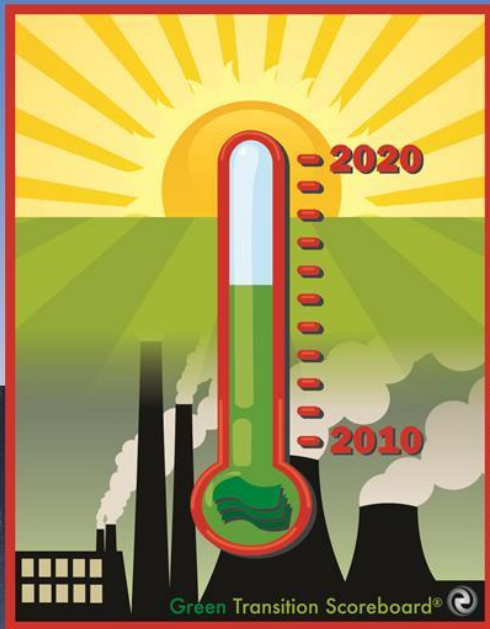


Breakdowns Driving Breakthroughs



2015 Green Transition Scoreboard® Report

Solar wind encountering Earth's magnetosphere © ESA/AOES Medialab

2015 Green Transition Scoreboard® Report: “Breakdowns Driving Breakthroughs”

Cover: Solar wind encountering Earth’s magnetosphere © ESA/AOES Medialab

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

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Executive Summary

For 2014, the Green Transition Scoreboard® (GTS) focused on water, which added \$484 billion to the overall total of \$5.3 trillion of private investments reported March 2014, 9% of the overall total, while the mid-year update focused on global green bonds which are regularly oversubscribed.

This year, the GTS tracks Renewable Energy, Energy Efficiency, Green Construction, Life Systems and Corporate Green R&D, representing broad areas of investment in green technologies. Life Systems is a new category tracking the system-wide interconnections among efficiency, information and digitization, energy, water, food, education and health. 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.

Sector	Amount US \$
Renewable Energy	\$2,807,484,000,000
Energy Efficiency	\$1,566,241,000,000
Life Systems	\$876,412,000,000
Green Construction	\$639,362,000,000
Corporate Green R&D	\$338,478,000,000
Grand Total	\$6,227,977,000,000

The upward trend in investments reported since 2009 aligns with our recommendation that investing at least 10% of institutional portfolios directly in companies driving the global Green Transition appropriately updates strategic asset allocation models both as opportunities and as risk mitigation. Even limiting government and institutional investments which are increasingly focusing on growing greener economies, \$6.22 trillion in private investments and commitments puts private investors growing green sectors globally on track to reach our projected \$10 trillion in investments by 2020.

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

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

Renewable Energy – Growing strongly despite huge continued subsidies to fossil fuels and nuclear, and scaling back on commitments as with the increasingly limited DESERTEC projects.

Energy Efficiency – Game-changer with widespread ripple effects positively impacting jobs creation, manufacturing and other metrics tracked by traditional GDP.

Green Construction – Experiencing an innovation boom as green construction standards are adopted worldwide.

Life Systems – Covers those broad areas of sustainability that are systemically linked, including natural resources, agriculture, water, smart cities, green infrastructure and the rapid digitization “infostructure” of many sectors now underpinning efficiency gains and quality of life. Life Systems tracks investments often overlooked as too small.

Corporate Green R&D – This sector remains powered by the automotive industry. A side benefit has been improved battery technology which makes renewables more adaptable and integrated.



Part One – Overview

Breakdowns Driving Breakthroughs By Hazel Henderson

2015 is the year when all the issues of global sustainability are going mainstream and becoming key agendas in the politics of most of the 193 United Nations (UN) member countries. The global transition from fossil fuels and nuclear power to efficient use of renewable energy and materials is now accelerating, as we expected when we launched our Green Transition Scoreboard® (GTS) in 2009.

Anticipating the disappointments of the UN Climate Summit in Copenhagen, we identified the trends in private sector investing in all the new companies and technologies in solar, wind, efficiency, storage as well as geothermal, wave power and research in the \$1.2 trillion total worldwide in 2009. We projected that if the pace of at least \$1 trillion annually continues until 2020, that the world’s economies would shift into the more sustainable, cleaner, knowledge-rich technologies of the next era as described in “[Mapping the Global Transition to the Solar Age](#)” (Journal of the ICAEW and Tomorrow’s Company, 2014). This transition is well underway as evidenced by numerous reports from [Financing the Transition](#), Long Finance¹; [Fiscal Policies and the Green Economy Transition](#)²; and [Greening China’s Financial System](#).³ Even the fall in oil

¹ Mainelli, M. and von Gunten, C. Financing the Transition: Sustainable Infrastructure in Cities, Z/Yen Group, Long Finance and WWF, March 2015.

² “Fiscal Policies and the Green Economy Transition: Generating Knowledge – Creating Impact,” OECD Green Growth Knowledge Platform Third Annual Conference Report, Ca’ Foscari University of Venice, The Energy and Resources Institute, United Nations Environment Programme, the Government of Switzerland, the Government of the Netherlands.

prices is not derailing the transition to renewable energy and efficiency, especially in developing countries where solar is growing and oil accounts for only 1.5% of electricity generation in the key markets where solar is growing.⁴ These trends can address the needs of the 1.3 billion people lacking electricity, particularly when combined with information technologies like mobile phones and virtual financial services.⁵ Even the natural gas from shale in the USA can no longer change the direction of the transition to renewables, while its current role usurping coal in electric utilities' fuel mixes is leading to new risks and vulnerabilities.⁶

So far, the drivers of this global transition have been the 1) growing risks of fossil fuels and nuclear energy, unaccounted rising costs of resource-degradation, waste, pollution and health impacts (still "externalized" from company and government accounts); 2) pressure on water supplies, collapsing fish stocks, spreading desertification and loss of forests and biodiversity; and 3) the growing recognition of the benefits of the green transition to sustainability in public health and safety, environmental quality, more equitable decentralized technologies – all of which are available and when scaled could provide unlimited sustainable energy for all countries.⁷ *Better Growth Better Climate*, the Synthesis Report of the Global Commission on the Economy and Climate, a global consortium of eight research institutes, documents that this green transition will also provide opportunities for jobs and boost sustainable global development.⁸

Since 2009, the rising awareness of these new global possibilities grew worldwide among the grass roots, in academia and at last reached politicians and traditional financial centers. These crises humanity faces were seen more clearly as caused by limited perception of planetary processes and our place in its living biosphere. As we humans began accepting our role in these crises, including climate change, many became empowered to take responsibility to act in this new Age of the Anthropocene. Scarcities of water, arable land and forests which had fueled "resource grabbing" by multinationals and government sovereign wealth funds increasingly meet with local resistance. A report by The Guardian demonstrated the failure of such privatization models.⁹

The tipping point was in 2012 where 50,000 civic leaders met with leaders of 193 UN member countries and many enlightened businesses and investor groups at the UN Summit Rio+20 in Rio de Janeiro, Brazil.¹⁰ Our GTS was presented at this summit in many venues with our 2012 total at \$3.3 trillion. Corporations and institutional investors signed [The Natural Capital Declaration and Roadmap](#) which has since then added hundreds of organizations.¹¹ Pension funds, particularly in Europe, joined the transition.¹²

³ Chenghui, Z., Zadek, S., Halle, M. "Greening China's Financial System: Synthesis Report," IISD and DRC, March 16, 2015.

⁴ Gilbert, K. "The Bright Side," Bloomberg, Institutional Investor, p. 44, March 2015.

⁵ Alstone, P., Gerhenson, D. and Kammen, D., "Decentralized Energy Systems for Clean Electricity Access," Nature Climate Change, vol. 5, pp 305-314, April 2015.

⁶ Deyette, J., et al. [The Natural Gas Gamble](#), Union of Concerned Scientists, March 2015.

⁷ See for example the Green Transition Scoreboard® reports from 2012 and 2013.

⁸ Better Growth Better Climate, Global Commission on the Economy and Climate, World Resources Institute, EDRI, Tsinghua University, Climate Policy Initiative, Global Green Growth Institute, Stockholm Environment Institute, CRIER, LSECities, September 2014.

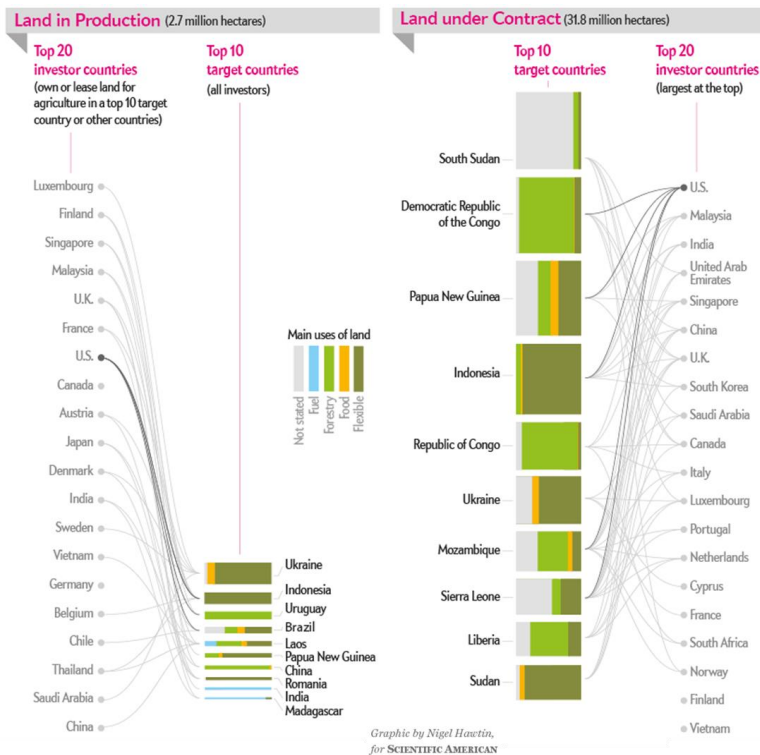
⁹ Vidal, J. "Water privatization: a worldwide failure?" The Guardian, January 30, 2015.

¹⁰ Report of the United Nations Conference on Sustainable Development, [UNCSD](#), Rio de Janeiro, Brazil, June 2012

¹¹ The Natural Capital Declaration and Roadmap, UNEP and GCP, 2014.

¹² Denmark, F. "The Greening of European Pensions," Institutional Investor, p. 56-9, March 2015.

Countries "grabbing" land outside their borders¹³



The alarming weather events and natural disasters of 2013 and 2014 finally brought widespread recognition of anthropogenic climate change and the growing debate about mitigation and inevitable adaptation to rising sea levels and security risks.¹⁴ [Global Insights on ESG in Alternative Investing](#) were provided by Mercer and LGT Capital Partners.¹⁵ Many pension fund managers who formerly cited financial risks in divesting from fossil fuels now cite the risks of “stranded assets.”¹⁶

Thus, defensive, rearview mirror responses gave way to more proactive approaches. Forward-looking financial groups¹⁷ promoted the wide range of new investments¹⁸ and the need to shift portfolios from fossil fuels and “stranded assets” to market reforms, including

carbon taxes and writing down “proven reserves” which clearly could not be exploited without increasing global warming beyond 2°C.^{19,20} While solar PV and thermal CSP, wind and efficiency became increasingly attractive and prices, particularly of solar PV continue to fall, even *The Economist* acknowledged the new circumstances in their special report “Let There Be Light”.²¹ All this was made even more attractive by the drop in oil prices below \$50 a barrel by January 2015, allowing governments to withdraw costly subsidies to consumers. London’s FTSE launched its ex-Fossil Fuels Index series, and the UN’s \$53 billion Joint Staff Pension Fund has seeded two low-carbon exchange-traded funds (ETFs).²² As carbon assets are downgraded in portfolios, we recommend that these be repriced as “in situ chemical feedstocks reserves” to soften the blow.

Looking ahead, this acceleration of the green transition is powered by fundamental shifts in human perspectives leading to paradigm shifts in science, academia, governance, leadership,

¹³ Fischetti, M. “This Land is My Land,” *Scientific American*, May 2015.

¹⁴ Henderson, Hazel. “Mapping the Global Transition to the Solar Age,” ICAEW and Tomorrow’s Company, UK, February 2014.

¹⁵ *Global Insights on ESG in Alternative Investing*, Mercer and LGT Capital Partners, March 2015.

¹⁶ Rose-Smith, I. “Big Difference,” *Institutional Investor*, p. 41, April 2015.

¹⁷ Ceres [Investor Network on Climate Risk, Portfolio Decarbonization Coalition and others](#).

¹⁸ Ceres “[Clean Trillion](#)”.

¹⁹ Carbon Tracker, UK.

²⁰ McGlade, C. and Ekins, P. “The geographical distribution of fossil fuels unused when limiting global warming to 2 °C,” *Nature*, January 8, 2015.

²¹ “Let There Be Light,” *The Economist*, Jan. 17, 2015

²² Gilbert, K. “Performance Anxiety,” *Institutional Investor*, p. 49, May 2015.

finance, business, social norms, media, communications and network structures. The role of space and Earth-observing satellites led to a greater focus on exploration of [earth systems science](#).²³ The computerized digital revolution and social networking underlie all these shifts as efficiency in energy, manufacturing, urban redesign, transport, healthcare, finance and many other sectors of post-industrial societies are digitized and dis-intermediated.

While we are seeing ourselves anew as one confused, troubled human family, trying to adjust to each other's differing experiences, beliefs and cultural practices, we are also acknowledging the globalization and technologies we have created which we must now address and manage if we are to survive. As we deal with the resulting conflicts, inequality, social fragmentation and mindless violence, humans are learning and survival strategies are emerging. We recall that stress has been a basic tool of evolution in all species, including our own.

Breakdowns drive breakthroughs. There is much good news, submerged in mainstream media, still operating on the old commercial formula: violence, sex, scandal as weapons of mass distraction – “if it bleeds, it leads.” In *The Better Angels of Our Nature* (2011), Harvard psychologist Steven Pinker tells the more hopeful story based on millennial historical trends including the feminization of societies, “gentle commerce”, expanding reason and sympathy and social order. Charles Johnston, MD, sees these trends as leading toward cultural maturity in *Hope and the Future* (2014). Even in the face of rising sectarian conflicts in the Mid-East, similar reports from *BusinessWeek* and *New Scientist* document how humans are “changing the juice we use to run our civilization” and “witnessing a complete transformation of the world.”^{24, 25} Even US populations are beginning to see climate change as a threat and surveys now show bipartisan support for government regulation of greenhouse gases and majorities now favor solar energy.^{26, 27}

Key drivers in 2015 accelerating the green transition to more equitable, peaceful, sustainable societies are knowledge-intensive, paradigm shifts – new source codes now steering social, political, financial, corporate and academic decisions and changes:

- Beyond quantitative economic models to qualitative growth, systems approaches to human development, wellbeing and happiness
- Beyond short-term gain to long-term sustainability
- Beyond competition to collaboration and cooperation

These more inclusive systemic paradigms are re-shaping:

- Markets and commons in new global agreements
- MOOCs revolutionizing academic-based learning²⁸
- Beyond scarcity economics to abundance and embracing earth systems science

²³ [NASA](#) and <http://www.ethicalmarkets.com/category/earth-systems-science/>.

²⁴ Kenny, C. “The Economic Power of Positive Thinking,” *Bloomberg BusinessWeek*, p. 8-9, Jan. 12, 2015.

²⁵ Brathic, C. “Climate for Optimism,” *New Scientist*, p. 24, Dec. 27, 2014.

²⁶ Polling the American Public on Climate Change, Environment and Energy Study Institute, April 2015.

²⁷ U.S. Homeowners on Clean Energy: A National Survey, SolarCity, Clean Edge and Zogby Analytics, March 2015.

²⁸ See for example, Carey, K., *The End of College*, Riverhead/Penguin, New York, 2015.

- Beyond mining the Earth for energy to harvesting the Sun’s free photons – that safely sited nuclear power 93 million miles from Earth

These new source codes are now pervading our organizations, new strands of cultural DNA deep in our operational hard drives, leading to new strategies, assumptions and decisions:

- Accounting and internalizing all social and environmental costs into public and private balance sheets (beyond GDP and “externalizing,” toward full-spectrum, truthful accountability and circular economies).²⁹
- Transforming finance beyond short-term, money-based [fossilized asset allocation](#) still mispricing energy and risk³⁰ to long-term value creation standards based on use of six forms of capital: human, intellectual, financial, social, built and natural (IIIRC, [SASB](#), [GRI](#) and Ethical Markets’ [Principles of Ethical Biomimicry Finance®](#)).
- Market-based reforms – pollution taxes (including carbon)³¹; democratizing financial services; reforming electronic markets and trading³²; [crowdfunding](#), cellular phone banking, revival of public banks, time banking, credit unions, cooperatives, worker-owned companies, hybrid social enterprises and the rise of shareconomies and the [circular economy](#).³³
- Focus on inequality, technology-based unemployment and the globalized power-law race-to-the-bottom; new forms of distribution of purchasing power, aggregate demand, guaranteeing minimum basic security, incomes, contingent cash transfers.^{34, 35}
- Focusing on technological threats – artificial intelligence (AI), cybercrime and terrorism, synthetic biology, geo-engineering, nanotechnologies, space race for helium 3 and other minerals, gene driving³⁶; beyond animal protein to plant protein, more insect-based foods for energy and resource efficiency and human health.
- Designing and financing urbanization, efficient infrastructure,³⁷ focusing more on “infostructure” (broadband, expanding internet access, online education, tele-democracy),³⁸ public goods and services, mobility, food, cultural and environmental amenities.
- Beyond fresh water intensive glycophyte agriculture to salt-loving halophyte-plant foods, fiber and fuels (based on four underutilized, abundant resources: 40% desert lands, 97% seawater, 10,000 halophyte varieties and free photons).³⁹

²⁹ Capra, F. and Henderson, H. [Qualitative Growth](#), ICAEW and Tomorrow’s Company, London, UK, October 2009

³⁰ Henderson, H. [“Fossilized Asset Allocation Still Mis-Pricing Energy And Risk,”](#) SeekingAlpha.com, Jan. 22, 2015

³¹ Henderson, H. “2015’s Winning Coalition,” CSRWire, Jan. 7, 2015

³² Henderson, H. “Reforming Electronic Markets and Trading,” CSRWire, Nov. 19, 2014

³³ Sanquiche, R. “Beyond Wall Street: the encouraging growth of new financial models,” TheGuardian.com, Jan. 14, 2015

³⁴ Henderson, H. “Facing Up To Inequality: New Approaches Beyond Economism,” *The Globalist*, Dec. 31, 2013

³⁵ Henderson, H. “Reforming Money and Banking: Keys to Debt and Jubilee,” Tikkun, Jan. 21, 2015

³⁶ Global Risks 2015 10th Edition, World Economic Forum, Geneva, January 2015

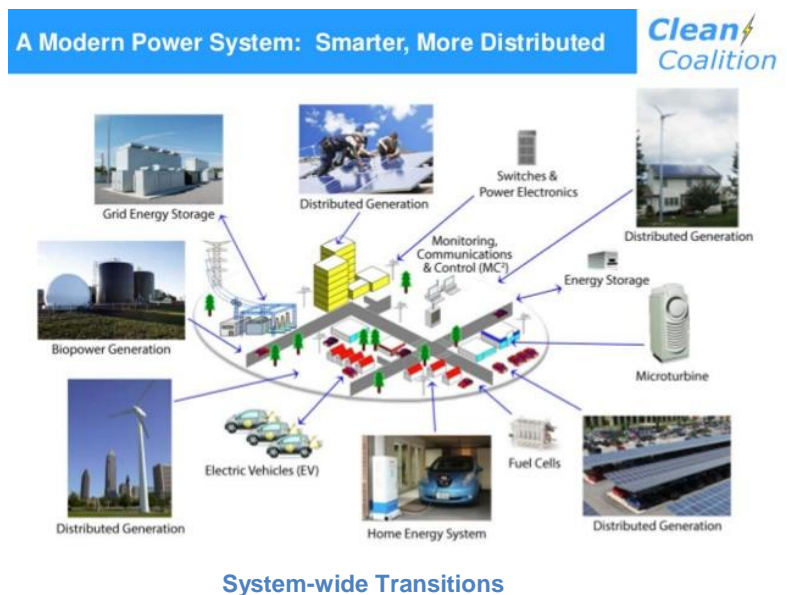
³⁷ Henderson, H., Sanquiche, R. and Nash, T. “Green Bonds Growing Green Infrastructure,” Green Transition Scoreboard Update, Ethical Markets Media, August 2014.

³⁸ See for example, Henderson, H. Global Infrastructure Fund Conference, Tokyo, Japan, 1998.

Life Systems

These broadened approaches to sustainability will be tracked in our GTS under our new section: Life Systems, including technologies protecting nature, human wellbeing, food, water, education and quality of life. We continue to cover green infrastructure finance by green bonds⁴⁰ and purposes to which such funds are applied. Long-term sustainability requires redesign of major infrastructure from past eras – now no longer fit for purpose: from national electricity grids, urban infrastructure, obsolete dams, crumbling bridges, over-investments in roads and private vehicles versus rail, public transit, bike lanes and pedestrian malls to the massive global fossil fuels apparatus and trade facilities for shipping material goods in our increasingly digitized 21st century Information Age. All these system-wide transitions toward efficiency, information and communications technologies (ICT) now digitizing many sectors of economies worldwide can best be viewed through our Life Systems lens.

This helps keep us aware of vital interconnections, such as between energy, water, food and other tightly coupled systems of agriculture, forestry, ecosystem services, financial speculation and climatic changes (all monitored daily by 120 Earth-observing satellites of many countries cooperating through GEO and the International Space Station). For example, the Inter-American Development Bank is financing smart transportation solutions through new public-private partnerships.⁴¹ Even California's drought is producing new approaches such as generating the electricity to run water and waste water system with solar energy.⁴²



The Global Infrastructure Basel conference is revealing its first selection of sustainable infrastructure between \$5 and \$400 million on May 27, 2015, allowing investors to connect with partners and opportunities including wind farms in Vietnam and Senegal, energy and water-saving projects in China, Tanzania; public transit projects in Accra, Mexico City and Fortaleza, Brazil.⁴³

The rapid digitization of legacy industries, manufacturing, retail, traditional banking toward mobile-payments systems like Kenya's M-PEA, crowdfunding sites like Kickstarter and cryptocurrencies like Bitcoin are now spreading to healthcare, legal services and the new "shareconomy"

³⁹ Henderson, H., Sanquiche, R. and Nash, T. "Plenty of Water," Green Transition Scoreboard Report, Ethical Markets Media, March 2014

⁴⁰ Henderson, Sanquiche, Nash, op. cit. 2014.

⁴¹ Public-private partnerships offer smart transportation solutions for Latin America and the Caribbean, Economist Intelligence Unit, Inter-American Development Bank and the Multilateral Investment Fund, April 15, 2015.

⁴² Hales, R. "A Partial Solution to California's Water Problems," Sun Xtender, April 10, 2015.

⁴³ First Infrastructure Projects Announced, Global Infrastructure Basel, April 15, 2015.

hybrids like Uber, AirBnB, Couchsurfer and employment sites like E-Lancer and Task Rabbit. While these new ICT services help consumers' budgets and provide casual work for struggling people in developed economies, they can also exacerbate inequality in countries applying austerity, cuts to public services, pensions and healthcare. In addition, electricity-gulping, inefficient server farms are at last being addressed by a consortium of IT industry leaders formed in 2007 in their Green Grid initiative⁴⁴ and a Power Usage Effectiveness (PUE) effort with EPA's Energy Star program.⁴⁵

The International Telecommunications Union (ITU) has tracked these trends in ICT and how different countries provide infostructure: internet, broadband, fiber-optic cables, WiFi, phone services and how communications networks are provided and under what standards. For example, Scandinavian countries rank highest in providing standard access to this ICT infostructure while Finland defines such access as a human right. The World Economic Forum (WEF) in Davos, Switzerland, since 2001, has produced its Global Information Technology Report comparing progress in ICT across 143 countries because "ICTs have become key enablers of business and employment creation and of productivity growth." While "ICTs have significant potential for supporting inclusive grow ... paradoxically, ICTs have opened up new digital divides."⁴⁶ This is seen both within and between countries, largely due to different standards and politics. ICTs can exacerbate inequality of access, condemning many rural and poor communities to structural poverty and unemployment.

In the USA , for example, access to internet and broadband falls behind many countries, where small cities can be stranded without minimum broadband speed for their small businesses and job creation. Left to the private market, large telecom and cable companies have duopoly or monopoly power and simply will not provide access. The [Financial Times](#) reported on how these policies deny service to millions of consumers and small businesses, and which US neighborhoods, small cities and rural areas do not have broadband connections.⁴⁷ The WEF report ranks the USA 7th behind Singapore, Finland, Sweden, Netherlands, Norway and Switzerland for networked readiness; 14th in access standards behind New Zealand, Britain, Canada and the United Arab Emirates (UAE); 12th on infostructure and affordability and only 10th on business usage.⁴⁸ According to the US Federal Communications Commission,

"High-speed Internet access has become fundamental to modern life. Broadband connectivity can overcome geographic isolation and put a world of information and economic opportunity at the fingertips of citizens... Forty-one percent of America's rural schools couldn't get a high-speed connection if they tried... Connectivity is only available at an unreasonably high price."

Yet, the Connect America Fund will invest \$20 billion in broadband through 2020, paid by small fees on consumer bills.⁴⁹ Google, Facebook and new entrants into providing internet and broadband connectivity to all humanity are gearing up with new technologies. Google is

⁴⁴ "PUE to Become Global Standard for Data Center Efficiency," GreenBiz, April 5, 2010.

⁴⁵ Siegel, R. "New Server Technology Reduces the Power Required to Save Energy," Just Means, April 9, 2015.

⁴⁶ The Global Information Technology Report 2015, WEF, 2015.

⁴⁷ Crow, D. "Digital divide exacerbates US inequality," Financial Times, October 28, 2014.

⁴⁸ Global Information Technology, op. cit.

⁴⁹ Wheeler, T. Closing the Digital Divide in Rural America, Official FCC Blog, November 201, 2014.

developing girdling balloons; Facebook has launched its internet.org and will provide access to basic services in tandem with several governments in Africa and hopes to develop solar-powered drones. OneWeb, a Florida-based start-up, aims to provide fast connectivity to all with swarms of cheap, low-flying satellites.⁵⁰ However, these innovations are unproven and years away.

Thus, this huge underlying transition enabling smarter energy, water, cities, online education, waste recycling and more inclusive green growth will be tracked in our GTS under Life Systems, and currently totals over \$876 billion.

This array of deeper issues is now emerging in thousands of top-level, global scientific conferences and will be the subject of at least three major UN summits in 2015: 1) Financing for Development in Addis Ababa, Ethiopia, July 2015; 2) the UN General Assembly, New York, September 2015, to debate and ratify the new Sustainable Development Goals (SDGs) which build on the Millennium Development Goals (MDGs) which succeeded in advancing education, women's and all human rights and reducing poverty; and 3) the Climate Change Summit in Paris, France, December 2015. The SDGs, launched in 2012 at Rio+20 placed all human goals within the framework of ecological sustainability and inclusive, equitable, low-carbon green economies in member countries and supported open working groups (OWG) in all these countries. A global Stakeholder Forum was initiated to review the goals [see insert]. Its report on achieving a better balance between economic, social and environmental dimensions produced deeper research and clarification in a systems-based synthesis ([OWG Outcome Document](#)).⁵¹ An inter-governmental negotiating session at the UN, New York, January 19-21, 2015, conducted a "stocktaking" in preparation for adoption of the final SDGs at the September General Assembly.⁵²

The report, "Sustainable Development Goals and Integration," Stakeholder Forum 2015, by Amy Cutter, et al.,⁵³ identified cross-cutting issues and where some goals could be focused and integrated with others, for example, how **Goal 7**: "Ensure access to affordable, reliable, sustainable and modern energy for all" was related to **Goal 12**: "Sustainable consumption and production patterns" (closely followed in our GTS). All the SDGs are related and may be further integrated into a smaller group as advocated by some economists and politicians. However, we agree with those who take a systems view beyond economics and money-based measures, such as Secretary-General Ban Ki-moon, Bill and Melinda Gates and others.⁵⁴ We have reported on **Goal 2**: "Promote sustainable agriculture"; **Goal 6**: "Ensure availability and sustainable management of water and sanitation"; **Goal 8**: "Promote inclusive and sustainable economic growth, full productive employment and decent work for all"; **Goal 9**: "Build resilient infrastructure, promote inclusive, sustainable industrialization and foster innovation"; **Goal 11**: "Make cities and human settlements inclusive, safe, resilient and sustainable"; **Goal 14**: "Conserve and sustainably use the oceans, seas, marine resources for sustainable development"; **Goal 15**: "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss".

⁵⁰ "Expanding the Internet: Sky-Fi," *The Economist*, April 11, 2015.

⁵¹ Open Working Group proposal for Sustainable Development Goals, United Nations, 2014.

⁵² "First Intergovernmental Negotiation on the Post-2015 Development Agenda," IISD Reporting Services, January 21, 2015.

⁵³ Cutter, Amy, Derek Osborn, John Romano and Farooq Ullah. "Sustainable Development Goals and Integration," Stakeholder Forum, German Council for Sustainable Development, 2015.

⁵⁴ "Economics of optimism," *The Economist*, p. 61, Jan. 24, 2015.



United Nations Sustainable Development Goals

Ethical Markets supports all these and the other SDGs which relate to gender equity, human rights and social justice which lie beyond the focus of this GTS but are fully embraced in our [Transforming Finance](#) initiative and [TV series](#), our Principles of [Ethical Biomimicry Finance](#)® and our [EthicMark® Awards](#) raising the ethical bar for advertising, our [Quality of Life Indicators](#) and the [Caring Economy Indicators](#) of our partner the Center for Partnership Studies. We have promoted such goals since the launch of the [Earth Charter](#) and its 16 Principles of Human Responsibility at the 1992 Earth Summit in Rio de Janeiro which I have supported ever since.⁵⁵ Accordingly, we are expanding the focus of our GTS to include coverage of investments in quality-of-life access to basic needs, including water, healthier agriculture and food, as well as infrastructure: internet access, broadband, electronic education and political participation.

The UN Secretary General Ban Ki-moon’s report “The Road to Dignity by 2030: Ending Poverty, Transforming All Lives and Protecting the Planet” synthesizes the widespread deliberations of the 193 country members of the United Nations in RIO+ 20, in Rio de Janeiro, Brazil in 2012, with the over 50,000 civic, business and investor groups, including us, also participating.⁵⁶ The global consultations since then led to these new SDGs to expand on the Millennium Development Goals’ progress since 2000. The Rio Outcome document *The Future We Want* summary states “We recognize that people are at the center of development and, in this regard, we strive for a world that is just, equitable and inclusive, and we commit to work together to promote sustained and inclusive economic growth, social development and environmental protection and thereby to benefit all.” My report, the 56-page e-book: [“Mapping the Global Transition to The Solar Age: From Economism to Earth Systems Science”](#), co-published by Britain’s Institute of Chartered Accountants of England and Wales and Tomorrow’s Company,

⁵⁵ The Earth Charter, [Earth Charter International](#), San Jose, Costa Rica.

⁵⁶ Secretary-General. “The Road to Dignity by 2030,” United Nations, New York, December 2014.

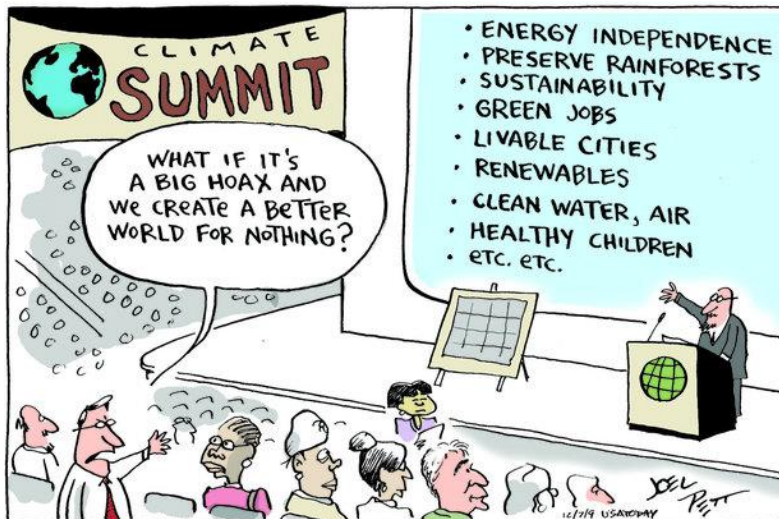
Foreword by NASA Chief Scientist Dennis Bushnell (London 2014) is free, downloadable at www.ethicalmarkets.com.

Secretary General Ban Ki Moon masterfully synthesizes all these global debates and agreements into “A Universal Call to Action to Transform Our World Beyond 2015”. It contains many of the proposals and new paradigm approaches, new metrics beyond GDP, new Principles and Standards for guiding ethical businesses and investors, cooperatives, NGOs, auditors, accountants and financial firms which we have produced and advocated, both in my books and papers since the 1970s, and those of our company Ethical Markets Media (USA and Brazil), a Certified B Corporation since our founding in 2004.

Thus, we intend to continue fully supporting these unfolding transformative processes, including the UNEP [Inquiry on Design of a Sustainable Financial System](#) and its 3rd Report “Pathways To Scale”,⁵⁷ to which we contributed and posted, and continue reporting on them in our Daily Headlines, as well as our Green Transition Scoreboard®, our Ethical Money Directory, our Quality of Life Indicators, our Principles of Ethical Biomimicry Finance®, our TV series “Transforming Finance” distributed worldwide by www.films.com to colleges and libraries (free at www.ethicalmarkets.tv) and our EthicMark® Awards for Advertising that Uplifts the Human Spirit and our Future Potentials, now accepting nominations for our 10th annual Awards at www.ethicmark.org, as well as our MOOC: the Ethical Markets Exploratorium, free to students, lifelong learners and global citizen activists.

We believe that 2015 can be a year where these transformations are truly launched in academia, public, private and civic sectors worldwide, because the stresses now occurring globally are largely due to limited perspectives, ancient ideologies and defunct economic models. These transitions show that stress is evolution’s tool and that breakdowns do drive breakthroughs! We favor the “cap and dividend” policies as more equitable and carbon taxes as preferable to carbon trading.⁵⁸

2015 will see the December Climate Change Summit to be held in Paris, France, focus on hammering out a set of agreements succeeding the earlier Kyoto Protocols (on which I commented in [“From Rigged Carbon Markets to Investing in Green Growth”](#), 2011).⁵⁹ Hopes lie in the US Obama administration’s agreements with India’s Prime Minister Narendra Modi and their compact with



⁵⁷ Zadek, Simon and Nick Robins. “Pathways to Scale,” Inquiry: Design of a Sustainable Financial System, UNEP, January 2015.

⁵⁸ See for example, Kunkel, C and Kammen, D. “Design and implementation of carbon cap and dividend policies,” Energy Policy vol. 39, pp. 477-486, October 2010; and Barnes, P. *With Liberty and Dividends for All*, Berrett-Kohler, San Francisco, 2014.

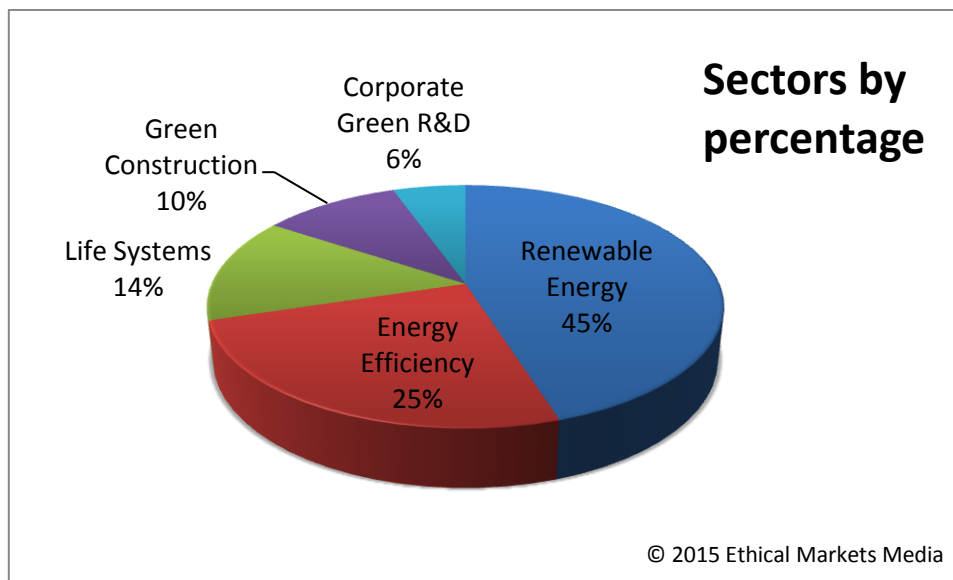
⁵⁹ Henderson, H. “From Rigged Carbon Markets to Investing in Green Growth,” Real-World Economics Review, no. 57, September 6, 2011.

China's President Xi Jinping to reduce emissions and shift to more renewable energy use. The GTS focuses on this key shift from fossil fuels, carbon emissions and their huge subsidies to inclusive, knowledge-richer, green economies. As we show in this latest GTS report, private investments are still leading in financing this global transition with our new total at \$6.22 trillion. Fossil-free portfolios now outperform those with coal, gas and oil, while MSCI, a well-known financial provider is launching a family of fossil-free indexes.⁶⁰

Part Two – Sector Data

Sectors Covered

The Green Transition Scoreboard® (GTS) tracks private investments growing the green economy worldwide since 2007, totaling in Q4 of 2014 **\$6,228,543,000,000**. The Green Transition Scoreboard® tracks five sectors: Renewable Energy, Energy Efficiency, Green Construction, Corporate Green R&D and this year adding Life Systems.



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](#)." Focusing on the institutional level, we have long recommended investing at least 10% of institutional portfolios directly in companies driving the global Green Transition which provides a way to update strategic asset allocation models both as opportunities and as risk mitigation. For example, we recommend

⁶⁰ "Fossil-Free Portfolios Outperform Those With Coal, Gas, Oil," SustainableBusiness.com, April 13, 2015.

institutional investors shift from fossilized sectors which include increasingly stranded assets as low-carbon regulations are implemented. Investments serve as risk mitigation as oil, coal and gas markets demonstrate volatility sensitive to politics, wars and dated infrastructure. Bloomberg reports that 87% of fund managers integrate ESG metrics for a positive risk-adjusted return.⁶¹

CERES "[Clean Trillion](#)" campaign⁶² aligns with a strategy recognized in the 2012 report by Mercer which suggests 40% of portfolios should be in Green Transition sectors.⁶³ This growing consensus includes several "fossil-free" portfolios⁶⁴ and 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, corporate green R&D, sustainable land-use, smart infrastructure, transport and urban re-design to accelerate the Green Transition globally. 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.⁶⁵

What's Included

Renewable Energy, Green Construction, Energy Efficiency, Life Systems 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.

New to the GTS is the Life Systems category. The system-wide transition toward efficiency, information and digitization can best be viewed through a Life Systems lens as mentioned in the [Overview](#), highlighting the interconnections between energy, water, food, education, health and quality of life.

Companies, organizations and the sources of financial data are screened by social, environment and ethical auditing standards. Increasingly, we are finding companies which aspire to the even more rigorous 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, 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 [Ethical Money Directory](#), StockSmart and findings from CSRHub, as well as other individual company reports. Also tracked are the latest auditing standards for sustainability, including [IIRC](#), [SASB](#), [ICAEW](#), [Tomorrow's Company](#), [Long Finance](#), [CIMA Global](#) and others.

⁶¹ 2014 Global Sustainable Investment Review, Global Sustainable Investment Alliance, February 2015

⁶² <http://www.ceres.org/issues/clean-trillion/clean-trillion>

⁶³ "Through the Looking Glass: how investors are applying the results of the climate change scenario study," Mercer, LLC, New York, 2012.

⁶⁴ "Beyond Fossil Fuels: The Investment Case for Fossil Fuel Divestment," Impax Asset Management, London, UK, July 2013; www.gofossilfree.org.

⁶⁵ 2014 Global Sustainable Investment Review, op. cit.

What's Omitted

Because the GTS focuses on private sector investments, government funded projects and initiatives are heavily discounted. Sustainable technologies suffer from the misperception that they cannot stand alone. For example, renewable energy and efficiency are often cited as competitive only because of subsidies, yet fossil-fuel consumption subsidies worldwide are four times greater than subsidies to renewables.⁶⁶ 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 \$6.22 trillion, showing that green technologies are competitive in today's market and renewables specifically are already cheaper than nuclear power,⁶⁷ as well as coal and oil especially when their external costs are included. What governments are NOT financing is nearly as important as what they are: Norway's Government Pension Fund Global has eliminated a total of 114 companies because of their risk to the climate.⁶⁸

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, and 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.⁶⁹ Even experimental designs introduce new concerns as with Germany's abandoned pebble-bed prototype which cost \$7.3 billion to decontaminate,⁷⁰ while TepCo admits that decontaminating areas surrounding its crippled Fukushima reactors will take forty years. Duke Power owns a crippled nuclear reactor in Florida and will assess customers with costs for decommissioning.⁷¹

We omit clean coal, still unproven, given coal carbon sequestration (CCS) would reduce the efficiency of coal-fired plants by as much as 40%.⁷² Delays and cost overruns, despite major government subsidies, have made the closest-to-completion clean coal plant in the US "one of the most expensive fossil-fuel projects ever."⁷³

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 consequence perhaps more dire than the problem they may be employed to resolve. Recognizing its potential and obstacles, then European Commission is investing in nanotechnology with research, financing of responsible

⁶⁶ [World Energy Outlook: Energy Subsidies](#), International Energy Agency, accessed April 2015.

⁶⁷ Blackburn, J. (former chancellor of Duke University). "Solar and Nuclear Costs – the Historic Crossover," NC WARN, July 2010.

⁶⁸ "Work on responsible investment strengthened," press release, Norges Bank Investment Management, February 5, 2015.

⁶⁹ "Price-Anderson Nuclear Industries Indemnity Act," Title 42 U.S. Code, Ch. 23.A.XIII (2006).

⁷⁰ "China's Nuclear Muscle," Bloomberg Businessweek, p. 11, February 25-March 3, 2013.

⁷¹ Florida TV Channel, "Capital Update," April 17, 2015.

⁷² Hamilton, M., et al., op. cit.

⁷³ Smith, Rebecca and McWhirter, Cameron. "Mississippi Plant Shows the Cost of 'Clean Coal'", Wall Street Journal, October 13, 2013.

innovation and upgrading of the regulatory framework to render it capable of addressing the new challenges.⁷⁴ Particularly worrying are the nanotech particles already present and untested in the food supply, cosmetics and household products.⁷⁵ 3-D printing has enormous potential, however its use to manufacture destructive products such as weapons, drones and the toxicity of its many chemical components require prudent observation and inclusion only on a case by case basis. For similar reasons, we exclude genetic engineering and artificial life-forms.

The huge costs of CCS could price coal out of many markets.⁷⁶ As mentioned in the 2014 GTS report, efforts to set fire to underground coal deposits to capture their methane are even more preposterous.⁷⁷ 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.⁷⁸

Global Reserves of Unburnable Fossil Fuels⁷⁹

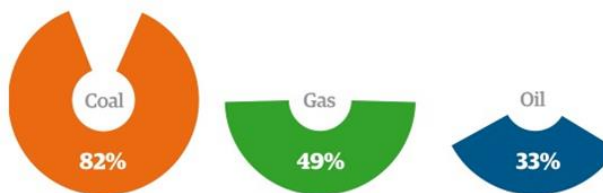
Biofuels are limited in the overall GTS tally even though their use worldwide is growing. While local use of biomass recycled sustainably on small farms and other traditional uses in developing countries will continue, too much is invested in industrial-scale facilities and exporting, as well as in genetically 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.⁸⁰ As noted in the Life Systems sector, exceptions are made for biofuels from algae or halophyte plants grown on seawater.

Unburnable fossil fuels

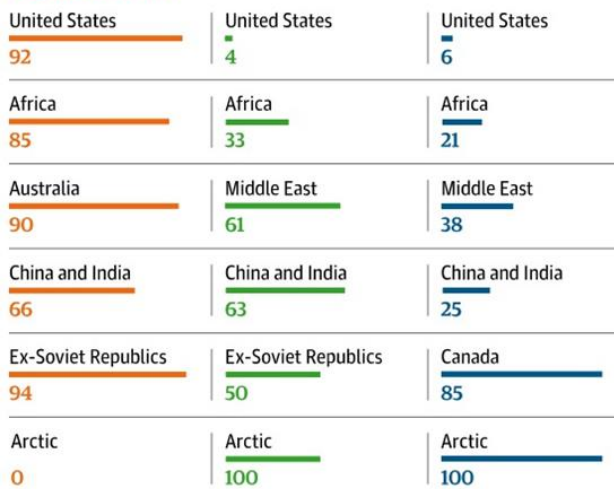
Known, extractable coal, oil and gas reserves that must not be burnt in order to prevent dangerous climate change of more than 2C

Global reserves

Per cent that cannot be burned



Regional reserves



GUARDIAN GRAPHIC

SOURCE: McGLADE & EKINS, NATURE, 2015

⁷⁴ Dawson, K. "Nanomaterials' functionality," Thematic Issues, European Commission Science for Environment Policy, February 2015.

⁷⁵ Belli, B. "Eating Nano," E-The Environmental Magazine, vol. XXIII, no. 6, December 2012.

⁷⁶ "Carbon Capture and Storage: Trouble in store." The Economist, March 5, 2009.

⁷⁷ Pearce, New Scientist, op. cit.

⁷⁸ Brodwin, D. "A Carbon Tax Everyone Can Love," American Sustainable Business Council, September 1, 2014.

⁷⁹ Carrington, D. "Leave fossil fuels buried to prevent climate change, study urges," The Guardian, January 7, 2015.

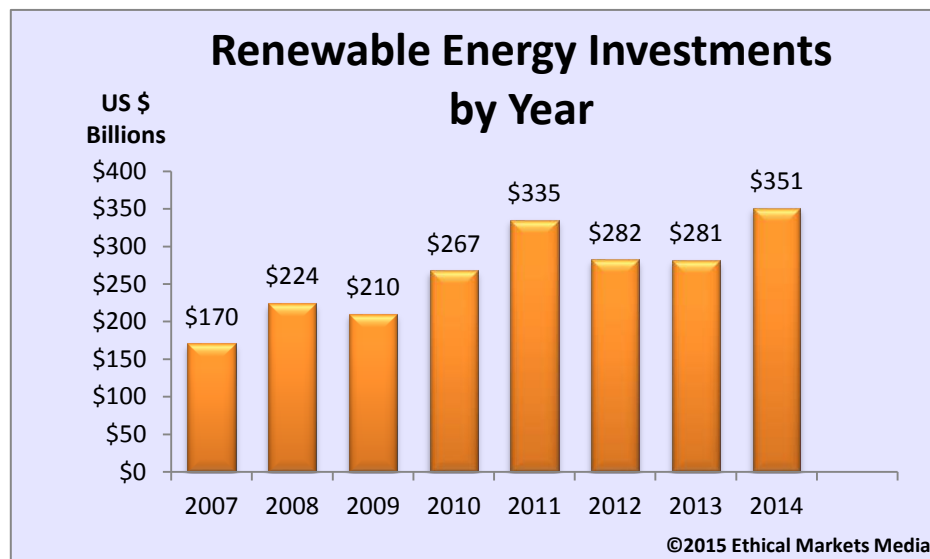
⁸⁰ "Exploring Super Capacitors to Improve Their Structure," www.sciencedaily.com, February 18, 2013.

Notes

- International investments in the GTS tally are reported in US dollars, based on conversions from XE.com on April 12, 2015.

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 UNEP⁸¹ as well as other international studies. This is the largest sector in this report which from 2007 to 2014 reached \$2.8 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 big US banks such as Bank of America, Goldman Sachs and Wells Fargo which have committed \$50, \$40 and \$30 billion respectively.⁸² Asset managers, particularly institutional investors, are being targeted by labor unions and student

⁸¹ McCrone, A., et al. "Global Trends in Renewable Energy Investment 2011," United Nations Environment Programme, Frankfurt School UNEP Collaborating Center and Bloomberg, 2011.

⁸² "Bank of America Announces New \$50 Billion Environmental Business Initiative," Bank of America Newsroom, June 11, 2012; "Goldman set \$40 billion clean energy investment plan," Reuters, May 23, 2012; "Wells Fargo: \$30 Billion in Green Economy Loans by 2020," SustainableBusiness.com News, April 23, 2012.

movements to redeploy their portfolios from big fossil-fuel and nuclear projects to renewable energy companies.

The commitments line item is adjusted regularly as projects move from concept to implementation or are removed from consideration. The \$542 billion Desertec 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. While “Desertec” per se is being dissolved, some of its projects are being taken in-country such as the CSP plant being built in Marrakesh to power Moroccan homes.⁸³

Despite support for reducing subsidies, which “can lead to a more efficient allocation of resources, which will help spur higher economic growth over the longer term,” says David Lipton of the IMF⁸⁴, the IMF estimates petroleum, coal and gas receives \$1.9 trillion worldwide through direct subsidies, consumer rebates and avoided taxes on pollution.⁸⁵ The IMF projects that removing energy subsidies will “strengthen incentives for research and development in energy-saving and alternative technologies,” allowing private investments to “crowd-in.”⁸⁶ The tremendous waste of capital to fossil-fuel subsidies will continue until energy efficiency and energy are included in economic models (see GTS 2014); until pollution taxes, including on carbon, take hold; and external costs are fully reflected in financial models, corporate balance sheets and national accounts, as is happening in Indonesia and Malaysia and being considered in Egypt and India,⁸⁷ and in China’s Greening Financial System plan.⁸⁸

All the fossil fuels are being challenged by renewables, sometimes from unexpected places. The US military is opting for solar over shale gas as often as possible, as life-saving (minimizing dangerous convoys), back-saving (solar cells embedded in backpacks) and cost saving measures.⁸⁹ 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 2018.⁹⁰ Massive shifts from coal to natural gas by US utilities are risky since price spikes in gas are likely due to lack of pipelines, exports as now shipped through LNG terminals, water shortages for fracking and other unconnected costs and risks.⁹¹ Geothermal technologies are being redesigned to address the question of intermittency, normally managed with coal or gas, to provide flexibility in delivering energy to the grid without imposing significant cost.⁹² 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.⁹³

⁸³ Rees, E. “Desertec’s Plan for Sharan Sun to Power Europe Burns Out,” China Dialogue, January 5, 2015.

⁸⁴ Lipton, D. “Energy Subsidy Reform: The Way Forward,” International Monetary Fund, March 27, 2013.

⁸⁵ Clements, Benedict, et. al. “Energy Subsidy Reform: Lessons and Implications,” IMF, January 28, 2013.

⁸⁶ Ibid.

⁸⁷ “Fuelling controversy: the economic case for scrapping fossil-fuel subsidies is getting stronger,” The Economist, January 11, 2014.

⁸⁸ Henderson, H. “China: The Emerging Green Giant,” CSRWire, April 3, 2015.

⁸⁹ Evans-Pritchard, Ambrose. “Solar power to trump shale, helped by US military,” The Telegraph, August 14, 2013.

⁹⁰ “Renewable Energy 2013: Market Trends and Projections to 2018,” International Energy Agency, 2013.

⁹¹ Natural Gas Gamble, op. cit. 2015.

⁹² Trabish, Herman. “California Grid Operator Asks Geothermal to Help ‘Feed the Duck,’” GreenTechMedia, June 28, 2013.

⁹³ Rader, B. “The Finance Industry on DERs: Solar and Batteries are Coming,” RMI Outlet, April 14, 2015.

Coal India is identifying locations to for 1,000 megawatts of combined solar capacity, bowing to pressure from the energy minister who has labeled Coal India and major coal producer NTPC as massive polluters who need to give back to society.⁹⁴ India's Prime Minister Narendra Modi, pushing for round-the-clock electricity to accelerate economic growth, expects more than \$100 billion in investment in renewable energy such as wind farms and solar parks.⁹⁵ These moves support Pegasus Capital Partners belief that utilities will benefit substantially from wind and solar development.⁹⁶ India is working toward its goals in part using green bonds with Yes Bank offering a bond for INR 500 Crores (\$80 million).⁹⁷ China still leads the world in renewables and is redesigning its financial system for green investments.⁹⁸

Other challenges to fossil fuels: finance, manufacturing and functionality flaws as acknowledged by the corporate world.⁹⁹ Walmart is receptive to long-term, fixed-priced contracts.¹⁰⁰ BP predicts renewables will continue to be the fastest growing energy sector, outpacing natural gas, the fastest growing fossil fuel, and supplying more of the world's demand than nuclear will by 2025.¹⁰¹ 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.¹⁰² In 2013, Cloud Peak Energy passed on the lease to an estimated 149 million mineable tons of coal, citing economic feasibility.¹⁰³ Existing nuclear infrastructure is losing capacity because many nuclear reactors face "economic abandonment."¹⁰⁴ Major players BP, England's BG Group and Canada's Encana have taken write-downs on their shale assets.¹⁰⁵

Notes

- 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.¹⁰⁶ However, the Renewable Energy tallies for 2010, 2011 and 2015 Commitments and Corporate Green R&D (Appendix 1) are aggregates from industry and company press releases, limiting our ability to remove all biofuels.

⁹⁴ Singh, R. K. "Coal India may build Rs7,000 crore of solar projects," LiveMint, September 22, 2014.

⁹⁵ Ibid.

⁹⁶ Makower, J., et al. "[State of Green Business 2015](#)," GreenBiz.com and Trucost, 2015.

⁹⁷ Kidney, S. "Yes Bank going for India's first green bond / India's amazing renewables buzz," Climate Bonds Initiative, February 19, 2015.

⁹⁸ Henderson, H. "China" op. cit.

⁹⁹ Sanquiche, R. "Renewable Energy: Profiting from Fossil Fuel Woes," CSRWire October 18, 2013.

¹⁰⁰ Makower, op. cit. 2015.

¹⁰¹ "Energy Outlook 2035," BP Plc., January 2014.

¹⁰² "Window for thermal coal investment is closing," Rocks & Ores, Goldman Sachs, July 24, 2013.

¹⁰³ "Cloud Peak Energy Inc. Confirms It Did Not Bid on Maysdorf II North Tract LBA," press release, Cloud Peak Energy, August 21, 2013.

¹⁰⁴ Cooper, Mark. "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.

¹⁰⁵ Engdahl, F. William. "The Fracked-up USA Shale Gas Bubble," Global Research, July 14, 2013.

¹⁰⁶ Pimentel, David and Patzek, Tad W. "Ethanol Production Using Corn, Switchgrass and Wood; Biodiesel Production Using Soybean and Sunflower." Natural Resources Research, vol. 14, no. 1, March 2005.

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

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 \$1.56 trillion in 2014, appropriately second only to Renewable Energy.

As with Green Construction, definitions are 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.¹⁰⁷ Significant to utilities and consumers, less energy used means less carbon is released, consumers pay lower energy bills and fewer power stations need to be built, lowering the construction costs often added to utility bills.¹⁰⁸

Year	Amount US \$
2007	\$ 90,827,781,344
2008	\$ 102,580,728,352
2009	\$ 116,162,035,630
2010	\$ 133,656,338,800
2011	\$ 173,463,850,000
2012	\$ 260,240,500,000
2013	\$ 272,725,200,000
2014	\$ 257,304,000,000
Commitments	\$ 159,280,396,820
TOTAL	\$ 1,566,240,830,946

¹⁰⁷ Russell, C. Multiple Benefits of Business-Sector Energy Efficiency: A Survey of Existing and Potential Measures, ACEE, January 7, 2015.

¹⁰⁸ Platt, Reg. "The real cost of 'green crap'," NewScientist, March 15, 2014.

Important to efficiency metrics is **exergy efficiency**. Lost exergy represents energy which could have been converted into work but was wasted instead. Skip Laitner, of the American Council for an Energy Efficient Economy (ACEEE), found that exergy efficiency has slowed from a 1.4 percent growth per year from 1950 to 1980, to a 0.4 percent growth per year from 1980 to 2010, weakening economic productivity.¹⁰⁹ As a glaring example, ACEEE estimates \$80 billion of the \$156 billion dollars' worth of energy used in production in 2013 was lost through inefficient conversion.¹¹⁰ Seeing opportunity in this waste, Project Exergy, a start-up tech company, is using crowdfunding to further a project heating smart homes using computers by transferring the computation done in data centers into millions of home and office computers and collecting and storing the heat which would otherwise be wasted.¹¹¹ An example of exergy efficiency is in the startup company Lucid Energy which installs small turbines in the gravity-fed water pipes supplying the city of Portland, Oregon. This captures additional electricity supplying the city's residents.¹¹²

Smart grid technologies, anything used on the grid that enhances use of renewable energy, largely electrical components and equipment, are included in Energy Efficiency. In Korea, private smart grid investments for technology out pace government funding 2 to 1; in infrastructure construction – 20 to 1.¹¹³

This sector also includes investments in batteries for electric vehicles and charging infrastructure. Every electric vehicle is also a storage battery as is demonstrated by the emphasis on R&D for electric vehicle batteries reported in the Corporate Green R&D sector. Other new storage technologies under development include passive green off-grid buildings which store solar energy¹¹⁴ to super capacitors which store electricity differently from batteries.¹¹⁵ Earlier GTS reports have covered many of these innovations in energy storage.¹¹⁶ Morgan Stanley predicts falling costs of batteries and solar PV will present a tipping point encouraging huge numbers of households and businesses to go off grid.¹¹⁷ This is continuing to affect legacy electric utilities which are experiencing lower demand, falling stock prices and the urgent need to overhaul their business models as was covered in the 2014 GTS report.¹¹⁸ Clean Edge agrees the tipping point is being driven by residential and commercial opportunities to move to distributed generation.¹¹⁹ Ethical Markets TV Series explored such scenarios in its "[Green Building and Design](#)" and "[Renewable Energy](#)" programs.¹²⁰

¹⁰⁹ Laitner, op. cit.; Tweed, Katherine. "Forget Energy Efficiency, Think Exergy," GreenTechMedia, August 7, 2013.

¹¹⁰ "Evaluating the Market for Industrial Energy Service Outsourcing," press release, ACEEE, March 19, 2014.

¹¹¹ Hower, M. "Startup Hoping to Turn Computers Into Primary Source of Heat Generation," Sustainable Brands, April 6, 2015.

¹¹² Sreenivasan, H. "How drinking water pipes can also deliver electric power," PBS Newshour, April 14, 2015.

¹¹³ "Korea's Smart Grid Roadmap," Korea Smart Grid Institute, <http://www.smartgrid.or.kr/10eng4-2.php>, accessed April 13, 2015.

¹¹⁴ "Green Building Outlook Strong for Both Non-Residential & Residential Sectors Despite Soft Economy," www.construction.com, November 12, 2012.

¹¹⁵ "Exploring Super Capacitors to Improve Their Structure," www.sciencedaily.com, February 18, 2013.

¹¹⁶ Henderson, H. "Introduction and Overview: Batteries Super Capacitors and More," Green Transition Inflection Point: Green Transition Scoreboard® 2013 Report, Ethical Markets Media, February 2013.

¹¹⁷ Parkinson, Giles. "Morgan Stanley: Tipping point nears for going off grid," RenewEconomy.com.au, March 26, 2014.

¹¹⁸ Henderson, Sanquiche, Nash. "Plenty of Water," op. cit.

¹¹⁹ Pernick, Ron, Clint Wilder and James Belcher. "Clean Energy Trends 2014," CleanEdge, March 2014.

¹²⁰ www.ethicalmarkets.tv. The series is available for college use at www.films.com.

Widely considered the lowest hanging fruit for investors, efficiency provides remarkable ROI. Analysis of a project in the southeast of the USA found that \$1 million in retrofits garnered \$3.87 million in economic input and 17 jobs.¹²¹ The EU's efforts toward 20% energy savings by 2020 has already resulted in EU buildings consuming half the energy used in the 1980s.¹²² 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 2010.¹²³ With public transportation, individual behavior is driving the change. In the US, there were a record-breaking 10.7 billion trips taken on public transportation in 2013.¹²⁴



Multiple Benefits of Energy Efficiency, IEA

Connecting transportation to supply chain efficiency, in the UK, supplier collaboration focuses heavily on transportation. German pharmaceutical Bayer, packaging manufacturer Tetrapak, Italy's CNH Industrial have reported millions of dollars in savings and emissions reductions in the tens of thousands of tonnes due to supply chain efficiency investments. In China, Walmart is ambitious in its supply chain efficiencies, inviting suppliers to participate in energy efficiency initiatives by the end of 2017, an effort to engage 70% of Walmart's China sourcing business.¹²⁵

Life Systems

While renewable energy and efficiency are popularly discussed as key to the transition to the Solar Age, many other technologies enhance quality of life, protect nature, provide for education, healthcare and food, protect and enhance ecosystem services. Many systems require redesign of major infrastructure from past eras now no longer fit for purpose, from national electricity grids, urban infrastructure, over-investments in roads and private vehicles versus rail and public transit to the massive global fossil fuels apparatus and around trade facilities for shipping

¹²¹ The Impact of Energy Efficiency Investments, SEEA, 2014.

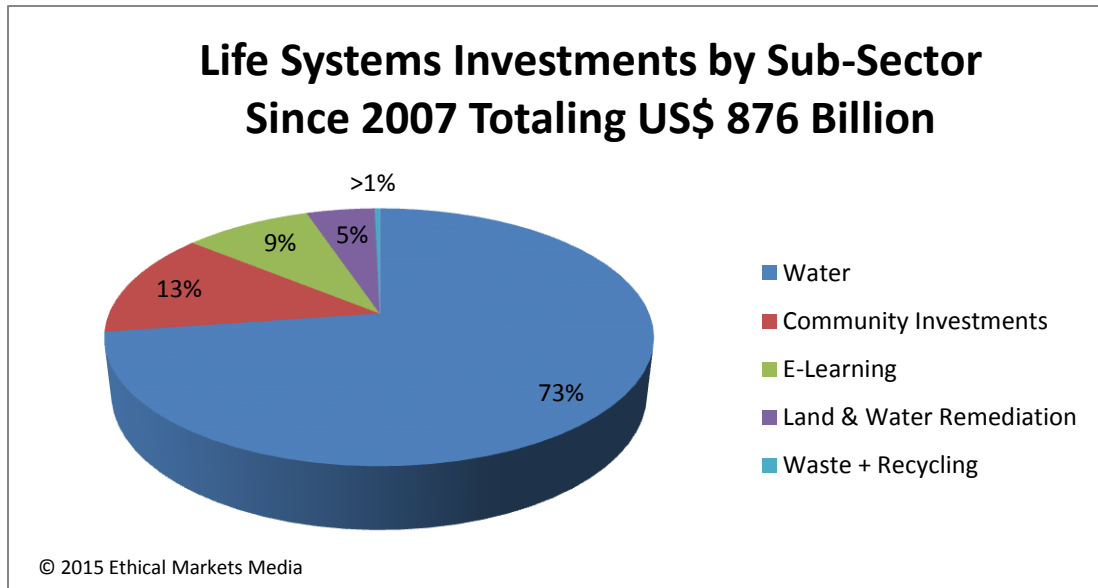
¹²² Energy Efficiency, European Commission, <http://ec.europa.eu/energy/en/topics/energy-efficiency>, accessed April 13, 2105.

¹²³ Ibid.

¹²⁴ "Record 10.7 Billion Trips Taken On US Public Transportation in 2013," Transit News, APTA, March 10, 2014.

¹²⁵ Supply Chain Sustainability Revealed:Supply Chain Report 2014-15, CDP and Accenture Strategy, 2015.

material goods in our 21st century Information Age. This system-wide transition toward efficiency, information and digitization can best be viewed through a **Life Systems** lens as mentioned in the [Overview](#), keeping us aware of the interconnections such as between energy, water and food and highlighted in the GTS [Green Bonds Growing Green Infrastructure](#) report.¹²⁶



The Green Transition Scoreboard® collects investments in these areas under **Life Systems**. For 2014, Water, Community Investment, E-Learning, Land & Water Remediation and Waste & Recycling reach threshold minimums for inclusion in the GTS, totaling \$876 billion in investments since 2007. Infostructure, e.g., broadband, is interspersed throughout these categories.

Water

After the Sun's daily free energy flow, **Water** is the most important commodity for life on this planet. The GTS totals private investments in water since 2007 at \$599 billion, feeding into what the [Global Water Intelligence](#) has identified as a global water market worth more than \$500 billion annually.

Most water infrastructure is hidden away and, if these work well, will go unnoticed for decades. These investments include pipes, valves, filters, membranes, meters, and even 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 greater than in Green Construction and Corporate Green R&D.

¹²⁶ Henderson, Sanquiche, Nash. "Green Bonds Growing Green Infrastructure," op. cit.

While water is abundant and plentiful on Earth, fresh water accounts for only 3% of water on the planet, and it is unequally distributed. Regions in [California](#)¹²⁷ and [Australia](#)¹²⁸ are experiencing significant droughts, as [China](#)¹²⁹ has been, and [climatologists warn there is worse to come](#).¹³⁰ These 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. As reported in “Plenty of Water” (GTS 2014), enormous opportunities are under-appreciated in desert-greening and growing food, fiber and biofuels from the 10,000 varieties of halophyte (salt-loving) plants which are grown in many countries, on desert lands using solar energy and biofuels grown from algae on seawater.

Saline water constitutes 97% of available supply. 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.¹³¹ In Europe, 44% of fresh water consumption is being used in energy production, mostly to cool thermal and nuclear power plants. In the US, the EPA estimates 92 billion gallons of water were used for fracking between January 2011 and February 2013,¹³² and **190,000 million gallons PER DAY** are used to produce the steam to create electricity from coal, nuclear and natural gas plants.¹³³

Investments in water apply both to infrastructure which improves delivery, recognizing tremendous savings from limiting leaks, and address clean drinking water and sanitation. The World Water Council and K-Water see “Water and Green Growth” as a new path to sustainability and opportunities for economic growth.¹³⁴ The US Environmental Protection Agency (EPA) estimates [\\$384 billion](#) is needed over the next 20 years to ensure safe delivery of drinking water in the US.¹³⁵ The Federation of Canadian Municipalities estimates [\\$80 billion](#) is needed to upgrade water infrastructure currently in “fair” to “very poor” condition.¹³⁶ The World Health Organization estimates an annual investment of only \$22.6 billion is needed to improve water and sanitation services globally, while access for all to quality-monitored in-house water supply and sewerage connection requires a total investment of US\$136.5 billion per year. Every US\$1 would yield an economic return of US\$3 to US\$4 depending on the region.¹³⁷

¹²⁷ “The Drying of the West,” *The Economist*, February 20, 2014.

¹²⁸ “Australia’s Queensland hit by record drought,” *BBC News Asia*, March 7, 2014.

¹²⁹ “All dried up,” and “Desperate measures,” *The Economist*, October 12, 2013.

¹³⁰ Romm, Joe. “Leading Scientists Explain How Climate Change is Worsening California’s Drought,” *ThinkProgress.org*, January 31, 2014.

¹³¹ Carroll, R. “Exclusive: California used 70 million gallons of water in fracking in 2014,” *Reuters*, April 3, 2015.

¹³² Ritenbaugh, S, “EPA analysis details water usage in fracking,” *Pittsburgh Post-Gazette*, April 7, 2015.

¹³³ Zerrenner, Kate. “Why water and energy policies do mix, or should,” *GreenBiz.com*, August 6, 2013.

¹³⁴ 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.

¹³⁵ Cart, Julie. “US water infrastructure needs \$384-billion upgrade,” *Los Angeles Times*, June 4, 2013.

¹³⁶ “Canadians’ water attitudes hurting infrastructure,” *The Canadian Press*, March 14, 2013.

¹³⁷ “Costs and benefits of water and sanitation improvements at the global level,” *World Health Organization*, 2004.

Community Investments

Community Investing refers to capital specifically directed to traditionally underserved individuals or communities. In 2014, community investing across the US, Europe, Asia, Canada and Australia/NZ totaled \$109 billion.¹³⁸ Still overlooked in traditional markets are the millions of cooperative enterprises which employ more people on Earth than all the traditional for-profit, commercial companies combined.¹³⁹ Community development financial institutions provide housing, healthcare and services across the USA, along with not-for-profit credit unions and B Corporations. All of this is facilitated by the rise of the digital shared economy.

E-Learning

E-Learning has experienced tremendous growth in the past several years and accounts for \$73.7 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 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 rates and employment results. The promise of for-profit educational institutions is still in flux and perceived as no better, and sometimes worse, than traditional bricks and mortar institutions, which are now pricing themselves out of the market.

Conversely, MOOCs and other self-directed learning methods have gained in popularity. While “graduation” or certificate earning rates are low, that final “piece of paper” misses the point of much of e-learning. It is self-directed, self-paced and self-realized (see for example the Ethical Markets MOOC).¹⁴⁰ While a learner may not earn a degree, she can absorb as little or as much information as needed to solve a problem in a village, advance in the work place, provide cost-effective training to volunteers or employees or become a citizen activist. The demonstrated pursuit of knowledge is driving investments in e-learning as well as perceived growth in the market, estimated at more than 7% per year.¹⁴¹

Other Listed Sub-Sectors

Land & Water Remediation and Waste & Recycling are reported individually based on specific project financing. Much of the data in this section comes directly from company reports, with a dozen international companies reporting on their worldwide efforts. 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.¹⁴²

¹³⁸ 2014 Global Sustainable Investment Review, *op. cit.* 2015.

¹³⁹ International Year of Cooperatives 2012, Cooperatives in Social Development, UN DESA-DSPD, accessed at <http://social.un.org/coopsyear/>, April 16, 2015.

¹⁴⁰ www.ethicalmarketsexploratorium.com

¹⁴¹ E-Learning Market Trends & Forecast 2014 - 2016 Report, Docebo S.p.A, 2014.

¹⁴² \$40 Billion World Site Remediation Annual Market by 2015, news release, The Mcllvaine Company.

Other Unlisted Sub-Sectors

Investments in Life Systems are as wide-ranging as life on earth. While water, education and waste management are big ticket items which can be meaningfully aggregated into the GTS, many other subsectors are ripe for green investment while not meeting the GTS reporting threshold.

Agriculture: Sales of organics and non-GMO products are exploding, however sales figures are not easily translatable to investment numbers. As the GTS continues to track to the year 2020, we expect a surge here as is being experienced with E-Learning. Improved techniques developed by research such as at the Land Institute and the Savory Institute will increase in demand as they prove better yields than chemical farming, particularly in land and water scarce areas. Urban centers are benefiting from vertical agriculture as being developed by companies like [Sky Vegetables](#).

Forest and farmland remediation: we expect this surge to come from natural methods of carbon sequestration such as with the ancient technique of biochar. There is also a movement to invest in protected areas both for intrinsic value and to increase values of adjacent lands for development.

Aquaculture: besides reference to fisheries and the growth of seaweed for food and feedstock, aquaculture benefits from the 97% saline water on Earth combined with abundant wasteland, salt-loving halophyte plants and the Sun. The potential for fiber, food and biofuel is largely untapped.

Healthcare: The healthcare industry generates more than 30 pounds of waste per bed per day.¹⁴³ In the US alone, healthcare facilities spend \$8.8 billion per year on energy.¹⁴⁴ The dip into green R&D for healthcare is supported by a global Harris Poll survey commissioned by Johnson & Johnson finding more than three-quarters of healthcare professionals across six countries believe sustainability initiatives protect staff, and nearly 70 percent believe they make business sense.¹⁴⁵



Green Construction

From 2007 to 2014 Green Construction reached \$639 billion in investments and commitments, up substantially in 2014, as newly available research confirms actual figures are better than were anticipated in previous forecasts. The sector is divided into current investments by

¹⁴³ Howard, J. "10 reasons health care needs sustainability treatments," GreenBiz.com, February 12, 2014.

¹⁴⁴ Bendewald, M. and Tupper, K. "A positive diagnosis: How hospitals are reducing energy consumption," Rocky Mountain Institute and GreenBiz.com, November 21, 2013.

¹⁴⁵ Sutter, K. "How Healthcare Pros Can Build the Business Case for More Sustainable Hospitals," Sustainable Brands, April 16, 2015.

year of funding. Since public-sector information is not reported separately, the total has been discounted for government projects.



Initially, green construction investments broadly included new building construction and existing building retrofits. Some stricter reporting limited itself to only LEED building. The GTS does not restrict the green construction figure solely to LEED buildings, wanting to give credit for effort and to recognize those innovations too new to be incorporated into LEED and other standards which often experience a lag behind entrepreneurs. For example, well ahead of anything currently in use, Living Breakwaters, a climate change amelioration project, is an engineering and infrastructure-related intervention with a biological function, integrating ecologically engineered "Oyster-tecture," bringing together technology, ecology, community partnership, education around coastal resiliency, restoration of traditional coastal livelihoods and systemic change in regulatory pathways.¹⁴⁶

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. In refining the definition, the focus has turned to structural materials such as timber, steel and other metals, concrete, glass, insulation and green rooftops and broad application categories of framing, insulation, roofing, exterior siding and interior finishing.¹⁴⁷ More specifically, these figures include innovations in green roofs, eco-friendly carpets, recycled tiles, VOC-free glues and paints and cement-making that uses CO₂. Projected CAGR (compound annual growth rate) through 2019 is 12.5% with the largest current subsector being insulation application, estimated at 21 percent of the total market share.¹⁴⁸

¹⁴⁶ "Living Breakwaters Wins 2014 Buckminster Fuller Challenge", Buckminster Fuller Institute, December 1, 2014.

¹⁴⁷ Green Building Materials Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast, 2013 – 2019, Transparency Market Research, January 2014.

¹⁴⁸ "Green Building Materials Market to Reach \$235bn by 2019," Environmental Leader, January 12, 2015.

Stepping back from looking at construction from a single building perspective to that of multiple buildings, Guangzhou, China, is an example of multi-use built environment where businesses are situated on the bottom floors of high rises, residential units range above and walkways on multiple levels connect buildings to each other. This form of “green construction” is more to create a greener city rather than a greener building, as Guangzhou and many cities in China face the problem of smog exacerbated by an automobile infrastructure.¹⁴⁹

A frequent argument against green construction is its possible added cost. Dubai, UAE, in its mandate to host a sustainable World Expo 2020, is addressing these misconceptions through the development and marketing of the newly inaugurated eco-friendly market place, the Al Fahidi Souq, built in full compliance with the Dubai municipality green ratings. The \$13 million green project was completed with a 0% increase in costs after using entirely green building materials, with water and energy savings of 25% and 43%, respectively.¹⁵⁰ Masdar city in Dubai is also a leader in systemic urban design.

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.¹⁵¹

Notes

- Aggregate data for countries other than the USA has been 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** performed to date. The GTS research team scours press releases, sustainability reports, and financial statements. The team has identified nearly 200 companies responsible for green R&D tallied in this report. From 2007 to 2014, Green R&D reached \$339 billion in investments and commitments.

¹⁴⁹ Moore, J. “Considering Impacts of Scale: Reflections on Guangzhou, China,” Ecocities Emerging, Ecocity Media, December 2014.

¹⁵⁰ Malik, T. “Sprouting Sustainable Buildings Across the Emirates: Green Construction and Building Regulations,” The Energy Collective, September 26, 2014.

¹⁵¹ Sanquiche, R. “Green Construction,” 2014 Green Transition Scoreboard® Report: “Plenty of Water!”, Ethical Markets Media, March 2014, p. 25.



The \$339 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 reporting thresholds.

Supporting the R&D tally is the number of patents emerging from the research. Research from MIT and the Santa Fe Institute shows that investments in R&D for energy technologies, combined with the growth of markets for products, have led to a sharp increase in patents over the last decade beyond historical trends.¹⁵² The increase in patents was most dramatic related to renewable energy, particularly solar energy and wind, while patents in fossil-fuel technologies showed a modest increase, and those for nuclear technology were flat.¹⁵³

Significant investments in corporate green R&D show that a company has integrated sustainability into its core strategy. This data helps identify innovative companies who are ahead of the curve in responding to heightening environmental risks and regulations.¹⁵⁴ It serves as a strong indicator to investors, betting on increasing consumer demand for green products, that the company is both long-term and forward-looking. Green R&D provides a competitive advantage as it prepares companies for market trends reflecting rising energy costs, water scarcity, demographic changes, and new regulations.¹⁵⁵

¹⁵² Bettencourt LMA, Trancik JE, Kaur J. "Determinants of the Pace of Global Innovation in Energy Technologies," PLoS ONE 8(10): e67864. doi:10.1371/journal.pone.0067864, October 2013.

¹⁵³ Chandler, David L. "Innovation in renewable-energy technologies is booming," MIT News Office, October 10, 2013.

¹⁵⁴ 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.

¹⁵⁵ Shapiro, A. "Make Green R&D a Competitive Advantage," Harvard Business Review, August 11, 2008.

Sector Data

Once again, the GTS data shows the automotive industry is the largest investor in green R&D. Each year, from 2007-2014, Volkswagen has led in reported green R&D, followed by Toyota and Robert Bosch, considered the world's largest supplier to the automotive industry.¹⁵⁶ Volkswagen projects they will [invest upwards of €84.2 billion](#) in R&D by 2018 for efficient vehicles and greening their production sites.¹⁵⁷ The sector total of \$172 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.

Combining its many subsectors, energy gains the next largest benefit from R&D. Companies have invested more than \$16 billion into smart grid R&D, with an additional \$16.7 billion for R&D categorized as electrical components and equipment; \$11.7 billion for wind; \$11 billion for solar. Biofuels register at \$260 million, with jet fuel from algae grown on seawater the most promising biofuel,¹⁵⁸ and \$8.7 billion for energy storage.

The trendy news is in the increased R&D for battery technology which Hazel Henderson reported on in her introduction to the 2013 GTS report.¹⁵⁹ Customer-sited energy storage and solar-plus-storage are growing in popularity. Kyocera is selling to residential customers in Germany; Japanese Mistui is collaborating with US STEM.¹⁶⁰ "Flow" batteries integrate into systems which rely wholly on on-site and local "green" energy resources. A pilot program in the Alps plans to demonstrate how flow batteries manage multiple applications, such as renewable energy system integration, peak demand reduction, backup power and EV charging. Flow systems can deliver a higher return on investment than systems with single use applications. The experiment is part of the European AlpStore program, partnering seven countries to develop a long-term energy strategy for Europe's Alpine regions.¹⁶¹

Batteries research sounds a little like science fiction with a push to develop better materials such as silicon, lithium metal and metal-air where oxygen interacts with metal to create high-density storage eight times higher than current lithium batteries once they overcome size and recharging constraints.¹⁶² Of course, the automotive industry for EVs is pushing battery manufacturing, first movers for storage technology which is then adopted by residential and "behind the meter" applications, off grid, what the Rocky Mountain Institute calls "grid defection."¹⁶³

¹⁵⁶ Thesing, G. "German Business Confidence Fell for a Second Month in April," Bloomberg Business, April 21, 2011.

¹⁵⁷ Mihalascy, D. "W Group Pledges to Invest €84.2 Billion in New Models and Technologies by 2018," CarScoops.com, November 26, 2013.

¹⁵⁸ Henderson, Sanquiche, Nash, "Plenty of Water," op. cit. 2014.

¹⁵⁹ Henderson, H. "Introduction and Overview" op. cit. 2013.

¹⁶⁰ "GTM:Storage," Greentech Media Newsletter, April 13, 2015.

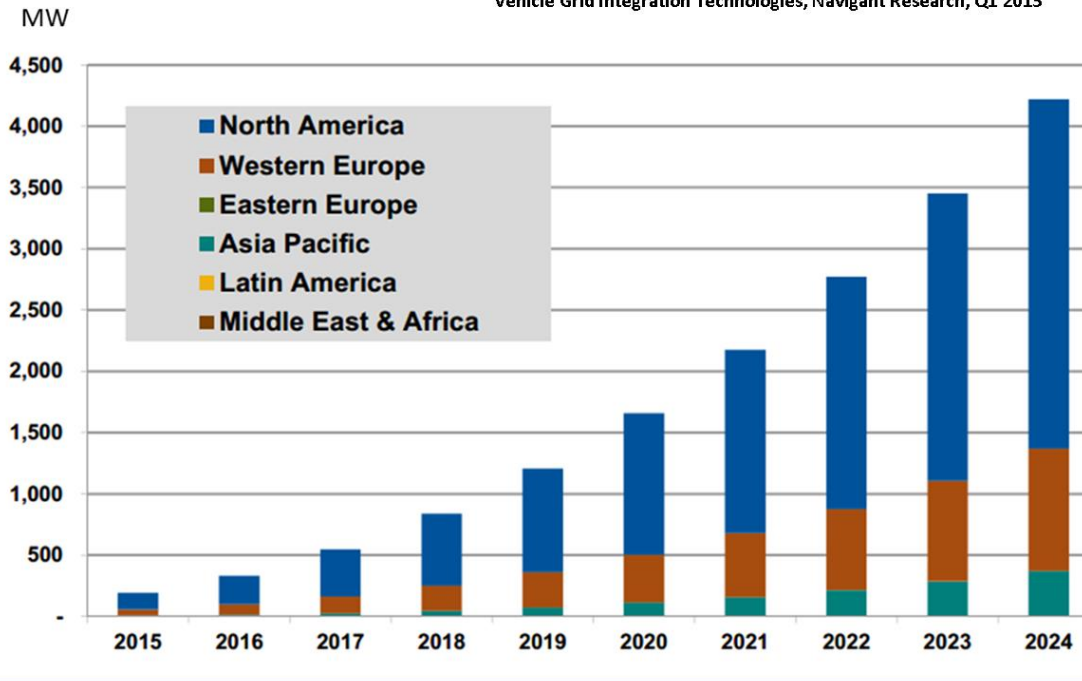
¹⁶¹ Burger, A. "Flow Batteries Installed at Slovenian Alps Restaurant Renowned for Its Donuts and Renewable Energy," Renewable Energy World, January 24, 2015.

¹⁶² "The Cutting Edge of Battery Technology," The Atlantic, May 2014.

¹⁶³ Lovins, A. Economics of Grid Defection, Rocky Mountain Institute, February 2014.

VGI Installed Capacity by Region, Aggressive Scenario, World Markets: 2015-2024

Vehicle Grid Integration Technologies, Navigant Research, Q1 2015



Vehicle Grid Integration Global Capacity

In keeping with GTS attention to Life Systems, R&D for water is at \$10.6 billion; infostructure via green R&D for communications, computers and software is at \$1.6 billion; medical is at \$631 million (see Life Systems).

Notes

- For more depth on Green R&D, see the [August 2012 GTS update](#) focused on Corporate R&D.

Appendices

Appendix 1 – Investment Totals

Sector Totals

Sector	Amount US \$
Renewable Energy	\$2,807,484,000,000
Energy Efficiency	\$1,566,241,000,000
Life Systems	\$876,412,000,000
Green Construction	\$639,362,000,000
Corporate Green R&D	\$338,478,000,000
Grand Total	\$6,227,977,000,000

Renewable Energy

Year	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	\$ 350,900,000,000
Commitments	\$ 687,583,926,850
TOTAL	\$ 2,807,483,926,850

Energy Efficiency

Year	Amount US \$
2007	\$ 90,827,781,344
2008	\$ 102,580,728,352
2009	\$ 116,162,035,630
2010	\$ 133,656,338,800
2011	\$ 173,463,850,000
2012	\$ 260,240,500,000
2013	\$ 272,725,200,000
2014	\$ 257,304,000,000
Commitments	\$ 159,280,396,820
TOTAL	\$ 1,566,240,830,946

Life Systems

Year	Amount US \$
Water	\$637,301,446,811
Community Investments	\$115,645,600,000
E-Learning	\$78,310,133,333
Land & Water Remediation	\$42,044,800,000
Waste + Recycling	\$3,110,444,000
TOTAL	\$876,412,424,144

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	\$98,600,000,000
2014	\$127,500,000,000
TOTAL	\$639,361,879,757

Corporate Green R&D

Year	Amount US \$
2007	\$23,101,491,000
2008	\$23,517,533,000
2009	\$26,551,301,000
2010	\$27,611,354,000
2011	\$39,857,659,000
2012	\$54,036,737,000
2013	\$48,489,760,000
2014	\$46,420,723,000
Commitments	\$48,891,891,000
Total	\$338,478,449,000

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 March 31, 2015

3D Systems Corp	Johnson Control
Acuity Brands	LightPath Technologies
Autodesk	Lindsay Corporation
Biomimicry 3.8	NASDAQ OMX CleanEdge Smart Grid
Comverge	Infrastructure Index
CREE	Natcore Technology
Domini Social Investment Fund	Nevada Geothermal
Enernoc	Ormat
Entech Solar	Pax World Fund
EnvisionSolar	PowerShares Cleantech Portfolio
Equal Exchange	Seimens
Facebook	Solar City
FirstSolar	Solaria
Generate Capital	Suntech
GrainPro	Unilever
Green Garmento	US Geothermal
Google	Waterfurnace Renewable Energy
Hannon Armstrong	Whole Foods
Innergex Renewable Energy	ZBB Energy

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 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 as treasurer for the Northeast Florida Green Chamber.

Timothy Jack Nash, The Sustainable Economist, is a part-time economics instructor at Sheridan College in Mississauga, Canada. The rest of the time, he's a fee-only financial planner teaching ordinary people how to invest their own money online in sustainable investment funds. He is regularly featured in publications such as Reuters, Advisor's Edge Report, and MoneySense. He earned his BA in Economics from Dalhousie University (Halifax, Canada) and his Master's in Strategic Leadership towards Sustainability from the Blekinge Institute of Technology (Karlskrona, Sweden). He is treasurer of the Ontario Nonprofit Network and the lead researcher for Ethical Market's Green Transition Scoreboard® which details more than \$6.22 trillion of private investments in the global green economy.

Special Advisors

Peter Lynch has worked for 37 years as a Wall Street security analyst, an independent security analyst and a private investor in small emerging technology companies. He has been actively involved in following developments in the renewable energy sector since 1977 and is a highly regarded expert in this field.

Claudine Schneider served in the US House of Representatives (R-RI), 1980-1990. She is an independent consultant, Boulder, CO, focusing on transformative technologies.

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 \$6.22 trillion 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**

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