCOM on the Nairobi Stock Exchange) cell phone banking created a new "fintech" financial model which bypasses the old banking models still operating in the global casino. This, in step with the explosion of IT (information technology) and broadband, has made Kenya the internet provider for other East African countries. The chapter on Nigeria, which has now overtaken South Africa as the continent's biggest economy, describes a thriving IT sector, movie industry and increasingly global music and entertainment sector. Nigeria's stock exchange capitalization of $84 billion and 193 listings is second only to South Africa's $1.01 trillion and 392 listings, with Kenya in third place with $25 billion and 65 listings. Kenya's M-Pesa mobile phone network carries 25% of its GDP.[55] IT infostructure is the new African norm with $5.86 billion of foreign direct investment (FDI) into SSA IT infostructure in 2014, according to cited data from the *Financial Times*. Other chapters cover capital investment and the "leapfrog" strategies now prevalent in emerging economies. These skip obsolete industrial models: from leaky expensive national electricity grids and centralized fossil fueled and nuclear power plants to distributed on-site solar and wind power as we cover in our Green Transition Scoreboard®. Most emerging economies are going beyond old telephone land lines to mobile phones and computing models. The South African government has set a target of 8.4 GW of solar PV capacity by 2030 and so far 2.3 GW has been procured.[56] In February 2016, 26 African countries launched a trading block, the Tripartite Free Trade Area (TFTA), with 620 million consumers with a combined GDP measure of $1.2 trillion.[57]

In spite of these optimistic views, African countries still face huge challenges as described in *The Economist* "More a marathon than a sprint".[58] Chinese investments in Africa present huge challenges.[59] Much corruption remains to be tackled as measured by Transparency International's Corruption Perception Index, ranking 174 countries worldwide. Population growth outpacing world estimates further stresses fragile resources. A report in *Scientific American* finds that a fertility decline can only be achieved by empowering women educationally, economically, socially and politically.[60] Such strategies

[55] Ross, A. *The Industries of the Future*. Simon and Schuster, 2016, p. 86.

[56] Hashem, H. "South African PV projects mitigate land rights risks amid strong growth." PV Insider, March 2, 2016.

[57] Kamal, B. and Mahdy, F. "Africa Launches Largest Trading Block with 620 Million Consumers". IPS, February 22, 2016; El-Sheikh, S. "Trade with Africa: Tear down these walls". *The Economist*, February 27, 2016.

[58] "More a marathon than a sprint". *The Economist,* November 7, 2015.

[59] "Not as easy as it looks". *The Economist*, November 21, 2015.

[60] Engelman, R. "Africa's Population Will Soar Dangerously Unless Women Are More Empowered". *Scientific American*, February 2016.

are evident in, for example, Rwanda and Mauritius where fertility rates fell from 6 to 1.5 children. A Club of Rome computer model indicates that providing women in developing countries with solar-powered lighting and micro-credit could result in some 3 billion avoided births.[61] Yet, women remain an underclass in many African countries, as well as worldwide. Journalists remain threatened as do media when problems are exposed.[62] Climate change threatens Africa with more droughts. African scientists were prominent at the Next Einstein Forum convened in Dakar, Senegal.[63] COP21 was a focus of mitigation and adaptation strategies and financing of distributed renewable energy. France committed €6 billion between 2016-2020 for development of renewable energy in Africa. President Hollande noted "Although Africa is not responsible for emitting greenhouse gasses, it suffers the consequences of climate change".[64] I introduced the concept of "ecological debt" in *Paradigms in Progress* (1991, 1995). The commitments made in COP21 in the 189 INDCs can help redeploy investments away from fossil-fueled electric power and broaden the trend to distributed solar wind and other renewables. The PV Insider conference in Cape Town, June 8-9, 2016, is sponsored by many green media and international providers.[65] Agriculture in African countries is receiving much attention and innovation.[66]

COP21 Country Pledges (INDCs)

Similar progress is evident in Brazil where over 70% of electricity is hydro-powered, while local biofuels from sugarcane wastes power farms and flex-fuel cars. Brazil is now one of the world's fastest growing solar markets and has added 7 GW of installed wind capacity since 2009. Recent droughts threatened hydro-electricity and led to this focus on Brazil's huge solar and wind resources, as well as 1-2 GW of utility scale solar with net-metering to credit local small solar generation. The Brazilian Development Bank (BNDES) has been a leader in supplying low-cost financing for renewable energy.[67] Financial markets still based on obsolete models continue mispricing energy and risk, since they are wedded to fossilized sectors and oil prices. For such reasons, as well as the corruption scandals over Petrobras, Brazil is oversold since its natural resources and human capital are still unpriced. In fact, Brazil's scandals are intertwined with global corruption and US banks which inflated Petrobras' debt

[61] Khosla, A. "Worlds to Dream About". Tällberg Forum, 2009.

[62] "Press freedom in east Africa: Pencil blunted". *The Economist*, March 26, 2016.

[63] "African science: Crucible". *The Economist*, March 12, 2016.

[64] Poulson, T. "Closing Africa's energy gap". RenewableEnergyWorld.com, March 3, 2016.

[65] PV Insider South Africa 2016. NewEnergyUpdate, CSP Today, PV Insider, Wind Energy Update, June 8, 2016.

[66] "Foreign Investment: Sowing the Seeds of a Farm Boom in Africa". *Bloomberg Businessweek*, April 4, 2016; "Briefing African agriculture: A green revolution". *The Economist*, March 12, 2016.

[67] Figueiredo, R. and Pascal, L. "New Developments in Brazil's Solar Power Sector." RenewableEnergyWorld.com, February 18, 2016.

burden. New York judge Jed Rakoff consolidated all lawsuits against Petrobras and its bankers Citigroup Global Markets, JP Morgan Securities and Morgan Stanley into one class action.[68]

New tools beyond conventional economics will now compare the INDC pledges countries made at COP21 in Paris. The ECIU Comparator Tool is produced by the non-profit Energy and Climate Intelligence Unit (ECIU) and uses information from the World Bank, the World Resources Institute and will be regularly updated. [69] Another tool developed by our partner Paris-based HELIO International is the HELIO Index for Investors (HIFI), which complements our GTS.[70] HIFI helps investors in renewable energy assess which countries have conditions most conducive to develop such projects to shift to low-carbon economies and prioritize the general welfare of their citizens and environmental quality. Energy efficiency continues to provide the best returns in the USA, and the American Council for an Energy-Efficient Economy (ACEEE) sees the market at $100 billion.[71] Clean Edge now ranks global companies which are leading in low-carbon, clean energy, tracking six different indicators to create these rankings.[72] Global Management Accounting Principles® promulgated jointly by the CIMA and AICPA promote the integrated management and reporting model covering social, environmental and governance performance criteria, and certifying Chartered Global Management Accountants.[73] Even Wall Street traders and bankers are under pressure to report their ethical missteps in a proposed registry by the Federal Reserve Bank of New York.[74] Disclosures like the Panama Papers also illuminate financial predators such as Wall Street creditors of Argentina's and Puerto Rico's debt, with such hedge funds labelled as "hedgehogs". Argentina's new President Mauricio Macri, lauded by Wall Street for repaying creditors, was named as holding concealed funds in Panama.

Fintech: The Good and Bad News

An ingenious method of monitoring the ethical performance of financial intermediaries is offered by finance critic Brett Scott, using Blockchain models.[75] This and other applications by Silicon Valley

[68] Prins, N. "Think Brazil's scandals have nothing to do with US banks? Guess again". All the President's Bankers blog. March 14, 2016.

[69] Hower, M. "New Tool Compares Countries' Low-Carbon Progress and Pledges". Sustainable Brands Issues in Focus, December 22, 2015.

[70] HELIO Index for Investors. Press communique, HELIO International, December 2, 2015.

[71] Stickles, B. "Meet the $100 billion market of energy efficiency financing". ACEEE, February 17, 2016.

[72] "Clean Edge Launches Rankings of Corporate Clean Energy Leaders," Press release, Clean Edge, March 1, 2016.

[73] "Global Management Accounting Principles." Chartered Institute of Management Accountants and American Institute of Certified Public Accountants, October 2014.

[74] Katz, I. "This Is Going on Your Record". *Bloomberg Businessweek*, pp. 37-38, January 11, 2016.

[75] Scott, B. **"**Blockchain Technology for Reputation Scoring of Financial Actors". *Finance and the Common Good*, September 2015.

startups, the “unicorns” with sky-high valuations prior to IPO are all part of the disruption of many sectors of 20th century industrial societies and finance called “fintech”. The good news for sustainability are such financial platforms that enhance efficiency and transparency and democratize financial transactions. These are companies we now include in our GTS which are revolutionizing payments, banking, lending, microfinance, community development and crowdfunding of new models of renewable energy and efficiency. All were overlooked by incumbent legacy financial firms, now desperately trying to catch up their models, partner with or acquire these startups. Ethical Markets will be tracking all these more democratic, transparent and sustainable companies, including those reforming stock markets, such as the revolutionary electronic platform Investors’ Exchange (IEX) which invented the electronic “speed bump” slowing down high-frequency trading (HFT). We reported this in our UN report and how HFT firms use this kind of “front-running” of investors’ orders. IEX also innovated more transparent order types – all of benefit to pension funds, college endowments, foundations and other institutional investors, many of which now choose to trade on IEX. The UNPRI counts these as its signatory members and invited the founder of IEX, Canadian Brad Katsuyama, to address their academic conference at the London School of Economics, September 2015. Ethical Markets has sent support letters to the SEC which has been holding up accreditation of IEX due to pressure from opposing competitors, including the NYSE, Nasdaq, BATS, Citadel and other big players.

Fintech - the good news for sustainability are financial platforms that enhance efficiency and transparency and democratize financial transactions.

This brings us to some of the bad news about fintech, documented in *Raw Deal* (2016) by Steven Hill; *Throwing Rocks at the Google Bus* (2016) by Doug Rushkoff and others. These include the jobs lost to these disruptive companies which economists surveyed by the World Economic Forum released at Davos indicate that in four years such companies could destroy more than 7.1 million jobs. While 2 million new jobs can be created, the net loss would still be 5 million [76] (e.g., the some 2 million US drivers dis-employed by driverless vehicles, and millions of white-collar jobs in legal, medical, educational and financial professions). Google, General Motors and other auto firms petitioned the US Congress for $3.9 billion of taxpayer subsidies to accelerate adoption of driverless vehicles, while Professor of Mechanical Engineering Mary Cummings revealed all of the downplayed problems, risks and hype by the auto industry.[77] Thus, GTS will continue sorting out the good and bad news of fintech which banks foresee as taking some 25% of their current markets. We will be working with the next 2-year phase of the UN Inquiry, focusing on “Fintech for Sustainability”.

[76] Hayes, A. “Economists Say 7M Jobs Lost to Computers by 2020”. Investopedia, January 19, 2016.

[77] Cummings, M. and Ryan, J. “Who Is In Charge?” *TR News*, May-June 2014; Cummings, M. “Hands Off: The Future of Self-Driving Cars”. Testimony before Senate Committee on Commerce, Science, and Transportation, March 15, 2016.

Action Plan for Decarbonization

The G-20, presided over by China for 2016 has set an ambitious calendar through October with multiple meetings on Green Finance, Climate Finance, Energy Sustainability and the International Financial Architecture reforms.[78] China's solar and wind capacity soared in 2015 by 74% and 34% over 2014, while coal use dropped by 3.7% and imports down by 30%.[79] Clearly, 2016 will see acceleration of all the reforms needed if CO2 is to stay within the official "carbon budget" to keep global warming within the 2 °C limit. However, there is no time to lose and action plans are laid out to deliver on the Decarbonization Roadmaps of COP21, such as the joint conference in London convened by BIS, Forum for the Future and other groups, March 7, 2016.[80] As we have reported, the official "carbon budget" used at COP21 is questioned by scientists who think it is overstated. Some say this "carbon budget" is only half as big as thought, while others believe that due to unacknowledged long feedback loops, that the world is already facing a "carbon deficit".[81] The "De-carbonize Green Paper, released by a group of financial firms, provides a roadmap for institutional investors.[82] Beyond capping CO2 emissions, efforts to curb soot and particulates, particularly in cities, pay big benefits in avoided healthcare costs. Also, ultra-small particles known as aerosols are receiving more attention.[83]

All this focuses on possible ways to limit global warming to 1.5 °C. Many proposals to sequester carbon from coal-fired power plants, which we reported in GTS, are too expensive and cut energy efficiency by up to 40%.[84] The best way to sequester carbon is in properly-managed land use and forestry practices as we have reported. Now efforts to capture CO2 directly from the air are proposed in various projects to accelerate vegetable growth in greenhouses, produce cement and jewelry[85] and to inject into exhausted oil and shale deposits. Most of these schemes, including chemically absorbing CO2 from the air are costly.[86] New interest is emerging in 35 year old schemes to collect solar energy from satellites and beam electricity to Earth. Previous assessments make these projects doubtful.[87] Other

[78] G20 2016 China, G20.org, http://tinyurl.com/h9gvbwp

[79] "Winds of Change." *New Scientist*, p. 7, March 5, 2016.

[80] "Joint Actions to Deliver the 2050 Decarbonisation Roadmaps," conference briefing pack, Shaping the Future, BIS, London, March 7, 2016.

[81] "Carbon budget is only half as big as thought". Eco-Business, February 26, 2016.

[82] "Decarbonise/Re-energise 2016 Green Paper". Responsible-Investor.com, March 2016.

[83] Ramanthan, V., Seddon, J. and Victor, D. "The Next Front on Climate Change". *Foreign Affairs*, pp.135-142, March/April 2016.

[84] Biello, D. "Cheap Oil Undermines Climate Cleanup". *Scientific American*, March 2016.

[85] Budds, D. "This Tower Gobbles Up Air Pollution, Turns It Into Jewelry". Fast Company, July 30, 2015.

[86] Pearce, F. "Hello, cool world". *New Scientist*, February 20, 2016.

[87] Marks, P. "Star power". *New Scientist*, February 13, 2016.

projects include the pilot plant at the University of Newcastle, Sydney, to bind CO2 into concrete.[88] Shifting some agriculture from fresh-water plants (glycophytes) which make up most of human food supplies to salt-loving plants (halophytes) including algae-based fuel from seawater, would use four currently wasted resources: 10,000 varieties of these halophytes for food, fiber and fuel; some 40% of desert and scrubland; 97% of the planet's water which is salty; and abundant free photons from our Sun (see GTS's *Plenty of Water*).

Climate Deniers at Bay

Meanwhile, in the USA, the many climate deniers in Congress and fossil-dependent states are still fighting a rearguard action. The corporate-friendly US Supreme Court blocked the Environmental Protection Agency's Clean Power Plan – putting it on hold, despite much support from US companies and ASBC. Clean energy powered states fought back, and the ACEEE created a SUPR2 calculator, providing policy makers and stakeholders with an estimate of some of the costs and benefits of different policies and technologies that could help all states meet air quality goals.[89] Oregon's Senate passed a bill to abandon coal power by 2030. Coal's decline continued on April 13, 2016, with the bankruptcy of Peabody Coal so as to restructure its $10.1 billion of debt, which includes the $4 billion it paid to acquire MacArthur Coal, LTD, of Queensland.[90] This Australian government has approved of the coal mine adjacent to the Great Barrier Reef planned by India's Adani company.[91] The "divest-invest" movement has now persuaded over 60 cities and 500 organizations to divest from fossil fuels.[92] In the UK, the electricity sector came around to the transition management challenge, offering Pathways to 2030 for its 80 power supplying company members.[93] The International Hydropower Association reports total installed hydro capacity reached 1,211 GW in 2015 and 33GW of new hydro was commissioned.[94]

We reported on storage and batteries in the GTS 2015 report and pointed to new sources and technologies beyond the over-reliance on lithium. We predicted that markets targeting lithium were over-shooting and would lead to the price spikes that have occurred since. The use of chemical storage of

[88] Schiffman, R. "Emissions reveal a constructive side". *NewScientist*, April 2, 2016.

[89] Kubes, C., Hayes, S. and Kelly, M. "State and Utility Pollution Reduction Calculator Version 2 (SUPR 2)". Research Report E1601, ACEEE, January 19, 2016.

[90] Kary, T. "Coal Slump Sends Mining Giant Peabody Energy Into Bankruptcy". Bloomberg.com, April 13, 2016.

[91] "Greenlight for giant mine". *NewScientist*, April 9, 2016.

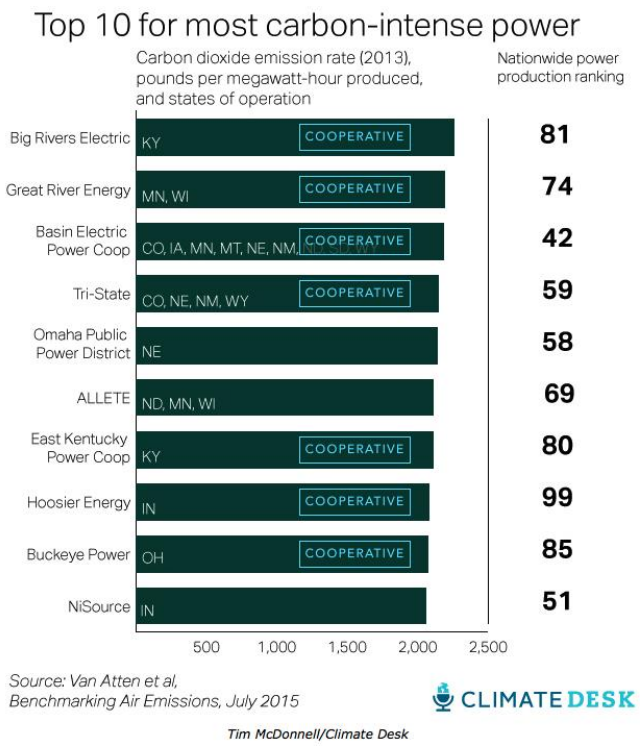
[92] Koch, W. "World's Cities Join Growing Push to Divest From Fossil Fuels". *National Geographic*, December 2, 2015. http://tinyurl.com/h7cmecp

[93] Pathways for the GB Electricity Sector to 2030. Energy UK, February 2016.

[94] Ingram, E. "IHA says 33 GW of new hydropower commissioned in 2015". Hydroworld.com, March 1, 2016.

energy in transparent polymer film is a new material developed by MIT researchers.[95] Internet devices can be powered by Wi-Fi by repurposing radio signals.[96] More efficient solar devices can combine silicon with perovskites.[97] The expansion of solar EV chargers is extending the range of electric vehicles along with increasing use of inductive charging through the air and via braking systems, as reported by Envision Solar.[98] Large capacity storage batteries are available, for example from Mitsubishi Electric Corporation.[99] As national electrical grids become targets of cyberattack as reported by Ted Koppel in *Lights Out: A Cyberattack* (2015), distributed renewable energy systems become more attractive vis a vis national security concerns. Rural electric cooperatives, like the 900 serving small communities in the USA, have operated for over 80 years but 75% of them are trapped in long-term coal contracts which are now slowly shifting to renewables.[100]

Carbon Tracker's latest report sees oil becoming another stranded asset with oil majors Chevron and Exxon-Mobil seen as particularly vulnerable.[101] Investors in Exxon-Mobil asked the SEC to deny the company's request to block their shareholder proposal for information on how the company will weather the COP21 global agreement to rein in climate change.[102] Under COP21 and the SDGs, commitments will require some $10 trillion in annual capital investments from public and private sources. Much of this will come from green bonds as we reported in the GTS 2014 report. The symposium Global and National Perspectives on Implementation of SDGs in Kuala Lumpur, Malaysia, February 2016, addressed the global paradigm shifts



[95] Chandler, D. "A 'Battery' for Solar Heat". *MIT News*, March/April 2016.

[96] Harris, M. "Power from the Air". *MIT Technology Review*, vol. 119, no. 2, 2016.

[97] Orcutt, M. "A Boost for Solar". *MIT Technology Review*, vol. 119, no. 2, 2016.

[98] For full disclosure: Ethical Markets principal Hazel Henderson is a shareholder of Envision Solar.

[99] "NAS - Making Renewables More Renewable". Advertisement, NGK Insulators, LTD. *The Economist*, March 26, 2016.

[100] Farrell, J. "Re-Membering the Cooperative Way". ILSR Energy Democracy Initiative, March 2016.

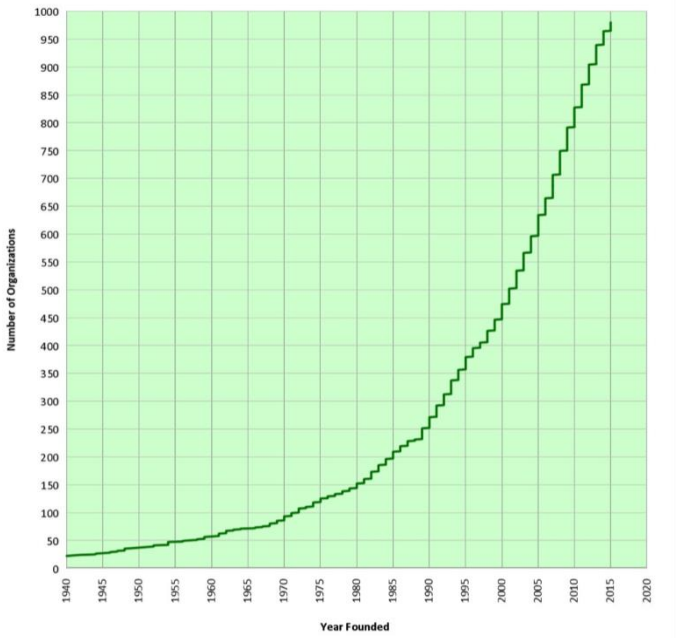
[101] Why Chevron Needs to Stress-Test the Business at Two-Degrees. Carbon Tracker, March 2016; McKibben, B. "Exxon's Never Ending Big Dig: Flooding the Earth with Fossil Fuels". TruthOut, February 18, 2016.

[102] "Church Commissioners Among Investors Challenging ExxonMobil's Attempt to Silence Climate Change Questions". News release. Church Commissioners for England, February 24, 2016.

occurring. These 17 Goals require systemic integrated approaches and the "circular economy" model (internalizing all social and environmental costs), i.e., ending the use and terminology of "externalities". Educating politicians on these new scientific models was emphasized.[103] Similarly, the 2016 International Summit on Finance Leadership and New Approaches to Sustainable Growth embodied this integrated approach to finance and accounting.[104]

Groups with "sustainability" agendas and terminology are exploding as we report in Life Systems. Groups including the term "ethics" in their names publish rankings of corporate ethical, social and environmental performance, including Ethical Corporation and Ethisphere, with its 2016 list of the World's Most Ethical Companies®, with 131 companies in 21 countries and 45 industries. This global ethical auditing industry covers a wide range of criteria ranging from strict standards and definitions to those self-congratulatory such as *Fortune's* World's Most Admired Companies or outright greenwashing.[105] Our EthicMark® Awards for Advertising sets the highest bar for this $500 billion global industry (see our 10th Annual Awardees' campaigns at www.ethicmark.org). Active engagement by concerned shareholders who attend company annual meetings and vote their proxies has driven many reforms, forcing companies to fully account for their social and environmental harm – rather than hiding behind "externalities" omitted from their balance sheets.[106]

Growth of Security and Sustainability Organizations, 1940-2015



The Security & Sustainability Guide: 1500 Organizations Pursuing Essential Global Goals, prepared by Michael Marien, David Harries and Michael Sales. PDF Interim Draft available for limited distribution May 2016. Requests to mmarien@twcny.rr.com.

Global Finance at Bay

The focus is also moving to challenge the global financial system which drives global business activity worldwide. Corporations are now "puppets of finance" pushed into short-term thinking to please

[103] "Briefing Note on SDSN Symposium and Workshop". IISD Reporting Services, March 4, 2016. http://tinyurl.com/jpas3z6

[104] 2016 International Summit: Finance Leadership: New Approaches to Sustainable Growth. Accounting for Sustainability and CIMA. March 10, 2016.

[105] "The World's Most Admired Companies." *Fortune*, February 2016.

[106] Smith, T. "Impact Through Shareholder Engagement". *Journal of Environmental Investing*, vol. 7, no. 1, 2016.

stock analysts and their focus on quarterly reports and fossilized asset allocation models still mispricing risk.[107] The power of global financial networking and their interconnectedness was a cause of the 2008 financial crisis and the danger to Main Street of banks becoming too big to fail and their costly bailouts in the USA and Europe by taxpayers. The US Treasury announced on April 13, 2016, that five US banks, JP Morgan Chase, Wells Fargo, Bank of America, Bank of New York Mellon and State Street had failed their "living will" plans and now have until October 2016 to revise them.[108] The UN Inquiry: Design of a Sustainable Financial System is one of the few direct challenges to conventional financial models and the enormous costs their "externalities" impose on societies, including exacerbating inequality and capturing regulators and political power in many countries. Stock markets are dominated by computers and algorithmic trading at blinding speeds, these cause "flash crashes" and daily volatility as we reported to the UN Inquiry in our paper "Perspectives on Reforming Electronic Markets and Trading," part of the bad news of fintech. The speedups caused by digitization also increase vulnerability of all electronic systems and devices as reported on *60 Minutes*, April 17, 2016. Thus security can be achieved by retaining old-fashioned mechanical systems.[109] Meanwhile, humans are more efficient, as attributed to NASA in a 1965 report: "Man is the lowest-cost, 150 pound, non-linear, all-purpose computer system which can be mass-produced by unskilled labor".[110]

Thus, in spite of the progress in reforming accounting, business and finance obsolete economic models are still taught in many business schools (see "How Adam Smith and Charles Darwin Got Hijacked", Ethical Markets TV). The dysfunctional language of "externalities" still blinds politicians, citizens, taxpayers and consumers about the true costs they pay. Many unsustainable industrial activities, products and services based on polluting technologies and energy sources are still not accounted for in company balance sheets or national accounts. Media reporting of business and finance perpetuates the myths of "externalities". For example, we are still told that coal is "cheaper" than clean energy sources and that industrial agriculture produces "cheaper" food than organic farms. Media editors rarely question macro-indicators like GDP – assuming that GDP-growth is an unalloyed good and the measure of national progress. Conventional thinking pervades societies, and new paradigms have required decades to change obsolete theories and practices. As Thomas Kuhn, author of *The Structure of Scientific Revolutions* (1962), responded to a question of when his "new paradigm" would be accepted, Kuhn answered, "one funeral at a time".[111]

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[107] Henderson, H. "Fossilized Asset Allocation Still Mis-Pricing Energy and Risk". SeekingAlpha.com, January 22, 2015.

[108] Hamilton, J. "Five Big Banks' Living Wills Are Rejected by U.S. Regulators". Bloomberg.com, April 13, 2016.

[109] Sax, D. "State-of-the-Art Safeguards". *Bloomberg Businessweek*, March 14, 2016.

[110] Brynjolfsson, E. "Will Humans Go the Way of the Horses?" *Foreign Affairs*, July-August 2015.

[111] Personal communication, Princeton, NJ, 1962.

Meanwhile, prior to the Panama Papers, the power of international banks and finance has been examined by many scholars, including Nicholas Shaxon in *Treasure Islands* (2011); John Kay in *Other People's Money* (2015); John Perkins in *New Confessions of an Economic Hitman* (2016); and Adair Turner in *Between Debt and the Devil* (2015). Brazilian economist Ladislau Dowbor summarizes these issues of financial scale and global interconnected networks in "Corporate Governance: the chaotic power of financial giants".[112] Dowbor has studied the extractive activities of US and European banks in Brazil and their usurious interest rates for extended payments on consumer goods. Dowbor collates much research on this global financial system, identifying 147 groups (75% of them banks) which control 40% of this system, while 16 groups control most of the planet's commodities.[113] These interconnected networks now dominate nation states and their politics and are studied by Robin Lumsdaine as these levels of complexity are as crucial as size in identifying "systemically important financial institutions" (SIFIs) as required by the Dodd-Frank Law in 2010.[114] Central bankers "quantitative easing" (printing money) becomes ever less effective, and negative interest rates punish savers. Monetary reform activists, NGOs and politicians now ask "Why not QE for people?" or "for solving climate change?"[115] Why not indeed! (see our TV special "The Money Fix"). This deeper dive into the politics of money-creation and credit-allocation, as well as structure of global finance and its myriad subsidies to favored companies and sectors, explains why the global transition to cleaner, green, inclusive economies has been lagging for 30 years. Sustainable societies now clarified in the UN's 17 SDGs also have been stalled for decades in many countries, including the USA as I described in "The Politics of the Solar Age 1975-2015".[116]

At last, after the historic agreements by 195 countries on the UNs 17 SDGs and the COP21 climate agreements of 2015, the model of GDP-measured economic growth is giving way to the new integrated model of sustainable, inclusive human development. As the textbooks and courses are updated, the irresponsible accounting allowed under the "externalities" rubric is becoming obsolete, and full-spectrum accounting and integrated thinking and reporting are becoming the new norm. Tracking and projecting all these changes is the purpose of our GTS.

[112] Dowbor, L. "Corporate Governance: the chaotic power of financial giants." *Ethical Markets Review*, March 2016.

[113] Ibid.

[114] Lumsdaine, R., Rockmore, D., Foti, N., Leion, G and Farmer, J. "The Intrafirm Complexity of Systemically Important Financial Institutions". Social Science Research Network, May 9, 2015.

[115] Kroll, M. "We print money to bail out banks. Why can't we do it to solve climate change?" *The Guardian*, January 30, 2016.

[116] Henderson, H. Cadmus 2015, op. cit.

Sectors Covered

The Green Transition Scoreboard® (GTS) tracks private investments growing the green economy worldwide since 2007, totaling in Q4 of 2015 **$7,130,000,000**. The Green Transition Scoreboard® tracks five sectors: Renewable Energy, Energy Efficiency, Life Systems, Green Construction and Corporate Green R&D.

2016 Sector Totals

Sector	Amount US$	
Renewable Energy	$	3,167,439,374,995
Energy Efficiency	$	1,698,230,838,007
Life Systems	$	1,030,740,404,335
Green Construction	$	745,227,254,757
Corporate Green R&D	$	488,883,488,787
Grand Total	**$**	**7,130,521,360,881**

Governments and investors at all levels are turning their focus to growing greener economies as evidenced by the explosive increase in green bonds worldwide reported in August 2014's GTS report, "Green Bonds Growing Green Infrastructure." At the institutional level, we have long recommended investing at least 10% of institutional portfolios directly in companies driving the global Green Transition, thus updating strategic asset allocation models – both as opportunities and as risk mitigation. Examples seen in 2015 include Norway which holds the world's largest sovereign wealth fund and CalPERS and CalSTRS, two of the world's largest pension funds held in California.[117] These government mandated shifts from fossilized sectors happened in part from concern for the environment and in part to mitigate holding stranded assets which will increase as low-carbon regulations are implemented. Now Saudi oil giant Aramco is making this shift, as described in the Overview. Investments also serve as risk mitigation due to oil, coal and gas markets' volatility sensitive to politics, wars and dated infrastructure.

This growing consensus validates models indicating that investing $1 trillion annually until 2020 can scale and reduce costs of wind, solar and other renewables, energy and material efficiency, green construction; can increase corporate green R&D, sustainable land-use, smart infrastructure, transport and urban re-design globally. Ceres Clean Trillion campaign[118] aligns with a strategy recognized in the 2012

[117] Carrington, D. and Howard, E. "Institutions worth $2.6 trillion have now pulled investments out of fossil fuels". *The Guardian*, September 22, 2015.

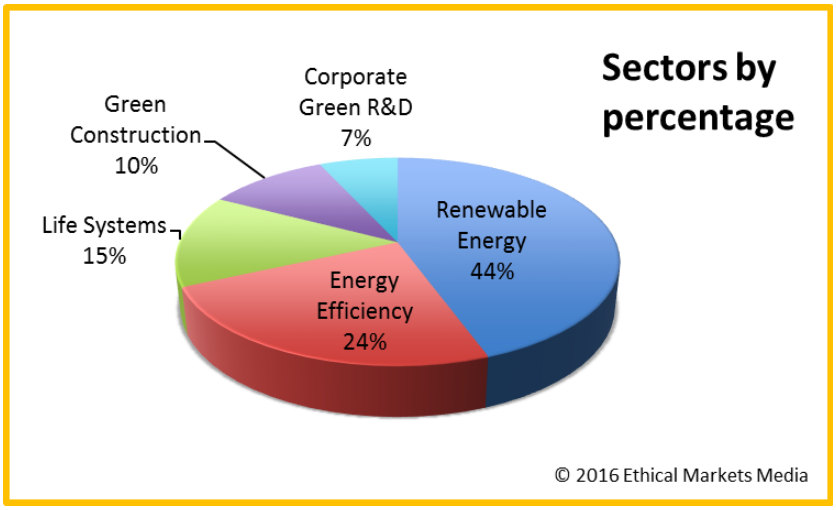
[118] Clean Trillion: Closing the Clean Energy Investment Gap. Ceres. Accessed on April 18, 2016, http://tinyurl.com/mf3bnt5

report by Mercer which suggests 40% of portfolios should be in Green Transition sectors.[119] While the GTS tracks highly targeted sectors within the green economy, there is more than $21.4 trillion of assets under management incorporating environmental, social and governance factors in investment selection, representing 30.2% of the professionally managed assets in Asia, Australasia, Canada, Europe and the United States.[120]

What's Included

Renewable Energy, Energy Efficiency, Life Systems, Green Construction and Corporate Green R&D represent broad areas of green technologies, covering 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 are continuing to contribute to a sustainable future.

The sectors evolve as the Green Transition takes hold. Last year the GTS added the Life Systems sector. The system-wide transition toward efficiency, information and digitization can best be viewed through a Life Systems lens as detailed in the 2015 GTS Report "Breakdowns Driving Breakthroughs", highlighting the interconnections between energy, water, food, education, health and quality of life.[121]



Companies, organizations and the sources of financial data are screened by social, environment and ethical auditing standards. Accounting organizations IIRC, SASB, ICAEW, Tomorrow's Company, Long Finance, CIMA Global and others are applying sustainability auditing standards making it easier to value these more comprehensive and rigorous screens. Increasingly, we are finding companies which aspire to the even more demanding metrics of the *Principles of Ethical Biomimicry Finance*®. Data can be found in indexes such as Calvert, Domini and Pax World, the PowerShares Cleantech Portfolio, MSCI,

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

[120] 2014 Global Sustainable Investment Review, Global Sustainable Investment Alliance, February 2015.

[121] Henderson, H., Sanquiche, R. and Nash, T. "Breakdowns Driving Breakthroughs : 2015 Green Transition Scoreboard® Report", Ethical Markets Media, April 2015.

Dow Jones Sustainability Indexes, London's FTSE4GOOD, NASDAQ OMX Green Economy Global Benchmark Index, ASPI Eurozone, as well as the many newsletters from around the world posted daily at www.ethicalmarkets.com. Data sources include Bloomberg, Yahoo Finance, Reuters and many UN and other international studies, reports such as the Roen Financial Report, Sonen Capital and other asset managers and companies listed free in our public service Ethical Money Directory, and findings from CSRHub and StockSmart, as well as individual company reports.

What's Omitted

International investments in the GTS tally are reported in US dollars, based on conversions from XE.com on March 26, 2016. Because the GTS focuses on private sector investments, government funded projects and initiatives are heavily discounted. Despite a common misperception, sustainable technologies can stand alone, without government subsidies. Fossil-fuel consumption subsidies worldwide are four times greater than subsidies to renewables.[122] Renewable energy and efficiency are competitive even in this hostile environment. The GTS purposefully discounts government investments so as to bypass the continuing political debate over the allocation of subsidies. Even limiting government funding, the GTS still exceeds $7.1 trillion, showing that green technologies are competitive in today's market and that renewables specifically are already cheaper than nuclear power,[123] as well as coal and oil when their external costs are included.

Our definition of 'green' is quite strict, omitting clearly unsustainable sectors as well as certain technologies having unsubstantiated claims, negative EROI or unexplored or untested consequences. For example, nuclear energy is not a sustainable option when EROI from mining, construction, uranium enrichment, processing, transportation, waste disposal and decommissioning costs are taken into account. Nuclear has enormous taxpayer subsidies. In the US, loans to nuclear power are secured by the Price-Anderson insurance provision of government underwriting because the insurance market cannot internalize the risk.[124]

Several emerging technologies have been purposefully omitted either because of controversy or lack of consensus that they will make a long-term contribution to sustainability.

- Most proposals for "geoengineering" are speculative with unknown consequences perhaps more dire than the problem they aim to resolve.

[122] World Energy Outlook: Energy Subsidies, International Energy Agency, accessed April 2015.

[123] Blackburn, J. "Solar and Nuclear Costs – the Historic Crossover". NC WARN, July 2010.

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

- Recognizing its potential and obstacles, the European Commission is investing in nanotechnology with research, financing of responsible innovation and upgrading of the regulatory framework to render it capable of addressing new challenges.[125]
- 3-D printing has enormous potential, however its use to manufacture destructive products such as weapons and drones and the toxicity of its many chemical components require prudent observation and inclusion only on a case by case basis.
- The internet of things (IoT) is widely lauded for increasing efficiency but security, privacy and future repercussions are still to be seen. For example, already Aetna is using sleep monitoring to "reward" its employees.[126]
- Similarly, we exclude genetic engineering and artificial life-forms.

We omit so-called clean coal, still unproven, given coal carbon sequestration (CCS) reduces the efficiency of coal-fired plants by as much as 30%-40%.[127] Despite major government subsidies, in the US there are only seven demonstration projects and no operational large-scale CCS projects out of 1300 coal-fired power plants.[128] As mentioned in the 2014 GTS report, efforts to set fire to underground coal deposits to capture their methane are even more preposterous.[129] In addition, carbon is only one pollutant from coal, along with many other emissions including mercury and particulates damaging to health and the environment. We recommend pollution taxes (including on carbon emissions) as the most efficient way to curb such external costs to society.[130]

Biofuels are limited in the overall GTS tally 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 and exporting, as well as in genetically modified microbes to produce fuels – dubious propositions for long-term sustainability. Biofuel crops require water and land better suited for range or agriculture food production. The future of transport is more likely to be electrically powered as super capacitors which store electricity differently from batteries are used in electric and hybrid cars to store braking energy.[131] As noted in Life Systems sector, exceptions are made for biofuels from algae or halophyte plants grown on seawater.

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[125] Dawson, K. "Nanomaterials' functionality". Thematic Issues, European Commission Science for Environment Policy, February 2015.

[126] Anderson, L.V. "Aetna Is Paying Its Employees to Sleep More. Is That Really a Good Idea?" Slate.com, April 11, 2016.

[127] U.S. Department of Energy (DOE) and U.S. National Energy Technology Laboratory (NETL). *Carbon Dioxide Capture and Storage RD&D Roadmap*, DOE/NETL 2010.

[128] Carbon Capture and Sequestration Technologies Program at MIT, sequestration.mit.edu.

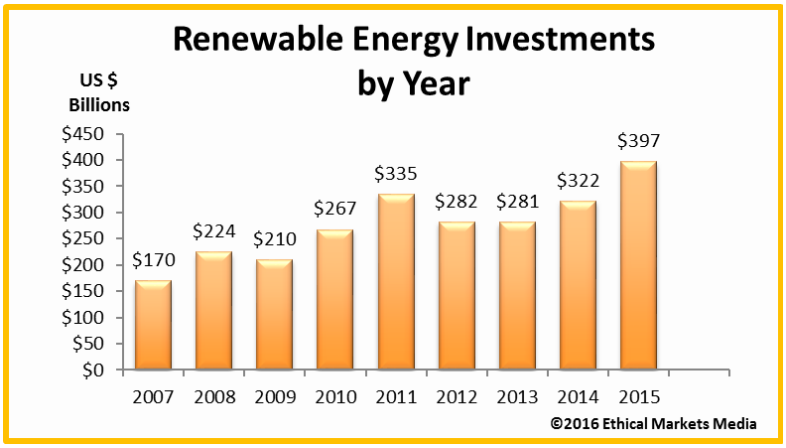
[129] Pearce, Fred. "Beyond Fracking". *NewScientist*, February 15, 2014.

[130] Brodwin, D. "A Carbon Tax Everyone Can Love". American Sustainable Business Council, September 1, 2014.

[131] "Exploring Super Capacitors to Improve Their Structure," www.sciencedaily.com, Feb. 18, 2013.

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. Many of the current investment numbers are based on global trends reported by Bloomberg New Energy Finance under contract with UNEP[132] as well as other international studies. This is the largest sector in this report which from 2007 to 2015 reached $3.16 trillion in investments and commitments.



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, SRI News, Trendspotting and Earth Systems Science pages. Future commitments include those from US banks such as Bank of America, Goldman Sachs, CitiGroup and Wells Fargo and includes Apple's new $1.5 billion green bond, minor compared to Tesla, Siemens, IKEA, Samsung and other retailers' commitments which received far less fanfare.

Coal India expects to save 30% on fuel from the 1,000 megawatts of combined solar capacity.[133] India is working toward its goals in part using green bonds with Yes Bank offering a bond for INR 500 Crores ($80m).[134] These moves support Pegasus Capital Partners belief that utilities will benefit substantially from wind and solar development.[135]

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[132] McCrone, A., Usher, E., Sonntag-O'Brien, V., Moslener, U., Andreas, J. and Grüning. C. "Global Trends in Renewable Energy Investment 2011", United Nations Environment Programme, Frankfurt School UNEP Collaborating Center and Bloomberg, 2011.

[133] Rakshit, A. "Coal India's 1,000-MW solar project may help it save 30% power costs". Business Standard, February 20, 2016.

[134] Kidney, S. "Yes Bank going for India's first green bond / India's amazing renewables buzz". Climate Bonds Initiative, February 19, 2015.

[135] "State of Green Business 2015." Op. cit.

The commitments line item is adjusted regularly as projects move from concept to implementation or are removed from consideration. The $542 billion Desertec (Dii) project (a Club of Rome initiative to provide 15% of energy needs to the European Union from the Sahara) is a good example of this process. The Desertec Foundation persists as do a few ongoing projects started before the investment arm Dii went from 50 participating companies and organizations to 3 in late 2014. Some of its projects continue, providing energy locally, in Tunisia, Morocco and Algeria.

Renewables are challenging fossil fuels from unexpected places. The US Navy Secretary Ray Mabus cites supply chain concerns as it transitions from fossil fuels and is taking the bold step of requiring vendors to report carbon emissions and to set lower targets.[136] Coal faces encroachment from natural gas, hydroelectric, solar PV, onshore wind, biofuels and geothermal which, together with other renewables, provide 20% of global power generation and are predicted to provide 25%, according to the International Energy Agency, by 2018.[137] Massive shifts from coal to locally produced natural gas by US utilities are risky given lower oil costs and price spikes due to lack of pipelines and water shortages from fracking.[138] New geothermal technology designs address intermittency, normally managed with coal or gas, providing flexibility in delivering energy to the grid without imposing significant cost.[139] New transmission lines for direct current (DC) are more efficient for renewable electricity than AC lines. Micro-grids and "islanding" of electricity generation are upending utility business models.[140]

Other challenges to fossil fuels: finance, manufacturing and functionality flaws as acknowledged by the corporate world.[141] Walmart, Procter & Gamble, Google, Facebook, General Motors, Dow Chemical, have all signed fixed-priced contracts.[142] Goldman Sachs cautions that coal mining and infrastructure "projects will struggle to earn a positive return," based on environmental regulations discouraging coal-fired generation, energy efficiency improvements and strong competition from gas and renewables, for example, recognizing onshore wind power as a mature technology.[143] Existing nuclear infrastructure is losing capacity because many nuclear reactors face "economic abandonment."[144]

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[136] Knickmeyer, E. "Navy to require climate change reporting from vendors". Associated Press, April 12, 2016.

[137] "Renewable Energy 2013: Market Trends and Projections to 2018," International Energy Agency, 2013.

[138] Deyette, J., et al. The Natural Gas Gamble, Union of Concerned Scientists, March 2015.

[139] Trabish, Herman. "California Grid Operator Asks Geothermal to Help 'Feed the Duck,'" GreenTechMedia, June 28, 2013.

[140] Rader, B. "The Finance Industry on DERs: Solar and Batteries are Coming," RMI Outlet, Aril 14, 2015.

[141] Sanquiche, R. "Renewable Energy: Profiting from Fossil Fuel Woes". CSRWire, October 18, 2013.

[142] Brady, D. "Why companies like Google and Walmart are buying so much wind power". *Washington Post*, April 12, 2016.

[143] "Window for thermal coal investment is closing". Rocks & Ores, Goldman Sachs, July 24, 2013.

[144] Cooper, M. "Renaissance in Reverse: Competition Pushes Aging US Nuclear Reactors to the Brink of Economic Abandonment". Institute for Energy and the Environment, Vermont Law School, July 18, 2013.

Reactors in two major US cities, Syracuse and Boston, will close within the decade because, even with their subsidies, it costs more to operate the plants than the revenue they generate.[145]

Subsidies to fossil-fuel generated energy continue as an obstacle. The IMF estimates petroleum, coal and gas receives $1.9 trillion worldwide through direct subsidies, consumer rebates and avoided taxes on pollution.[146] Yet the IMF agrees that reducing subsidies "can lead to a more efficient allocation of resources, which will help spur higher economic growth over the longer term," as per David Lipton of the IMF.[147] The tremendous waste of capital to fossil-fuel subsidies will continue until energy efficiency and exergy are included in economic models (see GTS 2014 report). Pollution taxes, including on carbon, need to take hold. External costs need to be fully reflected in financial models, corporate balance sheets and national accounts. Egypt has reduced its deficit by making deep cuts to fuel subsidies.[148] India has moved from subsidizing oil to taxing it, taking advantage of low oil prices.[149] Reducing fuel subsidies is also part of China's Greening Financial System plan.[150]

Inclusion of biofuels is limited because production competes with food production and because studies, such as that from Cornell and Berkeley, show that biofuels have a negative EROI.[151] The US Navy has proudly launched its "Great Green Fleet", running on biofuels, however it's based on beef tallow that must be subsidized to be competitive. As an exception, we include biofuels grown from algae on saltwater, as in the Boeing-Masdar project which yields better quality fuel for aircraft than petroleum distillates (see 2014 GTS report).[152]

As a rule, Corporate R&D is omitted here and reported in Corporate Green R&D to avoid double-counting.[153] Government R&D is discounted in our practice of limiting public investments as part of the tally.

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[145] Wernick, A. "Nuclear reactor closings in the US continue to roil the energy industry". PRI, November 22, 2015.

[146] Clements, B., et. al. "Energy Subsidy Reform: Lessons and Implications". IMF, January 28, 2013.

[147] Lipton, D. "Energy Subsidy Reform: The Way Forward". International Monetary Fund, March 27, 2013.

[148] Raval, A. "Egypt reduces budget deficit with cuts to fuel subsidies". *Financial Times*, November 9, 2015.

[149] Cunningham, N. "Low Oil Prices Enable India To Abolish Subsidies And Start Taxing Fuels". Oilprice.com, July 29, 2015.

[150] Henderson, H. "China: The Emerging Green Giant". CSRWire, April 3, 2015.

[151] Pimentel, D. and Patzek, T. "Ethanol Production Using Corn, Switchgrass and Wood; Biodiesel Production Using Soybean and Sunflower". Natural Resources Research, vol. 14, no. 1, March 2005.

[152] "Exclusive report – Boeing reveals 'the biggest breakthrough in biofuels ever'." www.energypost.eu, February 8, 2014.

[153] Note: the Renewable Energy tallies for 2010, 2011 and Commitments (Appendix 1) are aggregates from industry and company press releases, limiting our ability to remove all Corporate R&D.

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, reaching $1.69 trillion in 2015.

2016 Energy Efficiency Investments and Commitments

Year	Amount US $
2007	$ 85,994,451,247
2008	$ 94,107,749,303
2009	$ 103,011,531,368
2010	$ 112,784,229,050
2011	$ 148,667,945,000
2012	$ 228,240,600,000
2013	$ 233,883,200,000
2014	$ 262,299,000,000
2015	$ 270,514,250,000
Commitments	$ 158,727,882,039
TOTAL	**$ 1,698,230,838,007**

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The definition of energy efficiency is in flux. Energy efficiency broadly counts: heat, power, waste to energy; improvements in construction materials such as windows, insulation and lighting; hybrid vehicles and charging stations; waste management, smart grid and supply chain efficiencies. The ripple effect of energy efficiency includes: energy savings, jobs creation, increased productivity, improved product quality, improved system reliability and optimizing manufacturing processes.[154]

Energy efficiency metrics must include **exergy efficiency**, energy which could have been converted into work but was wasted instead. We use the overall exergy model of system-wide efficiency developed by our Advisory Board member Dr. John "Skip" Laitner.[155] The ACEEE estimates $80 billion of the $156 billion dollars' worth of energy used in production in 2013 was lost through inefficient conversion.[156] For example, using combustion to heat releases far more energy than is used – exergy inefficient.

Smart grid technologies, anything used on the grid that enhances use of renewable energy, largely electrical components and equipment, are included in Energy Efficiency. Researchers have been careful when including Smart Grid investments. Too often, companies use those costs to increase rates rather than provide the promised lower costs to customers based on improved efficiency, touting instead

[154] Russell, C. Multiple Benefits of Business-Sector Energy Efficiency: A Survey of Existing and Potential Measures, ACEE, January 7, 2015.

[155] Laitner, J. "Linking Efficiency to Economic Productivity, Recommendations for Improving the Robustness of the American Economy". ACEEE, Washington, DC, July 2013.

[156] "Evaluating the Market for Industrial Energy Service Outsourcing". press release, ACEEE, March 19, 2014.

power reliability, avoided outages and faster restoration times.[157] An advantage of smart grid has been to help emerging markets leapfrog technology for energy infrastructure.[158]

This sector also includes investments in batteries for electric vehicles and charging infrastructure, new storage technologies such as passive green off-grid buildings and super capacitors. The 2013 GTS report covered many of these innovations in energy storage.[159] Morgan Stanley predicts falling costs of batteries presents a tipping point encouraging households, vehicles and businesses to go off grid and off the pump.[160] This interest has driven up tremendously the use and hence the cost of lithium, as we predicted this overshoot, and however imperfect and toxic this commodity is.[161]

Widely considered the lowest hanging fruit for investors, efficiency provides remarkable ROI. The EU's efforts toward 20% energy savings by 2020 has already resulted in EU buildings consuming half the energy used in the 1980s.[162] Highlighting strides in production, the share of refrigerators meeting the highest energy efficiency classes increased from less than 5% in 1995 to more than 90% in 2010.[163] The US Energy Star program has developed a Cash Flow Opportunity calculator to create a sense of urgency for manufacturers to change their processes and the products offered.[164]

Supply chain efficiency is recognized as a key component of energy efficiency as noted by McKinsey & Co. in 2009.[165] Companies are realizing the value of providing services specific to meeting this need such as Johnson Controls which is specifically targeting scaling up its program to help small and medium-sized enterprises.[166] The numbers reported by the GTS are certainly understated as these smaller company efforts do not meet our $100 million investment accounting threshold.

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[157] Wong, G. "ComEd files for rate increase to help cover Smart Grid program". Chicago Tribune, April 14, 2016.

[158] Southeast Asia Smart Grid: Market Forecast: 2016-2026. Northeast Group, LLC, March 2016.

[159] Henderson, H. "Introduction and Overview: Batteries Super Capacitors and More". Green Transition Inflection Point: Green Transition Scoreboard® 2013 Report, Ethical Markets Media, February 2013.

[160] Parkinson, G. "Morgan Stanley: Tipping point nears for going off grid". RenewEconomy.com.au, March 26, 2014.

[161] Stafford, J. "Tesla And Other Tech Giants Scramble For Lithium As Prices Double". OilPrice.com, April 12, 2016.

[162] Energy Efficiency, European Commission, http://ec.europa.eu/energy/en/topics/energy-efficiency, accessed April 13, 2105.

[163] Ibid.

[164] US EPA. Calculate returns on energy efficiency investments. http://tinyurl.com/jcg3qwh

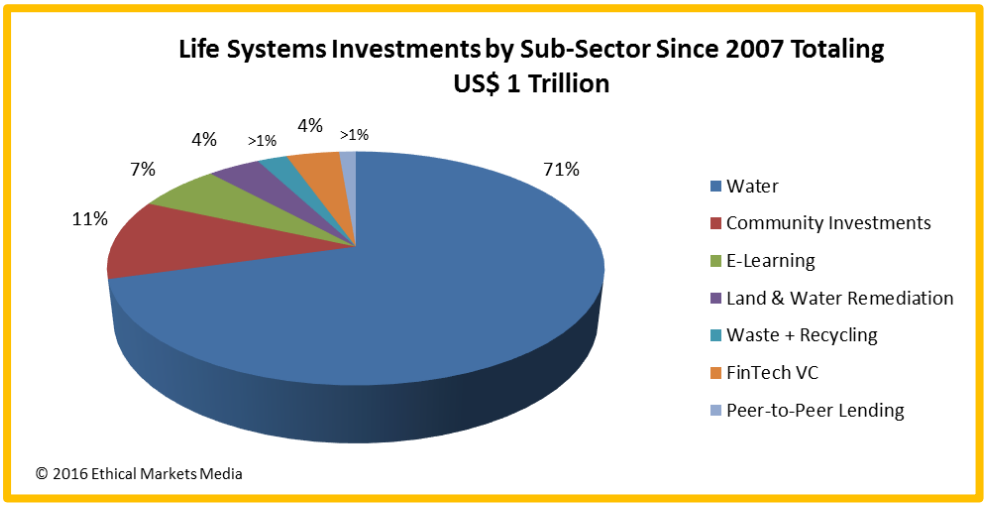
[165] Meyer, T. "Increasing the energy efficiency of supply chains". McKinsey Quarterly, August 2009.

[166] "Johnson Controls teams up to scale energy efficiency in corporate supply chains". Press release, ACEEE, June 11, 2015.

Life Systems

Technologies other than renewable energy and efficiency enhance quality of life, protect nature, provide for education, healthcare and food, protect and enhance ecosystem services. A system-wide transition toward efficiency, information and digitization can best be viewed through a **Life Systems** lens. Infrastructure from past eras no longer fit for purpose require redesign of urban infrastructure whether it be transit, healthcare, food and water delivery, education and information systems.

The Green Transition Scoreboard® collects investments in these areas under **Life Systems**. When we started tracking for 2014, Water, Community Investment, E-Learning, VC/PE/M&A, Land & Water Remediation and Waste & Recycling reached threshold minimums for inclusion in the GTS, totaling $876 billion in investments since 2007. For 2015, we have added Fintech VC and Peer-to-Peer Lending, including crowdfunding of sustainability, as described further in the Overview, reaching the new total of over $1.03 trillion invested since 2007.



Water, Land & Water Remediation, Waste & Recycling

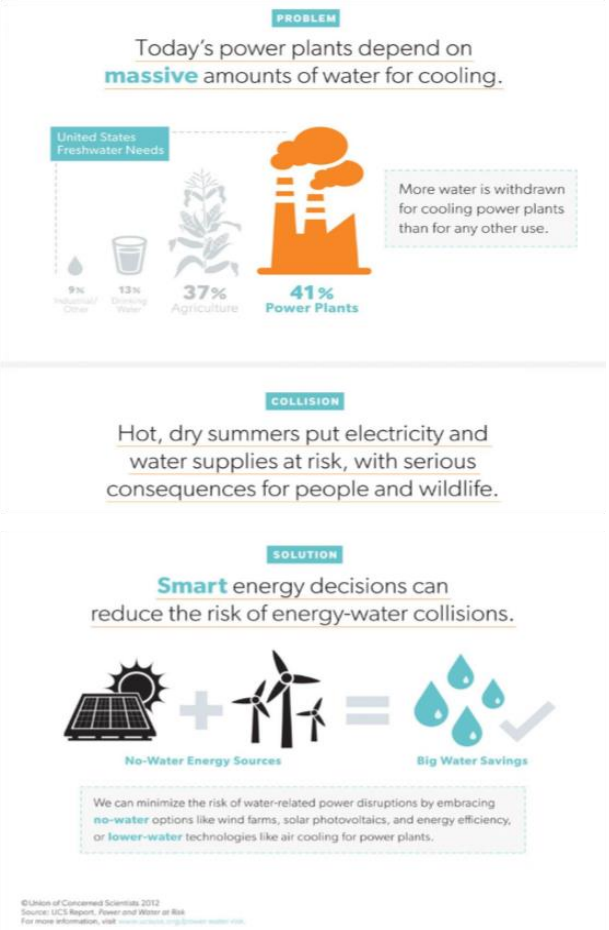
Water is the most important commodity for life originating on this planet. The GTS totals private investments in water since 2007 at $728 billion.

Most water infrastructure when working well goes unnoticed for decades. These investments include pipes, valves, filters, membranes, meters and biological systems. We omit the bottled water

industry, privatization, large-scale hydroelectric dams. The GTS does count investments by utilities in water and wastewater systems. Given many utilities are owned and operated by various levels of government, a 60% discount has been applied. Despite what the GTS omits and the discount applied, investments in **Water** are comparable to Green Construction and greater than Corporate Green R&D.

Fresh water accounts for only 3% of water on the planet, and it is unequally distributed. Droughts cost billions in lost economic activity, with taxpayers often paying to remedy the resource depletion in a way which falls far short of what healthy ecosystem services can provide, with climatologists warning there is worse to come.[167, 168]

As fresh water becomes increasingly scarce, questions arise as to the use of water in mining and fracking when fields and livestock are in distress or abandoned.[169] A concern based on the enormous waste in mining, including water waste and contamination, led to the creation of Ethical Markets' initiative the EthicMark® GEMS standard seeking to shift consumption from mined gems to lab-created gems from human ingenuity.[170] For mining deemed "necessary", methods to reduce water use reduce the cost of production as well.[171]



In Europe, 44% of fresh water consumption is used in energy production, mostly to cool thermal and nuclear power plants. In the US, a comparable 41% of freshwater used goes to generate electricity, beating out agriculture at 37%.[172] Investments in water include infrastructure and clean drinking water and sanitation. While in 2013 it was estimated it would take over $384 billion over 20 years to ensure safe drinking water in the US, resolving the lead

[167] "Australia's Queensland hit by record drought". BBC News Asia, March 7, 2014.

[168] Romm, J. "Leading Scientists Explain How Climate Change is Worsening California's Drought". ThinkProgress.org, January 31, 2014.

[169] Carroll, R. "Exclusive: California used 70 million gallons of water in fracking in 2014". Reuters, April 3, 2015.

[170] "Scio Diamond receives another patent for lab-grown diamonds". IP Frontline, February 9, 2016.

[171] "Mining: Reducing water usage, reducing costs". Eco-Business.com, April 3, 2016.

[172] Power and Water at Risk. Union of Concerned Scientists, 2012.

contamination disaster in Flint, Michigan, alone is estimated by Fitch Ratings at $275 billion.[173, 174] The World Water Council and K-Water see "Water and Green Growth" as a new path to sustainability and opportunities for economic growth.[175] Imagine where we would be if the 2004 World Health Organization recommended annual investment of only $22.6 billion had been implemented to improve water and sanitation services globally.[176]

Largely overlooked, saline water constitutes 97% of available supply. As reported in "Plenty of Water" (GTS 2014), enormous opportunities are under-appreciated in desert-greening and in growing food, fiber and biofuels from algae on seawater from the 10,000 varieties of halophyte (salt-loving) plants which are grown in many countries, on desert lands using solar energy. The UAE is pursuing aquaculture both for biofuel and food security.[177] Our TV program "Investing in Desert Greening" reviews the possibilities.

Land & Water Remediation and **Waste & Recycling** subsectors are reported individually based on specific project financing, totaling $66 billion combined. VC, PE, M&A refer to the same subsectors but reference market transactions. Much of the data comes directly from company reports. Site remediation in particular is on track to grow to a $40 billion market by the end of 2015, led in large part by remediation of contaminated land in China and the former Soviet Union.[178]

Community Investing, E-Learning and Fintech

Community Investing refers to capital specifically directed to traditionally underserved individuals or communities, totaling $114.6 billion. In 2014, community investing across just the US, Europe, Asia, Canada and Australia/NZ totaled $109 billion.[179] A more in-depth look needs to be taken at Latin America and Africa. Traditional markets still overlook the millions of cooperative enterprises which employ more people than all traditional for-profit, commercial companies combined.[180]

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[173] Cart, J. "US water infrastructure needs $384-billion upgrade". Los Angeles Times, June 4, 2013.

[174] Dolan, M. "US could face a $300 billion lead pipe overhaul". *Detroit Free Press*, March 5, 2016.

[175] Water and Green Growth: A New Path to Sustainability, announced at 7th World Water Forum, Daegu, Korea, World Water Council and K-water, April 13, 2015.

[176] "Costs and benefits of water and sanitation improvements at the global level". World Health Organization, 2004.

[177] Casey, T. "Aquaculture Meets Biofuel For Food Security In UAE". CleanTechnica, March 17, 2016.

[178] $40 Billion World Site Remediation Annual Market by 2015, news release, The McIlvaine Company,

[179] 2014 Global Sustainable Investment Review, *op. sit.* 2015.

[180] International Year of Cooperatives 2012, Cooperatives in Social Development, UN DESA-DSPD, accessed at http://social.un.org/coopsyear/, April 16, 2015.

E-Learning accounts for $66.4 billion in Life Systems. This subsector covers all forms of online and mobile education from MOOCs (massive open online courses) to education platforms to learning management systems (LMS) to for-profit institutions. The GTS research focuses on the first three, avoiding when possible investments in "for-profit" colleges and universities because of the many controversies over government subsidies, predatory lending, enormous student debt, poor graduation and employment results. Free MOOCs and other self-directed learning methods are popular despite low "graduation" or certificate earning rates, instead being self-paced and self-realized, where learners can absorb what is needed to solve local and personal challenges. Growth in the market is estimated at 7% per year.[181]

Fintech as a subsector is described at length in the overview, Fintech: The Good and Bad News. Fintech, totaling $42.5 billion, facilitates the rise of the digital economy, including community investing and peer-to-peer lending. Global VC investments in fintech for 2015 reached 860 deals totaling $12.5 billion in investments.[182]

Peer-to-Peer (P2P) lending, a subset of fintech, is often overlooked while adding $13.4 billion to the overall Life Systems total. Much of its investments came first from VC looking to invest in peer-to-peer enterprises. Investments surfacing in 2007 included online tools for collaboration, for example, the rise of Airbnb. Etsy was an early entrant to the retail marketplace, now trading on Nasdaq and a Certified B Corporation. P2P investments share in the e-learning boom with software development which allows online and mobile collaboration among students and between them and instructors. [183]

A current P2P hot topic is financial services which facilitate actual peer-to-peer investing. In 2015, BlackRock bought £12.7 million worth of shares in UK's Funding Circle investment trust.[184] In spite of much optimism, a lack of accountability has led to the prediction from Adair Turner, former chair of London's Financial Services Authority, that peer-to-peer lending losses "will make the worst bankers look like lending geniuses".[185] A counter positive, considered a form of green banking, funds transferred via e-remittances are an important component in local investments.[186] The remittance market brings increased transparency and competitiveness, lowering the costs of sending money in part because of online money transfers which can easily be done from ones phone.

[181] E-Learning Market Trends & Forecast 2014 - 2016 Report, Docebo S.p.A, 2014.

[182] "The 2015 Fintech Investment Landscape". Innovate Finance, February 2016.

[183] Jones, D. "Venture Capital Investments in P2P Companies". P2P Foundation, January 29, 2012.

[184] Williams, A. "BlackRock backs P2P with £12.7m investment". Financial Times, April 15, 2016.

[185] Farrell, S. "Former City regulator warns of potential peer-to-peer lending crisis". The Guardian, February 10, 2016.

[186] Bjuggren, P., Dzansi, J. and Shukur, G. "Remittances and Investment". Department of Economics and Statistics, Jönköping University and Centre for Labour Market Policy, Växjö Universit, Sweden, 2009.

Future Sub-Sectors

Investments in Life Systems are as wide-ranging as life on earth. Many subsectors other than those reported by the GTS receive green investment but do not have projects meeting the GTS $100 million reporting threshold.

- Agriculture: organics and non-GMO, vertical farming
- Forest and farmland remediation: natural methods of carbon sequestration, investing in protecting land for intrinsic value and to increase values of adjacent lands for development
- Aquaculture: fisheries, seaweed for food and feedstock, halophyte farming
- Healthcare: waste reduction,[187] energy reduction and efficiency,[188] quality of life for patients and healthcare workers [189]

Green Construction

From 2007 to 2015 Green Construction reached $745 billion in investments and commitments. The sector is divided into current investments by year of funding. Since public-sector information is not reported separately, the total has been discounted to account for government projects.

The GTS does not restrict green construction solely to LEED buildings and other certifications, wanting to give credit for effort and to recognize new innovations, given that established standards often experience a lag behind entrepreneurs. For example, the startup Carbon has raised $140 million for 3D printers which are faster and less-energy intensive than most 3D printers on the market.[190]

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, structural materials such as timber, steel and other metals, concrete, glass, insulation and green rooftops and broad application

[187] Howard, J. “10 reasons health care needs sustainability treatments”. GreenBiz.com, February 12, 2014.

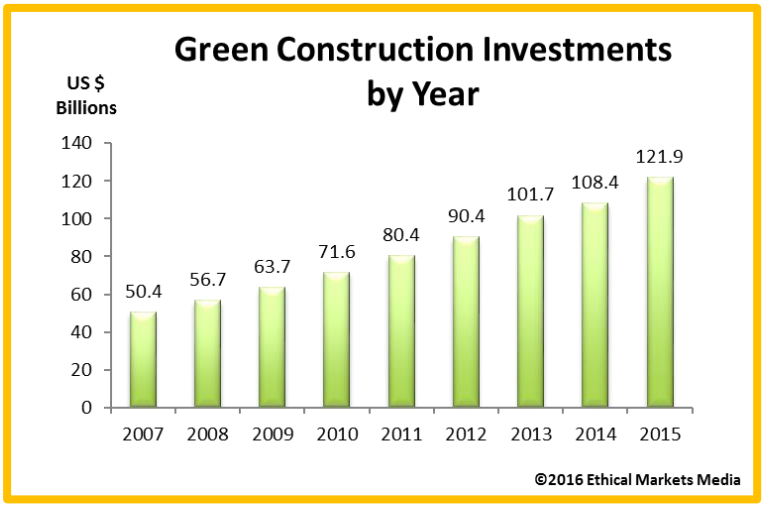
[188] Bendewald, M. and Tupper, K. “A positive diagnosis: How hospitals are reducing energy consumption“. Rocky Mountain Institute and GreenBiz.com, November 21, 2013.

[189] Sutter, K. “How Healthcare Pros Can Build the Business Case for More Sustainable Hospitals”. Sustainable Brands, April 16, 2015.

[190] Clark, J. “An Object Rises From the Goop”. *Bloomberg Businessweek*, April 4, 2016.

categories of framing, insulation, roofing, exterior siding and interior finishing.[191] Figures include innovations in green roofs, eco-friendly carpets, recycled tiles, VOC-free glues and paints and cement-making that uses CO2. Projected CARG through 2019 is 12.5%.[192]

Green construction also applies to creating greener cities rather than just greener buildings, for example, Guangzhou in China and the long-term symbiosis in Kalundborg, Denmark, which started in the 1970s [193] (see visual p. 1).



The GTS only counts green construction materials, **not including labor**, making this the most conservatively under-reported sector of the GTS as explained in the 2014 GTS Report.[194]

Aggregate data on green construction for countries other than the USA are a challenge to compile. To provide country-specific sources on green construction and efficiency not included here, please contact the GTS research team.

Corporate Green R&D

The data collected for the GTS is the most comprehensive assessment of **Corporate Green R&D** available. The GTS research team reviews press releases, sustainability reports, and financial statements. The team has identified over 190 corporations and organizations responsible for the green R&D tallied in this report. From 2007 to 2015, Green R&D reached $489 billion in investments and commitments.

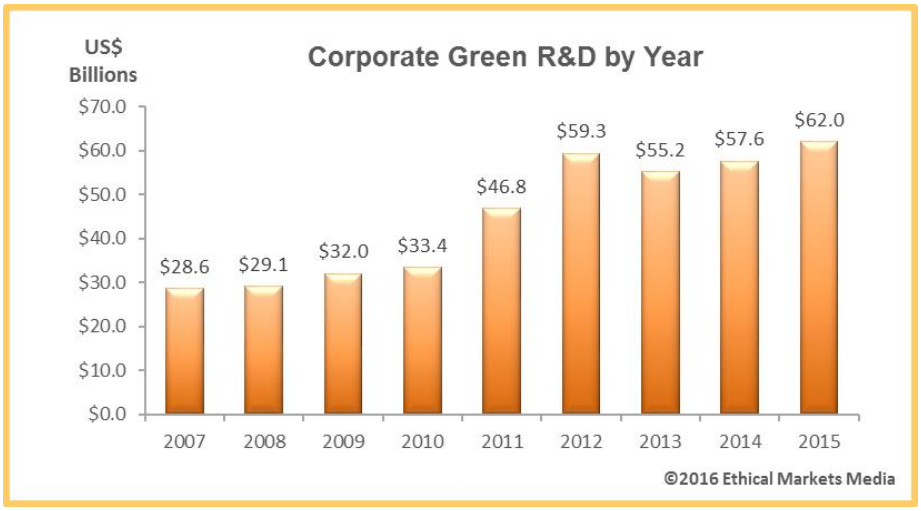
[191] Green Building Materials Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast, 2013 – 2019, Transparency Market Research, January 2014.

[192] "Green Building Materials Market to Reach $235bn by 2019", Environmental Leader, January 12, 2015.

[193] Moore, J. "Considering Impacts of Scale: Reflections on Guangzhou, China," Ecocities Emerging, Ecocity Media, December 2014.

[194] Sanquiche, R. "Green Construction," 2014 Green Transition Scoreboard® Report: "Plenty of Water!", Ethical Markets Media, p. 25, March 2014.

The $489 billion likely understates by half actual global Corporate Green R&D, considering how much goes unreported for competitive reasons. International companies' R&D does not make it into the media. In most countries, companies are not required to report, and tens of thousands of middle-market and smaller companies have R&D budgets below the GTS reporting threshold.[195]



Investing in green R&D shows that a company integrates sustainability into its core strategy. This data helps identify innovative companies ahead of the curve in responding to heightening environmental risks and regulations.[196] Green R&D serves as a strong indicator to investors, alert to the green transition to the Solar Age, that a company is both long-term and forward-looking. Green R&D provides a competitive advantage, preparing companies for market trends reflecting rising energy costs, water scarcity, demographic changes, and new regulations. [197]

Once again, the GTS data shows the automotive industry is the largest investor in green R&D. The top six have investments ranging from $14 billion to $98 billion. Despite its image woes, Volkswagen leads, followed by Robert Bosch, an automotive industry supplier, Toyota, BMW, Volvo and Audi. The sector total of $248.8 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 greening vehicles or production.

[195] Note: some companies' numbers for 2015 have yet to be counted because they have different year-end reporting cycles.

[196] 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.

[197] Shapiro, A. "Make Green R&D a Competitive Advantage". Harvard Business Review, August 11, 2008.

Energy generation, conservation and distribution account for the next large investment input. Combining smart grid and smart metering, this subsector accounts for $36.3 billion in R&D. The combination of solar, wind, biofuel from seawater algae and heat exchange benefits from $17 billion invested in R&D. The bad news is that there is still plenty invested in oil and gas exploration and production. The good news is that the 2016 spending outlook for oil and gas forecasts reductions of 15% globally after a decline of 23% in 2015.[198]

In keeping with GTS attention to Life Systems, R&D for water is at $12.5 billion, up over $5 billion in just one year. See Life Systems: Water for trends in water investments.

Again for 2015, battery technology is a hot topic, foreseen by Hazel Henderson in her introduction to the 2013 GTS report.[199] The automotive industry for EVs is pushing battery manufacturing, driving up the cost of key components such as lithium, mentioned previously. Storage R&D accounts for $10 billion of the R&D total.

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

[198] "Barclays: Global E&P budgets to see double-dip in 2016". *Oil and Gas Journal*, January 13, 2016.

[199] Henderson, H. "Introduction and Overview" op. cit. 2013.

Appendix 1 - Tallies

2016 Sector Totals

Sector	Amount US$	
Renewable Energy	$	3,167,439,374,995
Energy Efficiency	$	1,698,230,838,007
Life Systems	$	1,030,740,404,335
Green Construction	$	745,227,254,757
Corporate Green R&D	$	488,883,488,787
Grand Total	**$**	**7,130,521,360,881**

Renewable Energy	US $	
Year		Amount US$
2007	$	170,200,000,000
2008	$	224,200,000,000
2009	$	209,500,000,000
2010	$	267,300,000,000
2011	$	334,700,000,000
2012	$	282,100,000,000
2013	$	281,000,000,000
2014	$	322,200,000,000
2015	$	397,000,000,000
Commitments	$	679,239,374,995
TOTAL	**$**	**3,167,439,374,995**

Energy Efficiency	
Year	Amount US $
2007	$85,994,451,247
2008	$94,107,749,303
2009	$103,011,531,368
2010	$112,784,229,050
2011	$148,667,945,000
2012	$228,240,600,000
2013	$233,883,200,000
2014	$262,299,000,000
2015	$270,514,250,000
Commitments	$158,727,882,039
TOTAL	**$1,698,230,838,007**

Life Systems	
Water	$727,691,493,669
Community Investments	$114,638,600,000
E-Learning	$66,449,826,667
FinTech VC	$42,500,040,000
Land & Water Remediation	$42,101,660,000
Waste + Recycling	$23,943,664,000
Peer-to-Peer Lending	$13,415,120,000
TOTAL	**$1,030,740,404,335**

Green Construction	
Year	**Amount US $**
2007	$50,464,262,053
2008	$56,701,418,037
2009	$63,709,458,468
2010	$71,583,661,200
2011	$80,431,080,000
2012	$90,372,000,000
2013	$101,668,500,000
2014	$108,375,000,000
2015	$121,921,875,000
TOTAL	**$745,227,254,757**

Corporate Green R&D		
Year	**Amount**	
2007	$	28,584,453,309
2008	$	29,109,592,219
2009	$	32,049,053,183
2010	$	33,414,873,761
2011	$	46,843,034,537
2012	$	59,273,472,511
2013	$	55,283,846,063
2014	$	57,639,355,119
2015	$	62,009,785,998
Commitments	$	84,676,022,087
Total	**$**	**488,883,488,787**

Appendix 2 – Positions Held By Principals of Ethical Markets Media

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 or mentioned in this report, many of which are privately held, early stage, pre-IPO companies.

As of April 2016

Acuity Brands
Apple
Autodesk
Biomimicry 3.8
CREE
Domini Social Investment Fund
EnvisionSolar
Equal Exchange
Etsy
Facebook
FirstSolar
Generate Capital
GrainPro
Green Garmento
Google
Hannon Armstrong
Johnson Control
LightPath Technologies
Mobileye
Natcore Technology
NRG Yield
Pax World Fund
PowerShares Cleantech Portfolio
Seimens
Solar City
Solaria
Unilever
Wells Fargo
Western Union

Appendix 3 – Research Team

Research and Writing

Hazel Henderson, D.Sc.Hon., FRSA, founder and president of Ethical Markets Media (USA and Brazil), chair of the Advisory Board, is a futurist, evolutionary economist, author of *Mapping the Global Transition to the Solar Age*, of award-winning *Ethical Markets: Growing the Green Economy* and many other books. She founded the EthicMark® Awards for Advertising, created the Green Transition Scoreboard®, co-developed with Calvert the Ethical Markets Quality of Life Indicators and with Biomimicry 3.8 developed the Principles of Ethical Biomimicry Finance®. In 2012, she received the Award for Outstanding Contribution to ESG & Investing at TBLI Europe; was inducted into the International Society of Sustainability Professionals Hall of Fame in 2013, and in 2014 was again honored as a "Top 100 Thought Leader in Trustworthy Business Behavior" by Trust Across America. She is a Fellow of the World Academy of Art and Science, an Honorary Member of the Club of Rome, holds many honorary doctorates and is listed in Who's Who in the World.

Rosalinda Sanquiche, MA, Executive Director of Ethical Markets Media, Director of Ethical Biomimicry Finance®, Managing Director of the EthicMark®, began her environmental career with the American Wind Energy Association in Washington, DC, in research and communications. She has written and is a public speaker on the construction industry, the environment, sustainability and the media. She has taught environmental policy and team-taught field classes combining ecology and policy. Rosalinda's childhood hiking through Puerto Rico's *El Yunque National Forest* informed her belief that we must preserve the world we inhabit for generations to come. At the North Florida Land Trust, she focused on protecting environmentally significant places through B2B, educational and private/public easements. She serves on the board of the International Society of Sustainability Professionals.

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 teaches Economics at Sheridan College and is the principal of SSI – Strategic Sustainable Investments in Toronto, Canada.

Praise For the Green Transition Scoreboard®

"Over twenty years ago, Hazel Henderson talked of a most implausible goal: to both encourage Green investing and to track its growth worldwide. The remarkable $5.3 trillion [2014] now invested in Green still challenges the imagination. The world needs to know of this triumph and its significance to all our futures." **– Carson E. Beadle, former Director, Mercer; Executive Committee Chairman, Security Mutual Life Insurance of NY**

"No leader, from the CEO of the smallest of corporations to the president of the largest of nations, could do better than internalizing the principles of Ethical Markets and always keeping a sharp eye on the Green Transition Scoreboard." — **Ashok Khosla, Chairman, Development Alternatives and pioneer social entrepreneur.**

"The GTS adopts a much more comprehensive and therefore effective working definition of a green economy than is usually the case, and provides a robust and consistent framework for measuring our progress towards it." — **Matthew Kiernan, founder, Innovest; CEO, Inflection Point Capital Management; author, Investing in a Sustainable World**

"We usually do manage what we measure; so the GTS is an important contribution from Ethical Markets Media in getting to the future our polling suggests people intend for their children." **— Doug Miller, Chairman, GlobeScan Inc.; President, GlobeScan Foundation**

"Wonderful initiative. Finally an overview of the amount of private money invested and committed to Impact Investing." – **Robert Rubinstein, CEO, TBLI GROUP™**

"Because it enables tracking of the global macro-shift from the Industrial Era to the emerging sustainable economies of the 21st century the GREEN TRANSITION SCOREBOARD® is an important innovation. Check it out!" **Don Tapscott, author of the bestsellers Wikinomics and Macrowikinomics**

"Since 1987, we have guided our investors towards companies leading the growing green economy: the Sustainability Sector. The GTS is an important milestone in measuring the increasing economic viability of this CleanTech universe." – **Stuart Valentine, Founder, Centerpoint Investment Strategies**

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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