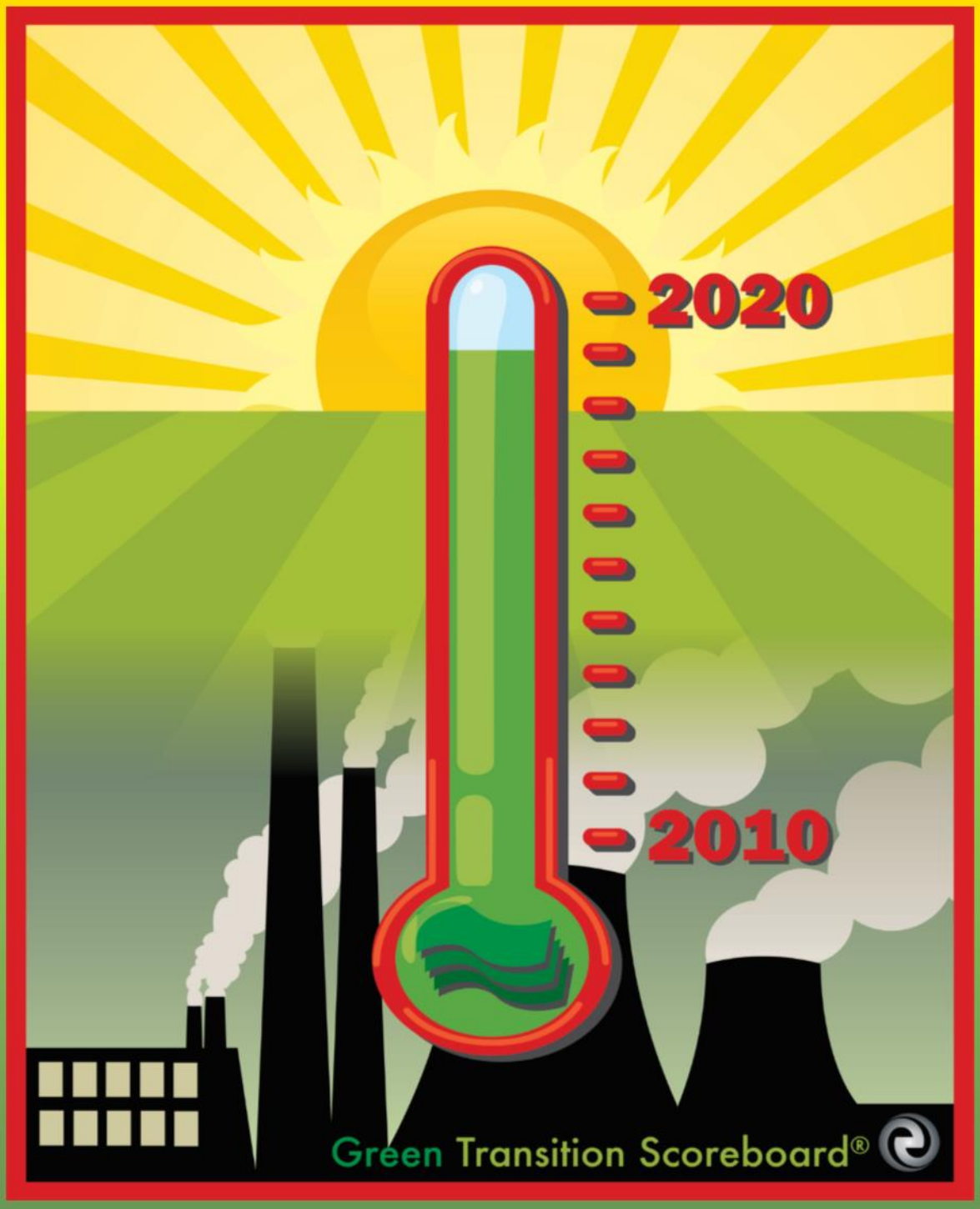
Ethical® Markets

2018 Green Transition Scoreboard® Report



CAPTURING CO_2 WHILE IMPROVING HUMAN NUTRITION & HEALTH

2018 Green Transition Scoreboard® Report: “Capturing CO2 While Improving Human Nutrition and Health”

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EXECUTIVE SUMMARY

The 2018 Green Transition Scoreboard® (GTS) explores the connections between water, food, agriculture and today's agro-chemical industrial complex and how these human activities could be re-directed to capture more carbon dioxide from Earth's atmosphere. The transition to renewable energy, green finance and more circular economies is still on track, as our latest total of private investment in green sectors worldwide at $9,317,882,308,406.90 indicates. Our new report follows our 2017 report "Deepening Green Finance" and our 2016 report on "Ending Externalities: Full Spectrum Accounting Clarifies Transition Management". Since 2007, companies tracked by the GTS are those avoiding negative externalities and focused on transition management in the context of the UN Sustainable Development Goals (SDGs) and the Climate Summits, COP21-22-23. All the GTS totals represent non-government investments and commitments in the green transition. All numbers on these totals are cumulative and global since 2007.

2018 Sector Totals

Sector	Amount US $
Renewable Energy	$3,864,203,673,121
Energy Efficiency	$2,038,487,667,163
Life Systems	$1,891,555,846,366
Green Construction	$1,072,360,379,757
Corporate Green R&D	$505,274,742,000
Grand Total	**$9,371,882,308,407**

The GTS tracks Renewable Energy, Energy Efficiency, Life Systems, Green Construction and Corporate Green R&D, representing broad areas of investment in green technologies. Each sector covers an area of substantial capital investment in technologies which Hazel Henderson's years of research as a science advisor and which the Ethical Markets Advisory Board expertise indicate are continuing to contribute to the growing green economy. Our Life Systems category tracks Fintech for sustainability, including peer-to-peer lending and crowdfunding, e-learning and social media in addition to other subsectors tracking the system-wide interconnections among information and digitization, water, food, education and health. Our 2018 GTS continues these systemic explorations and how investments can be redirected to address all 17 Sustainable Development Goals (SDGs) ratified by 195 member countries of the United Nations (UN) in 2015. In this report, we also explore the need to re-direct investments from the 3% of the planet's freshwater on which too much of human food is currently dependent. We present evidence of the viability and necessity of shifting attention and investments toward agriculture based on the planet's 97% saltwater,

using the 10,000 varieties of salt-loving (halophyte) plants for human nutrition that can grow on the degraded 40% scrub and desert lands worldwide. This halophyte agriculture has been practiced for millennia in many countries and can also provide quality fuels from saltwater-grown algae.

The upward trend in investments since 2007 aligns with our recommendation to invest at least 10% of institutional portfolios directly in companies driving the global Green Transition, updating strategic asset allocation models both as opportunities and as risk mitigation. Excluding government investments to the extent possible, the $9.37 trillion in private investments and commitments as of 2018 puts private investors on track to reach $10 trillion in green sectors investments globally by 2020.

We strictly define 'green' by omitting technologies such as nuclear, clean coal and most biofuels (except algae grown on brackish or saltwater or biofuels sourced and used on small local farms). while carefully assessing rapidly advancing technologies such as artificial intelligence (AI) see "AI + Algorithms = Assumptions!", as well nanotech and IoT (Internet of Things), see "The Idiocy of Things Requires An Information Habeas Corpus". We follow global digitization trends, the future of the internet and the politicization of social media in the Overview. Sources of financial data are screened by rigorous social, environment and ethical auditing standards, also tracking the evolution of these standards worldwide. For example, the Climate Disclosure Standards Board (CDSB) now aligns its framework's 5-year strategy with the Taskforce on Climate-Related Financial Disclosures (TCFD).[1]

Renewable Energy – Growing strongly, at our total of $3.86 trillion as fossil fuel becomes less appealing, is the rise of electrification in transport and in light of cost parity of renewables, limiting carbon emissions and driving evolution to sustainable societies. For example, the research of CDP finds an eightfold increase in global companies now pricing carbon since 2013. These include 100 FORTUNE 500 corporations with collective annual revenues of $7 trillion.[2] Such carbon pricing is recommended by the Taskforce on Climate Related Financial Disclosures (www.fsb-tcfd.org. Mexico's renewable energy grew toward the government's target of 13.9% of power to be green by 2022.[3]

Energy Efficiency –Grew to over $2 trillion, which reduces company costs and creates widespread ripple effects positively impacts jobs creation, manufacturing and other metrics tracked by traditional GDP and integral to transition management, quality of life metrics reported in Life Systems. The fundamental

[1] Climate Disclosure Standards Board, "CDSB" Framework", April 9, 2018.

[2] CDSB Framework, "Advancing and aligning disclosure of environmental information in mainstream Reports, April 2018, www.cdsb.net/framework.

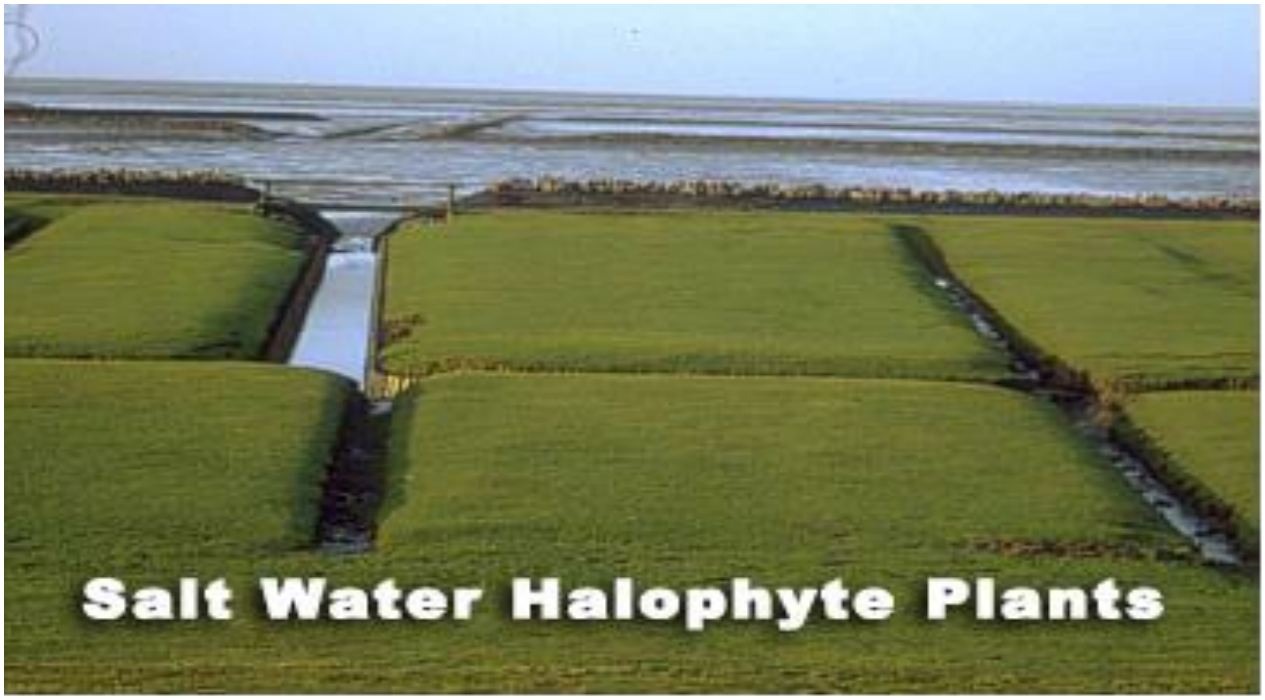
[3] Sustainable Brands, Finance & Investment, October 12, 2017.

underpinning of the circular economy now envisioned widely rest on systemic energy and material efficiency and re-using, re-manufacturing, recycling and upcycling of all resources as we describe in our Overview.

Life Systems – Grew to $1.89 trillion encompassing broad areas systemically linked, including water, remediation, waste and recycling, green infrastructure and info-structure, education, community investing and the myriad of digitization opportunities and risk in investments often overlooked as too small, such as the Fintech 100.

Green Construction – This sector advanced strongly to over $1 trillion ranging from “low-tech” passive solar buildings to "high-tech" and new construction methods. For consistency, we omit labor, thus undercounting a form of capital which intrinsically increases the value of green construction. We also point to new trends, such as high-rise food-growing on urban skyscrapers, and startups in vertical urban agriculture in our Overview.

Corporate Green R&D – Grew strongly to $505 billion, this sector is also heavily weighted in favor of automotive industries and their shift to electric vehicles, energy generation, conservation and distribution with a precipitous decline in fossil fuels P&E. In spite of oil prices hovering between $55-65 a barrel, even OPEC supply cuts have not cleaned backlogs and even Saudi Arabia's Crown Prince "MBS" is re-shaping Aramco toward renewables in anticipation of its IPO.


Salt Water Halophyte Plants

Capturing CO2 While Improving Human Nutrition and Health
Overview by Hazel Henderson

According to our Green Transition Scoreboard® (GTS) scenario of the systemic global transition now underway, we estimated and have tracked the continuation of at least $1 trillion of private investments annually which have occurred in green sectors worldwide since 2007. Thus, we indicate with greater assurance our original estimation that by 2020 human societies will enter their next stage of development: the evolution of knowledge, renewable sourcing of energy and materials in more sustainable, inclusive, recycling circular economies. Our view is that this shift is inevitable, will improve human nutrition and health and will continue progressing at an accelerated rate alongside but not necessarily driven by the climate debate, but rather by its own dynamics. This underlying shift we expected would be measured by an increasing array of new metrics, indicators, accounting standards of performance now evident worldwide as we reported in our GTS 2017: "Deepening Green Finance".

Today over 600 corporations are adopting these new multi-disciplinary metrics and standards,[4] Over 6,000 companies report their climate-related data to global watchdog CDP, formerly the Carbon Disclosure Project, founded in Britain by Paul Dickinson and Tessa Tennant, both of whom are on Ethical Markets global Advisory Board.[5] Standards and metrics on aspects of sustainability include IIRC,[6] SASB, CIMA, Global Footprint, ICAEW, CASB and increasingly target the 17 goals ratified by the 196 nations in 2015 of the United Nations (UN) Sustainable Development Goals (SDGs). The Chartered Institute of Management Accountants Journal, Financial Management (www.cimaglobal.com) explored new values measuring corporate performance.[7] New indicators include the US National Academy of Sciences report on companies' contribution to sustainability through global supply chains measured 449 publicly-traded companies Sustainable Sourcing Practices (SSPs) and found 52% had at least one such practice.[8] Just Capital ranks top corporations most trusted by the US public in its surveys.[9] Yahoo Finance publishes

[4] Carol Adams, "The Sustainable Development Goals: Integrated Thinking and the Integrated Report", ICAS, IIRC, Green Economy Coalition, March 15, 2018.

[5] The Economist, "Low-carb diet", January 13, 2018, www.cdp.org.

[6] Carol Adams, "The Sustainable Development Goals: Integrated Thinking and the Integrated Report", ICAS, IIRC, Green Economy Coalition, March 15, 2018.

[7] Chartered Institute of Management Accountants, "Financial Management", May-June 2018.

[8] Thorlakson, T., de Zeher, J. F., Lambin, E. F. "Proceedings of the National Academy of Sciences of the USA, February 12, 2018.

[9] Just Capital, February 6th, 2018.

Sustainalytics top 30 companies rated Most Socially Responsible.[10] Finance Watch, Z/Yen and MAVA Foundation rate financial centers for their level of green investing quality in the Global Green Finance Index.[11] Bloomberg New Energy Finance found global investment in renewable energy grew 3% in 2017 while costs continued to fall.[12] HELIO International's HIFI Index partnered with Ethical Markets helps steer investors to opportunities in developing countries.[13] New metrics such as investing using a gender lens grew in 2017 due to global movements for gender equality and many such portfolios out-performed other social impacts funds.[14] Cornerstone Capital's report "Structural Complicity" identified sexual and gender based violence (SGBV) as an emerging investment risk.[15] A 2017 report on integrating corporate social performance criteria with executive compensation finds these factors material to financial performance.[16]

FIGURE: 1 ©2017 Hazel Henderson

A comprehensive survey "Measuring Effectiveness: Roadmap to Assessing System-level and SDG Investing" refocuses asset managers on the systems approach to national development embodied the SDGs.[17] The European Commission's Action Plan on Sustainable Finance met on March 22, 2018 to discuss opportunities for reform geared to the SDGs.[18] The Calvert-Henderson Quality of Life Indicators, (2000) was an early macroeconomy critique of GDP by a private sector asset manager and this author. Now rebranded as the Ethical Markets Quality of Life Indicators, it is updated monthly in our Current Global Issues on our "Latest Headlines" at www.ethicalmarkets.com. The Gross National

[10] Sustainalytics 30 Most Socially Responsible Companies, 2018.

[11] Global Green Finance Index, Summary, Finance Watch, Z/Yen and MAVA Foundation, March. 2018.

[12] Bloomberg New Energy Finance, March 28, 2018.

[13] Helio International-Ethical Markets, HiFI, Paris, 2017 www.helio-international.org.

[14] The Economist, "The Power of Money", March 10, 2018.

[15] Cornerstone Capital, "Structural Complicity", February 12, 2018.

[16] Flammer, C., Hong, B., Minor, D. "Corporate Governance and the Rise of Integrating Corporate Social Responsibility Criteria in Executive Compensation: Effectiveness and Implications for Firm Outcomes", Paper for IRRC Institute, October 1, 2017.

[17] Burckart, W., Lydenberg, S., Ziegler, J., "Measuring Effectiveness: Roadmap to Assessing System-Level and SDG Investing", TIIP (The Investment Integration Project) and the Investor Responsibility Research Center Institute, March 2018.

[18] SDG Update, SDB Knowledge Hub, March 29, 2018, www.sdgs@iisd.org.

Happiness (GNH) of Bhutan was adopted by the UN and morphed into the World Happiness Report, which evaluates nation's surveys of subjective happiness and satisfaction and ranks Nordic countries highest in 2018.[19] The UN and several agencies convened a Roundtable in April 2018 on "Faith-Consistent Financing Prospects to Achieve the SDGs" and "Blockchain for Sustainable and Inclusive Finance".

The structure of stock markets has evolved rapidly as computers, satellite communications, big data, and algorithms, now dominate globally. This global financialization introduced many systemic risks, flash crashes and the crises of 2008.[20] Today, risks proliferate, from robo-investing to the proliferation of indices and benchmarks with 3.2 million index funds far exceeding the 44,000 listed companies worldwide.[21] We also documented how traditional money-denominated GDP growth models were becoming boxed in on all sides in Fig 1.

2020 AND BEYOND

Today, these multi-disciplinary scenario-based forecasting methods[22] which we have always used, are being applied in many sectors, industries, governments and corporations --- beyond the single-focus economic forecasts of yore, and increasingly challenging GDP-growth as a measure of national progress. An example is the World Economic Forum's Energy Transition Index (ETI) in "Fostering Effective Energy Transition: A Fact-Based Framework to Support Decision-Making".[23] Royal Dutch Shell's latest scenario "Sky 2070" on carbon emissions and climate change, sees the age of oil winding down, with electric vehicles, energy storage and other new technologies taking over.[24] Moody's reported that global green bond issuance is set to eclipse $250 billion in 2018.[25] Bond holders now demand credit raters include climate and environmental risk.[26] The International Institute for Applied Systems Analysis (IIASA) is now

[19] World Happiness Report, 2018.

[20] Henderson, H., "Perspectives on Reforming Electronic Markets and Trading, UNEP Inquiry on Sustainable Finance (2015).

[21] IPE Investments, Pensions Europe, "Indices and benchmarks: Let a million flower bloom", Christopher O'Dea, February, 2018.

[22] See for example "State of the Future" reports, Millennium Project.

[23] "Fostering Effective Energy Transition", World Economic Forum, March, 2018.

[24] "Royal Dutch Shell Throws In The Climate Change Towel, Sees Low-Oil Future By 2070", Casey, T., TriplePundit, March 28, 2018.

[25] Moody's Investors, "Green Bonds Global", January 31, 2018.

[26] Bloomberg Businessweek, "Putting a Grade on Climate Risk", January 29, 2018.

calling for a broader range of scenarios to support climate policy-making.[27] We also reported how blindsided mainstream asset managers had responded by calling for a slowdown in the pace of this green transition to a more sustainable circular world economy. Their financial models, risk-analyses and algorithms needed re-setting, with updated assumptions in many areas, in order to shift their portfolios toward all the new opportunities evident in this systemic global transition in every sector and national economies. This systems view is also evident in the UN's Sustainable Development Goals (SDGs). Fig: 2

FIGURE 2, SDGs

The widespread new use of scenarios at all levels of decision-making has begun driving this re-focusing of financial models and broadening their conventional risk-analyses, such as I advocated in "Assessing Risks of Fossil Reserves: Are They Fuels or Feedstocks?" (2017). Today, financiers are taking account of the rising evidence of the global risks, as reported by the World Economic Forum over the past decade.[28] The new global risks are forcing companies to take political stands so as to protect their brands, whether on gun violence in the USA or global pollution, waste and social inequality.[29] Global inequality, while not inevitable, is still widening as the top 1% captured 27% of total growth in 2016.[30] Many scenarios show that reducing inequality is essential to achieving efficiency goals and long-term sustainability, with examples in this report. Conventional economic textbooks rarely cover the full repertoire of human behavior ranging from conflict and competition to cooperation, sharing and altruism. Economics focus on competition contributes to structural inequality and winner-take-all outcomes, see Fig: 3. We cover these paradigm issues in our TV program How Adam Smith and Charles Darwin Were Hijacked".

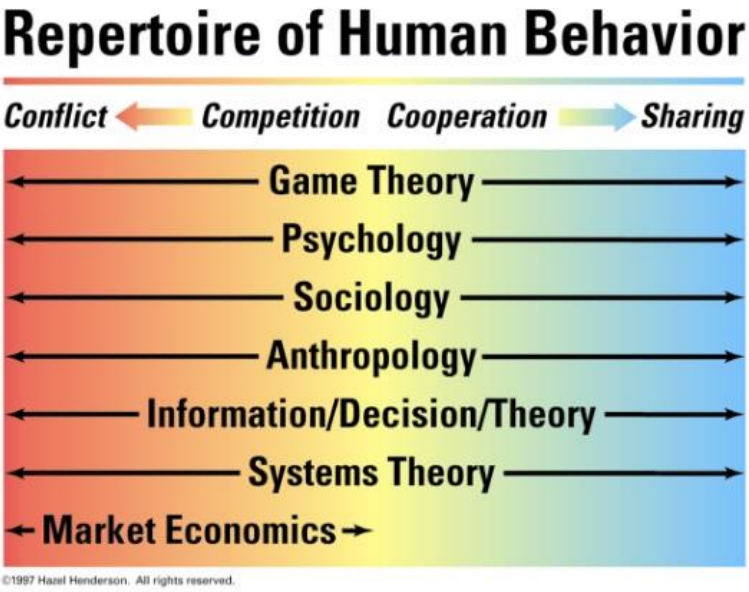
[27] Science Daily, "Thinking outside the box on climate mitigation", January 12, 2018.

[28] "Global Risks Report 2018", World Economic Forum, 13th Edition, 2018.

[29] Howell, J., "Brands Taking Stands", 3BL, March 13, 2018.

[30] World Inequality Report, 2018, www.wir2018.wid.world.

FIGURE: 3



The SDG's Goal 16, Peace and Justice addresses inequality and all forms of violence and calls for new levels of international cooperation and agreements of UN member countries. Diplomacy is essential to address unaccountable power and inequality, as described by Ronan Farrow in " War Against Peace", (2018) and in "Eliminating War" (2009) by US Army veterans Alan F. Kay and Daniel Smith. The growing numbers of movements of global citizens for human rights, democratization and shared prosperity support the SDGs. See for example the Millennium Project's 15 Global Challenges and the Global Peace Index.[31]

Today, there are greater human health and nutrition risks in *not* shifting portfolios toward the global green transition to sustainability. The rise of vegetarianism and veganism is driven by three motives: personal health, animal welfare and environmental concerns.[32] In 2017, 81 million people experienced severe food insecurity—much stemming from droughts in African countries.[33] Hunger also stems from speculation in commodities causing food prices to rise[34] according to the New England Complex Systems Institute, (NECSI). A Sustainable Food Summit, June 2018 addresses food impacts on health and the environment.[35] Indoor farming is taking off in many cities around the world, since this is where most people are living.[36] There are financial risks in the stranded assets now evident in fossil reserves,[37] but also in other 19th and 20th century production methods and practices in legacy sectors and industries now being disrupted by

[31] State of the Future, op.cit. and Global Peace Index, www.visionofhumanity.org.

[32] The Guardian. "The unstoppable rise of veganism: how a fringe movement went mainstream", April 1, 201.8

[33] Science Daily, "Climatologists render skillful predictions of drought and food insecurity that help avert Famine", March 14, 2018.

[34] Time Magazine, "Betting On Hunger: Is Financial Speculation to Blame for High Food Prices?", December 17, 2012.

[35] Sustainable Foods Summit, Ecovia Intelligence/Organic Monitor, March 21, 2018.

[36] The Economist, "Cities and farming", Feb. 17, 2018 and "Indoor farming", May 17, 2014.

[37] Carbon Tracker, "Mind the Gap: The $1.6 trillion energy transition risk", March 2018.

digitization and new technologies: banking, insurance, mining, food, agriculture, transport healthcare, education and infrastructure.[38] New taxonomies to shift investments toward the 17 goals of the SDGs are offered in a creative re-conceptualization of decision-trees by PGGM and APG[39] Examples include the "virtual power plants" such as developed in Germany by Sonnen, a battery company in 2015 which connects to 10,000 homes fitted with solar panels and batteries which share their electricity. Consumers pay a flat fee of $30 equivalent per month instead of the grid linked individual home cost of $200.[40]

FUTURE GOOD AND BAD NEWS

Scenarios ,such as in Fig 4,of these systemic local and global shifts have been available since the Club of Rome reports on “Limits to Growth", (1972), now underlined by its 50th Anniversary volumes, “Come On“ and “Investing Reinvented", Springer, (2018) in which we have a leading chapter and contributed this video conversation with founder Aurelio Peccei, in 1983. For example, the European Commission targets 2030 in its "Financing a Sustainable European Economy" Final Report, March 2018[41] while its "ProSum" report on shifting to a circular economy analyses a range of secondary uses for materials which can be recycled and re-used.[42] A series of scientific surveys of the US public in the 1990's found majorities supporting the financing of the UN agencies by financial transaction taxes (72%), pollution taxes (82%), and annual shifts of 3% of military spending to civilian priorities and retraining military personnel (approved by 56%).[43] India announced its Terawatt Initiative to meet the International Solar Alliance's objective of one terawatt of additional solar capacity by 2030.[44] India and France hosted the International Solar Alliance founding summit in March, 2018 and French president Macron committed 1 billion euros to solar deployment through

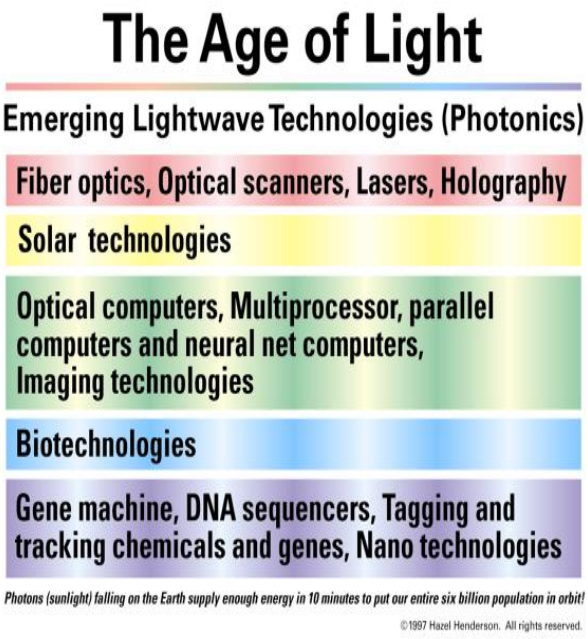


FIGURE 4

[38] Hazel Henderson "Fintech: Good and Bad News for Sustainable Finance", 2015.

[39] PGGM-APG Sustainable Development Investments (SDGs), Taxonomies, May 2017.

[40] New Scientist, "Virtual Power to The People". Alice Klein, March 10, 2018.

[41] European Commission Final Report, "Financing A Sustainable European Economy", March 2018.

[42] European Commission ProSum Report, December. 21, 2017.

[43] Kay, A. F., "Locating Consensus for Democracy", Americans Talk Issues, 1998.

[44] TW, "Launch of the Terawatt Initiative", December. 1, 2015.

2022.[45] Most current scenarios now focus on 2030 and 2050 timeframes for various transitions toward sustainability. Many are driven by the Paris Climate accords of 2015, the 2030 timeframe of the SDGs and the experiences of unusual disastrous weather events as evidence of climate change: flooding, droughts, superstorms, heatwaves, sudden freezes in temperate zones exacerbated by melting of Arctic ice and shifting of its polar vortex. A team from the GEOMAR Helmholtz Centre for Ocean Research in Kiel, Germany, has now found evidence that warming Arctic temperatures might increase ice melting and possibly shut down the North Atlantic current delivering warm water to Europe. This would cause a cooling of Europe's temperate climate and possible rise of 40 centimeters of the ocean around North America and North Europe.[46] This Overview looks widely at all these scenarios of 2030 and 2050 and how human societies are responding to all these new conditions and information using the emerging models of change processes in Fig. 5.

Some countries, including China, India and many in Europe, Africa and Latin America are enacting unprecedented policies in finance, as documented by the UNEP Inquiry on Design of Sustainable Finance[47], in which we have participated. Their final report "MAKING WAVES" summarizes this four year Inquiry including a scenario "Looking Back From 2028" depicting a trajectory for aligning finance with its purpose of facilitating humanity's goals and the SDGs. Along with policies of many private sector groups, governments are continuing to respond, many with statist approaches, such as banning fossil-fueled vehicles by 2030 in India, France, Norway and Britain.

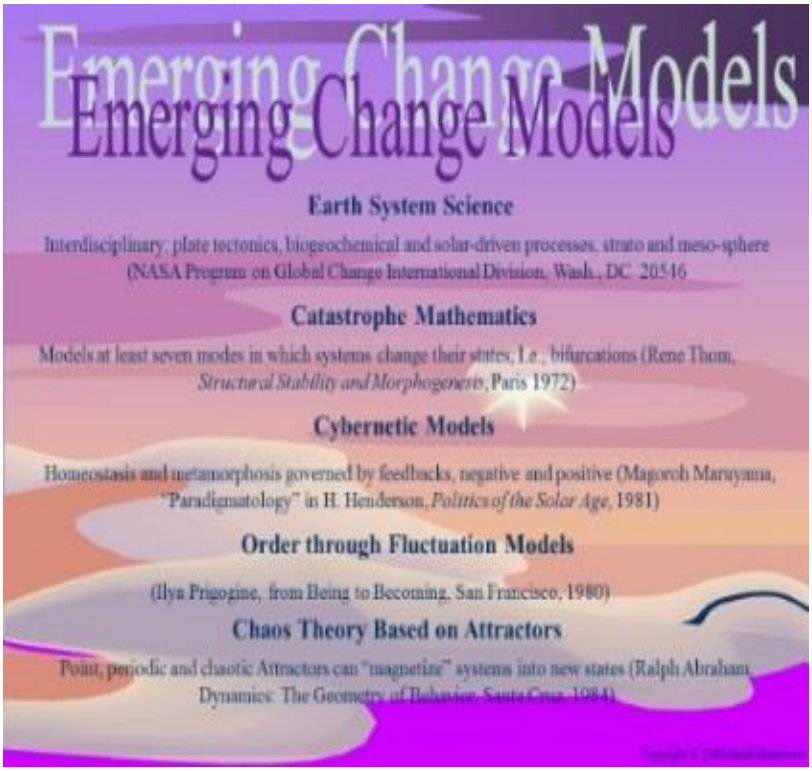


FIGURE 5 ©1997 Hazel Henderson

[45] Renewable Energy World, Jennifer Delony, March. 12, 2018.

[46] New Scientist, "Circulation in meltdown", Barras, C., March 17, 2018.

[47] UNEP Inquiry. www.unepinquiry.org.

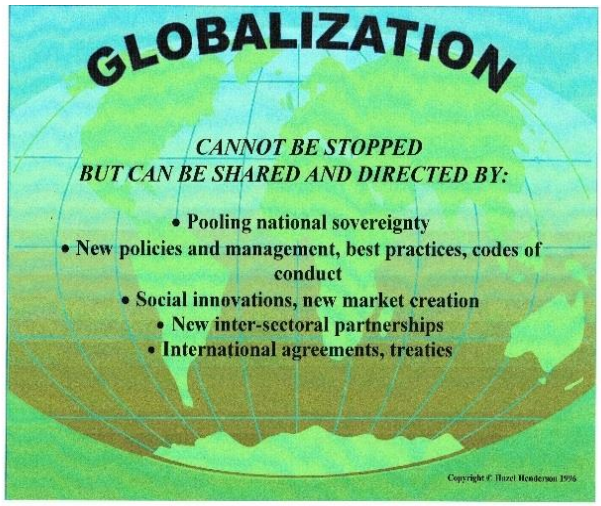


FIGURE 6:

Britain commissioned a task force in 2018 to further its recommendations toward "Growing a Culture of Social Impact Investing in the UK".[48] China has also mandated the shift in focus of its domestic economy toward internal changes including domestic consumption, growing production of solar panels, wind generators, electric vehicles and urban mass transit as well as urban re-design.[49] Nevertheless China still depends on coal for 73% of its electricity generation. Australia's shifting energy sector battles between fossil and renewables are being fought out in elections.[50] South Australia's government will fit 50,000 homes with Tesla's solar panels and batteries into another "virtual power plant" similar to that described in Germany.[51] Meanwhile auto makers are shifting to electric and hydrogen vehicles,[52] Yet their race to develop autonomous vehicles seems overhyped since artificial intelligence (AI) algorithms are accident-prone and not yet up to speed.[53] The new scramble is for minerals needed for batteries, particularly cobalt and lithium, for electric vehicles, as well as networks of charging stations across the countries.[54] Electric utilities are slowly changing as their customers flee their grids while microgrids enabling virtual power plants flourish by sharing rooftop solar energy in community cooperatives.[55] Even The Economist editorialized on the desirability to shift to a cleaner, safer post-oil world --- welcoming the "electricity era".[56] The power of sharing to reduce inequality and increase efficiency is well documented, not only in the digital platforms for sharing, swapping, bartering and monetizing spare rooms, as in Airbnb, but also in the fact that more people on our planet are employed in cooperative enterprises than by all the world's for-profit companies combined, documented by the UN in its Year of the Cooperative 2012 (www.un.org). Globalization can be re-directed to serve human rights, democracies and environmental

[48] GOV.UK, "PM commissions industry task force on social impact investment", March 9, 2018.

[49] New Scientist, "We Should Look To China For Renewable Success", April 14, 2018.

[50] The Economist, March 10, 2018.

[51] New Scientist, "Virtual Power to the People", op.cit

[52] The Economist "Reinventing Wheels", March 3, 2018.

[53] Bloomberg Businessweek, January 22, 2018, pg. 17.

[54] The Economist, "Electric Dreams", March 17, 2018.

[55] Farrell, J., "The 2018 Community Power State Scorecard", March 2018.

[56] The Economist, " Goblin metals: the scramble for better minerals.", March 24, 2018.

protection. Former UN Secretary General Boutros Boutros-Ghali pointed out prophetically "If we don't do everything possible to democratize globalization, globalization will pervert national democracies".[57] Fig: 6

All this is good news for human health, including reducing sickness and death from air pollution as a new report from the European Environment Agency outlines the huge human costs of such pollution.[58] Good news includes the re-affirmed commitments of all the national signatories, except the USA, to the Paris Climate accords to reduce their massive subsidies to fossil fuels and to continue shifting to renewable energy and resources. Thousands of US companies (including Ethical Markets), investors and cities joined the "We're Still In" campaign to show commitments to the Paris accords.[59] The US pullout will have little effect, since the price of renewables continues to fall and the transition continues in states, cities and markets.[60] Yet in Carbon Tracker's latest report, we see the continuing over-investment of fossil fuel companies and their financial backers and how this will cause losses in average investors' retirement pensions and portfolios.[61] Good news is evident in the worldwide grassroots civic and youth action, as well as shareholder activism now changing corporate behavior in many industries.[62] Values are changing around the world ,see Fig. 7 .

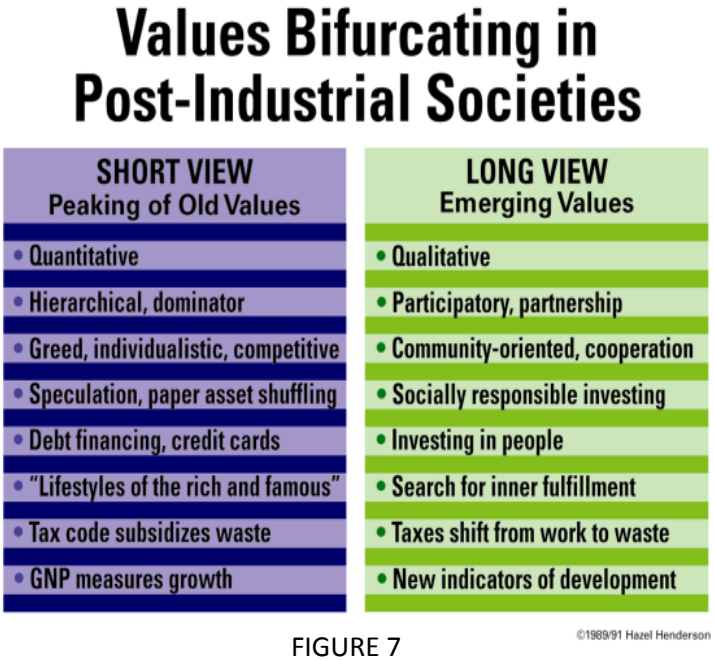


FIGURE 7

Consumers are demanding healthier choices in products and services in housing, food, fashions, workplaces, healthcare and public facilities. Britain's RSA Citizens Economic Council reports on its 2 year engagement with citizens on the state of the economy, "Building A Public Culture of Economics".[63] Debates

[57] Other News, "Boutros Boutros-Ghali, democratic multilateralism", Federico Mayor Zaragoza, April 19, 2018.

[58] European Environment Agency, "Air Pollution", 2017.

[59] "We're Still In', Ceres, www.wearestillin.com , 2017.

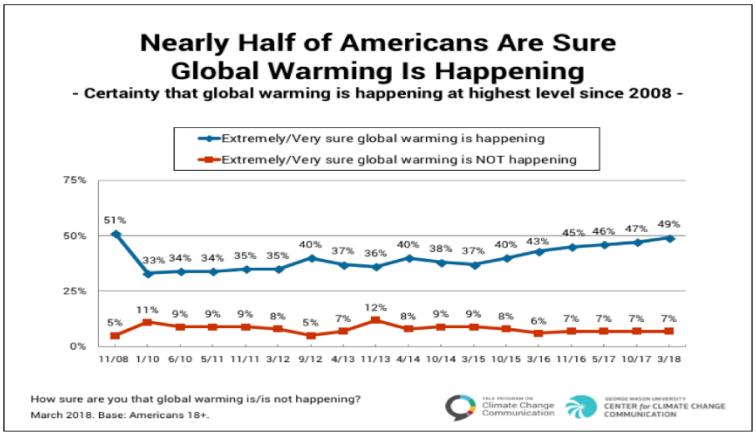
[60] Science Daily, "Even without the clean power plan, US can achieve Paris Agreement emission reductions", February 16, 2018.

[61] Carbon Tracker, "Mind the Gap: The $1.6 trillion Energy Transition Risk", March 2018 op. cit.

[62] Bloomberg Climate Changed, March 2018 op. cit.

[63] Patel, R., Gibbon, K., Greenham, T. "Building a Public Culture of Economics", RSA (Royal Society of Arts, Manufactures and Commerce), London, March, 2018, Full disclosure: Hazel Henderson is a Fellow of RSA.

FIGURE 8: GEORGE MASON UNIVERSITY POLL DATA



about climate change are no longer stifled by the denials and false advertising of private special interests often abetted by politicians and public policies. In addition, the rollbacks of consumer and environmental safety laws by the Trump administration in the USA are being challenged. A US poll by George Mason University now finds 47% are now sure that global warming is happening and 58% understand that it is human-caused.[64], see Fig. 8.

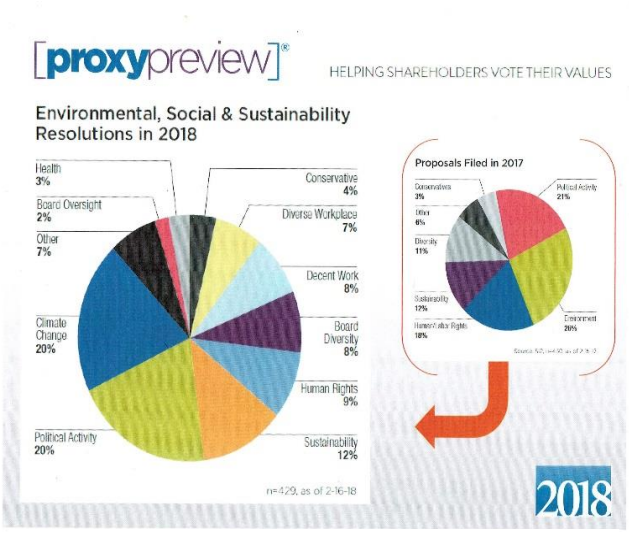


FIGURE 9

One such group of mostly teenagers won a lawsuit against such rollbacks on the grounds of violating their constitutional rights.[65] Nexus Global is another worldwide group of millennials who will inherit assets from their parents, and are sharing their own goals of a more equitable sustainable and peaceful future. Such young philanthropists are profiled as "The Giving Generation".[66] The rapid growth of ethical, green, ESG and "impact" investing that we covered in our GTS 2017 continues expanding in 2018 and is going mainstream with major Wall Street firms now offering "impact" funds. These will require monitoring to prevent "greenwashing", even as Larry Fink, CEO of BlackRock, the world's largest asset manager exhorted the financial community and corporations to act more responsibly in the public interest.[67] Shareholder activism continues to challenge

[64] George Mason University, Center For Climate Change Communication, April 18, 2018, www.emailbach@gmu.edu.

[65] Bloomberg Climate Changed, March 2018, ibid

[66] Barron's, "The Giving Generation", Winninghoff, E., December 3, 2012.

[67] New York Times, "BlackRock's Message: Contribute to Society, or Risk Losing Our Support", Sorkin, Andrew, January 15, 2018.

company policies,[68] including Walden Asset Management campaigns on climate change, inequality and governance issues.[69] Investment firms Octopus in Britain and OpenInvest in the USA empower their investors to use their money to create a better world.[70] Such shareholder activism is tracked by Proxy Preview in Fig. 9

Good news is in the proliferating fossil-free portfolios offered by many smaller asset managers, geared to longer-term sustainability goals as well as competitive financial returns --- some exceeding those of conventional portfolios. Innovators include Green Alpha Advisors and their "Next Economy Portfolio Theory[71]" and "Investing for the Next Economy", see Fig. 10. as well as Sonen Capital, TONIIC, RSF, the Global Impact Investing Network[72] and other organizational forms, such as those documented in our TV program "Rise of the B Corporation". Lawyers detail these B Corporations, including Frederick Alexander in "Benefit Corporation Law and Governance" (2017) and Jenny Kassan in "Raise Capital on Your Own Terms" (2017), as well as the growth in the USA of credit unions, many of which are in our free listings of our Ethical Money Directory.

FIGURE: 10 © 2018 Shelton Capital Management

MEDIOCRACIES AND THEIR ATTENTION ECONOMIES

[68] The Economist, "Voting With Yom Pocket", April 14, 2018.

[69] Walden Asset Management, ESG Research and Engagement Brief, First Quarter, 2018.

[70] See for example: "Octopus: Best Behavior" at www.octopusgroup.com and www.openinvest.com.

[71] "Next Economy Portfolio Theory" in "Mapping The Next Economy: Investing in Energy Efficiency", Green Alpha Advisors, Shelton Capital Management, San Francisco, February, 2018.

[72] GIIN News, March 12, 2018, www.thegiin.org.

More good news is in the closer ethical scrutiny of advertising, marketing and media, as news emerged about social media firms with their advertising-financed business models were becoming monopolistic news sources, but without the usual legal constraints of all other news media. Bloomberg Business Week editorialized that "Giant internet firms are poisoning the commons" and called for new government oversight in a Digital Protection Agency.[73] The Economist Intelligence Unit survey in 8 countries "What The Internet-of-Things Means for Consumer Privacy" found large majorities fearful of loss of privacy, identity and control of their personal information and over 80% demanded regulations similar to the European Union's General Data Protection Regulation (GDPR) which is enforceable from May 1, 2018.[74] The scandal of Facebook's and Cambridge Analytica's theft of personal data of 89 million Americans triggered a selloff of $80 billion in Facebook's market value.[75] The US Congress held hearings in 2017 examining the role of Facebook, Twitter, Google in the hacking and fake news during the 2016 election. The Economist editorialized on Facebook as "the antisocial network.[76] Today we all live in Mediocracies---whatever our country's form of government as I describe in "Mediocracies And Their Attention Economies",[77] See Fig. 11. Our EthicMark® Awards for Advertising that Uplifts the Human Spirit and Society have raised the bar in the $570 billion advertising industry worldwide and our winning ad campaigns from many countries show how advertising can fulfill its promise as truly educational resources, (see winners at www.ethicmark.com). Trust is the basis of all markets and societies as I re-emphasize in "Money Is Not Wealth" (2017). This is the reason Unilever announced it would pull its advertising from Facebook unless it removes toxic content. Media covering the global green transition are proliferating online, like our own TV series “Transforming Finance “and this GTS report,

FIGURE 11 ©1997 Hazel Henderson

[73] Ford, P., "Where's our Digital EPA?" Bloomberg Business Week, March 26, 2018.

[74] The Economist Intelligence Unit, "What the Internet of Things means for consumer privacy", March 22, 2018.

[75] Bloomberg Business Week, "Under Fire and Losing Trust", March 26, 2018.

[76] The Economist, "Epic Fail", and "The Antisocial Network", March 24, 2018.

[77] Henderson, H., "Mediocracies And Their Attention Economies", (2017).

FIGURE 12

distributed globally, along with our partners 3BL, TriplePundit as well as Green Money Journal, Other News, InterPress Service, Investment News, Impact Alpha Investing and many more.

Now for the bad news: sea levels are rising, threatening many coastal cities around the world as we reported in our TV shows with John Englander in his "Rising Tide on Main Street" (2014). These rises such as in the San Francisco Bay Area, Miami and other cities are "baked in" and often exacerbated by subsiding land. Efforts to limit global warming will not stop ice melting in the Arctic,[78] and there are signs that Arctic soils are releasing long-stored carbon and methane, another greenhouse gas.[79] Even the accelerating pace of the shifts to renewable resources and more efficient, sustainable circular economies, while necessary, will not be sufficient to halt, let alone reverse this trend, as reported by Jay Goodall in "The Water Will Come ", (2018). Furthermore, New Scientist reports that the global warming looks set to make many parts of the world uninhabitable.[80] NASA and NOAA, the two US agencies with Earth-observing satellites show that surface temperatures in 2017 were the second warmest since 1880.[81] Just as investors in fossil reserves and oil companies needed to learn geology, today's asset managers need to learn from satellite data the daily updates from the latest Earth systems science., in my "Mapping the Global Transition to the Solar Age, Fig 12.

Increasing CO2 is also changing marine life.[82] In the USA the Trump administration still considers climate change as a hoax, while the Department of Defense reports that 3,500 of its military sites in the US are facing national security threats as flooding occurs at many of its bases, including its Naval Station which is also sinking in Norfolk Virginia.[83] The US quadrennial National Climate Assessment reaches similar and other wider conclusions.[84] A study by Lund University in Sweden sees the need for new forms of decision-

[78] The Economist, "Skating on Thin Ice", April 29, 2017.

[79] Washington Post, "There's Worrying New Evidence That Arctic Soils are Releasing Ancient Stored . Carbon, Chris Mooney, March 2, 2018.

[80] New Scientist, "Too Hot to Handle?" John Pickell, January 20, 2018.

[81] Science Daily, "Long Term Warming Trend continued in 2017: NASA, NOAA", January 18, 2018.

[82] Science Daily, "Influence of Increasing Carbon Dioxide on the Seabed", February 8, 2018.

[83] The Economist, "Unchanging: climate and national security", February 24, 2018.

[84] The Economist, ibid. Quadrennial National Climate Assessment ,www.globalchange.gov

making to address sea level rises.[85] Such new decision making applies to the USA where new projections from climate models show increased heat affecting society and agriculture.[86] Policy-makers in the USA and other countries seem to be relying on the younger generation to solve their problems, whether gun violence in the USA or climate change worldwide.[87] Current Western science and technology may not save societies from their complex problems, from inequality, violence and ecological stresses.[88] The world also needs policy changes and more rapid action to reduce the greenhouse gas emissions, reports the Potsdam Institute for Climate Impact Research.[89] Climate scientists at the University of Melbourne, Australia warn that the world could surpass the 1.5° centigrade target of the Paris accord by 2026.[90] And as we have reported earlier, the so-called "Carbon Budget" estimating how much more fossil reserves could be safely burned was overstated and new estimates cut the earlier estimate in half---leaving only use of 1,240 billion tons.[91]

STRESS DRIVES EVOLUTION

Humanity is stepping up responses to all these self-inflicted problems created as a result of our limited perception of our home planet Earth's processes. Stress is evolution's tool and breakdowns drive breakthroughs. So we turn now to all the many viable solutions still available to address our social problems and environmental challenges --- including climate change. More systemic approaches to water issues are now evident in World Water Day, and its 2018 Report which stress understanding Nature's processes better and working with these forces.[92] Beyond the $9.3 trillion we track now cumulatively invested in knowledge-richer, healthier, green technologies, many firms like Coastal Risk Consulting research risks for real estate and insurance companies. This approach steers risk-taking away from building in floodplains, coastal areas and other unsustainable human activities while offering climate and catastrophe bonds.[93] The Virginia Institute of Marine Science recently launched sea-level report cards for 32 localities along coastlines in the USA for the first time.[94] Planners are re-designing building codes and preventing development in low-lying areas, such as those flooded in Houston, Texas and other urban areas. City mayors share information in

[85] Science Daily, "Sea Level Rise urgently requires new forms of decision-making", March 6, 2018.

[86] Science Daily, "High-resolution climate models present alarming new projections for US, December 13, 2017.

[87] New Scientist, "Time for a different story", Michael E. Mann, February 24, 2018.

[88] Science Daily, cover story on complexity, Laura Spinney, January 20, 2018.

[89] Science Daily, "Turning the climate tide by 2020", June 28, 2017.

[90] New Scientist, "We could pass1.5°C warming by 2026", May 11, 2017.

[91] Climate News Network, "Carbon budget is only half as big as thought", International Institute for Applied Systems Analysis, (IIASA) Austria, February 26, 2016.

[92] World Water Development Report, "Nature-Based Solutions for Water", U. N., March 19, 2018.

[93] Bloomberg Businessweek, "Catastrophe Bonds Survive A Stormy Year", January 8, 2018.

[94] Science Daily, "First annual sea-level report cards", March 12, 2018.

FIGURE13: VERTICAL FARMING

the C40 group hosted by New York's former Mayor Michael Bloomberg which now includes over 100 cities. The Cities-IPCC consortium now also includes UN-Habitat, Cities Alliance, ICLEI, the Sustainable Development Solutions Network (SDGN) and United Cities and Local Governments (UCLG)—all sharing solutions to climate change. Urban agriculture and vertical farming are now common in many cities, see Fig. 13.

New York City's pension fund plans to phase out its fossil investments, which are valued at $5 billion of the $189 billion total. The city is now suing Chevron, Exxon Mobil, BP, ConocoPhillips and Royal Dutch Shell for some of the billions Hurricane Sandy cost its infrastructure.[95] More than half of humanity lives in cities and this is expected to increase to 64-69% by 2050. Urban areas consume 75% of global energy use and resulting emissions.[96] As cities face more extreme weather, many are leading the shift toward green infrastructure, LED lighting, electrified mass transit, denser, more energy-efficient housing and involving their citizens in these transitions for using and sharing energy and water more efficiently, see for example, "Greening Trump's Infrastructure Plan".[97]

The lowest hanging fruit is still found in increasing across-the-board efficiency in most developed societies since they waste so much energy and materials. A study by the University of Leeds in Britain finds that meeting basic needs, nutrition, sanitation and eliminating extreme poverty could most likely be achieved in all countries without exceeding environmental limits.[98] The SDGs concur with their 16 goals and the 17th which calls for widespread partnerships to achieve the SDGs by 2030. Researchers at IIASA assess five

[95] EcoWatch, Common Dreams, "Tide Is Turning: Cheers Erupt for NYC's Suit Against Fossil Fuel Giants and for Divestment', Jan. 10, 2018 and Institutional Investor, "Can NYC Dump Fossil Fuels?", March, 2018.

[96] IISD Reporting Services, "Summary of the Cities and Climate Change Science Conference", 5-7 March. 2018.

[97] See for example, Henderson, H. "Greening Trump's Infrastructure Plan", (2017).

[98] Science Daily, "A good life for all within the planet's means", February 5, 2018.

models of Shared Socioeconomic Pathways (SSPs) on how societies could progress. All successful scenarios include a rapid shift away from fossil fuels to low-carbon sources, sharing, lower energy use and removal of CO2. Key challenges were the deep social and economic inequalities, yet conclusions show several viable pathways to achieving limits to CO2 emissions, warming below 1.5° by 2100.[99]

FULL-SPECTRUM ACCOUNTING

These sustainable paths are illuminated by all the new multi-disciplinary metrics beyond obsolete and failed money-based economic models, see Fig:14 which exclude social and environmental costs and impacts---so-called "externalities", We examined this shift in GTS 2016 "Ending Externalities: Full-Spectrum Accounting Clarifies Transition Management".

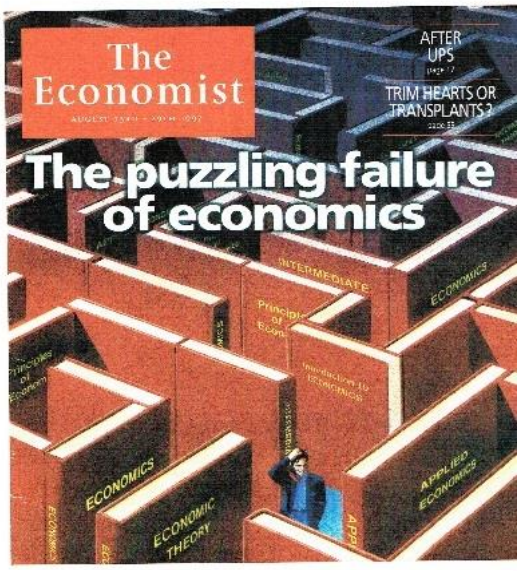


FIGURE 14

Beyond traditional economic text books, humanity is at last, valuing ecosystem services, such as natural systems and their regeneration, biodiversity and the value of intact food chains and forests, which currently absorb 25% of human-generated carbon dioxide emissions. The UN's reframing of such valuation methods is in its TEEB program (The Economics of Ecosystems and Biodiversity) led by former financier Pavan Sukhdev, now President of the Worldwide Fund for Nature. Using such new systemic metrics, the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) issued its 3 year report, finding that worsening worldwide land degradation is now "critical" and is undermining the wellbeing of 3.2 billion people.[100] The new metrics are now driving businesses and finance toward similar systemic evaluations. New digitized platforms, sharing models and those informing citizens and activist

[99] Science Daily, "Models show how to limit global temperature rise to 1.5° by 2100", March 5, 2018.

[100] "IPBES Science and Policy for People and Nature", Worsening Worldwide Land Degradation Now Critical: Undermining Well-Being of 3.2 billion people". Media Release, March 26, 2018.

movements are demanding shifts toward greater fairness, equality, social inclusion as well as greater disclosure and responsibility of companies, governments and all segments of societies.[101] The 2018 State of Green Business published over the past decade by GreenBiz Group, Inc. and Trucost, (now a part of S&P Dow Jones Indices) assesses corporate environmental performance of the world's largest 1200 companies monitoring ten trends in particular. While recording much progress, the report finds the natural capital cost to the public generated by company activities is almost twice as high as these companies' net income,[102] see Fig. 15.

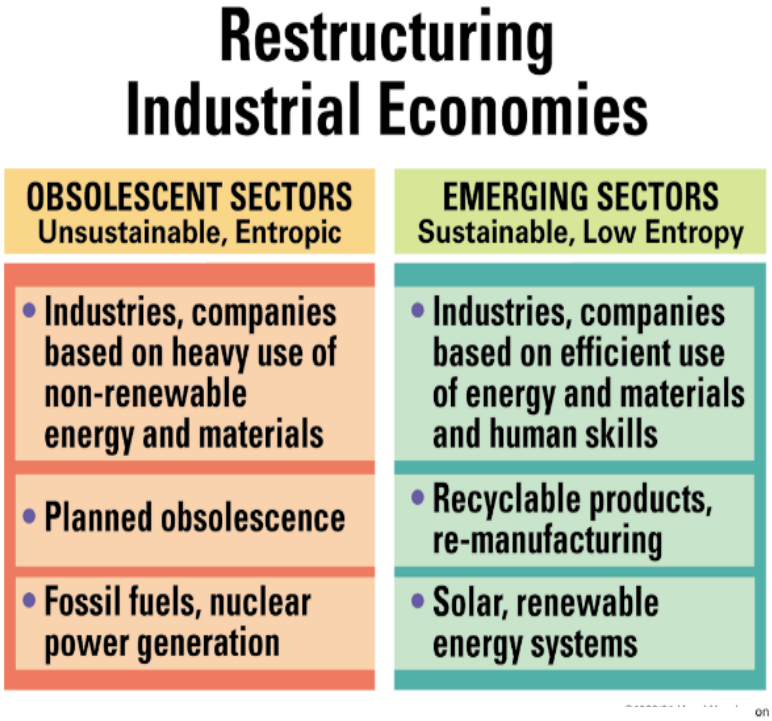


FIGURE: 15 ©1997 Hazel Henderson

Certainly the global shift to truly sustainable business practices and finance must go much further and faster, as outlined in the European Sustainable Investment Policy Mandates: Fiduciary Duty to account for environmental, social and governance (ESG) factors as material to all investments; Disclosure of all investment approaches including by pension funds, and recognition of civic duty.[103] New benchmarks for investing sustainably in timber, real estate and infrastructure are outlined by GIIN and Cambridge Associates.[104] Ethical Corporation's 6th Responsible Business Summit "Growing Green Finance" asked "Can we raise the trillions needed for the transition?".[105] Clearly, this is possible as investments are shifted from 19th and 20th century forms of production and redeployed in opportunities available in more efficient, sustainable green companies and infrastructure.

[101] Sustainable Brands, "New Metrics: Evolution of Disclosure, CEO Engagement, Measuring What Matters", New Metrics conference, Philadelphia, November 14, 2017.

[102] Makower, J. and Mattison, R. 2018 State of Green Business, Green Biz Group, Trucost, S&P Dow Indices, 20188.

[103] European Sustainable Investment Policy, RI Webinars, UNEP Finance, February 14, 2018.

[104] The Financial Performance of Real Assets Impact Investments, GIIN and Cambridge Associates, 2017.

[105] Ethical Corporation Business Summit, New York, March 26-27, 2018.

The Center for Sustainability and Excellence (a partner with Ethical Markets) published their Sustainability Reporting Trends in North America, 2017.[106] In spite of all this attention and activity on reforming financial models to steer economies toward sustainable, green circular transitions, blind spots still exist. For example, our Green Transition Scoreboard® 2014 "Plenty of Water" focused on the looming shortages of fresh water and its limitation on current agriculture---exacerbated by desertification, floods and heatwaves due to climate change. We questioned the exclusive focus on fresh water investments in better irrigation, desalination, sewage systems, pollution control, recycling and reuse, as well as on its use in agriculture and raising food production for an expected 9 billion population. A step beyond these approaches is the Climate Bonds Initiative and the Water Consortium which released new standards for use of the proceeds of its popular green bonds we covered in Green Transition Scoreboard® "Green Bonds Growing Green Infrastructure", (2012) , which now focus on "Nature-Based and Hybrid Water Infrastructure".[107] This involves a paradigm shift toward human technologies mimicking Nature, see Fig.16 and in our Principles of Ethical Biomimicry Finance ®

FIGURE: 16

[106] Center for Sustainability and Excellence, www.cse-net.org, 2017.

[107] Climate Bonds Initiative, "Water Criteria Phase 2", Media Release, October 19, 2017.

SHIFT TO PLANT PROTEINS AND HALOPHYTE FOODS

FIGURE: 17 UN

FIGURE 18 QUINOA

We pointed out that the excessive focus on the planet's 3% of fresh water and current agriculture's focus on plants for human food, animal feed and fiber that require fresh water (glycophytes) continues to ignore the 97% of our planet's water that is saline, as well as the other half of the planet's plant kingdom (halophytes) that thrive on salt water, such as the celebrated Andean native food: quinoa. In addition we pointed to the 40% of scrub and desert lands on which these salt-loving plants could grow---irrigated by salt water, using our abundant daily solar energy for growth. A comprehensive paper summarizes "The development of halophyte-based agriculture: past and present".[108] We have also stressed that shifting to saltwater agriculture, using all the thousands of species available, could support better human mineral nutrition, since these salt-loving halophyte plants contain important minerals now missing from fresh-water grown food crops in soils that are now depleted.[109] NASA Chief Scientist Dennis Bushnell states "We are

[108] Ventura, Y., Eshel, A., Pasternak, D., Sagi, M., "The development of halophyte-based agriculture: past and present". Annals of Botany, February 2015, 115(3):529-540.

[109] Bottemiller Evich, H. "The Great Nutrient Collapse", The Agenda 2020, POLITICO, September 13, 2017.

dealing with opportunities of enormous proportions driven by conflicts between energy, food and fresh water demands (and shortages); population growth and climate changes. The opportunity has now arrived to use what we now do not use: saltwater, wastelands, and a wholly different plant genus: halophytes",[110] see for example, Fig: 19

FIGURE: 19 SALICORNIA GREENHOUSE Courtesy Elizabeth Hodges

Moreover, our soils, aquifers and fresh water lakes are acidifying and becoming more saline, so these halophyte plants may be the best ones to thrive in such conditions.[111] NASA scientists Hendricks and Bushnell add: "The availability of freshwater, while considered a renewable resource, is rapidly reaching a peak, even while desalination is progressing (Fahey, 2009); in 40-50 years over half will be used in cities… (Gleick 2009)".[112] NASA's Bushnell adds many other needed changes beyond this shift to halophyte agriculture that are still overlooked: 1) Ocean iron dust fertilization, proven low cost carbon-sequestration or pumping CO2 into oceans where it forms a kind of cement; 2) encourage white roofs and roads to better reflect the incoming sun's rays, 3) install heat-exchangers in the Gulf Stream on the East coast of the USA, 4) Shift from lithium-ion batteries to the more efficient lithium-air batteries and use more solar-catalyzed hydrogen for storage and transport and 5) to rapidly increase the transition to renewable energy and

[110] Hendricks, R. C. and Bushnell, D. "Atmospheric and Soil Carbon and Halophytes", NASA Research Centers, Cleveland, OH and Langley, VA., ISROMAC13-2010-113, January 13, 2010.

[111] Scientific America, Gies, E. "Like Oceans, Freshwater is Also Acidifying", January 11,2018.

[112] Hendricks, R and Bushnell, D., Op. Cit.

materials.[113] The focus on better batteries for electric vehicles (EV's) should be matched by more EV charging stations to reduce "range anxiety". Such EV chargers should be free-standing, movable and powered by solar panels, thus using clean, rather than fossil electricity. Such solar EV chargers for example, see Fig.20, require no digging or permitting and can be installed in a regular parking space in minutes.

FIGURE: 20 ©Envision Solar International

Many geo-engineering proposals, such as spraying reflective particles or sulphur dioxide into the plant's stratosphere are seen by many as dangerous with unknown effects in agriculture.[114] Other geo-engineering schemes are even more risky, using bioenergy, i.e. growing crops like maize for fuel and storing the CO2 underground (BECCS)---which ignores the need for growing more human food![115] Indeed, this BECCS approach would worsen the critical degradation of land already threatening the wellbeing of 3.2 billion people reported by IPBES.[116] Nevertheless, the new challenges of climate change are also unleashing a torrent of more viable processes, plans, technologies and new company startups. The BIO-Based World Quarterly tracks many of these innovations pioneering the efficiencies of circular economies, many following the models of visionary architect William McDonough and his Cradle 2 Cradle model of upcycling all materials into new production, such as by ECOR on which

[113] Bushnell, D. personal communication with author, November 24, 2017.

[114] Science Daily, "Climate engineering, once started, would have sever impacts if stopped.", January 22, 2018.

[115] New Scientist, Earth at Risk, Olive Heffernan, February 10, 2018.

[116] IPBES, op.cit.

McDonough and I serve as technical advisors. ecorglobal.com. Geneticists are currently focusing on cross-breeding salt-tolerance into current crop plants such as beets and spinach[117].

FIGURE: 21 SALICORNIA FIELDS, ERITREA, AFRICA Courtesy Elizabeth Hodges

We now turn to the increasing evidence of a transition beyond efforts to breed salt-tolerance into fresh water-dependent glycophyte plants for human food needs, is vital. The shift is practical for employing already salt-loving plants in halophyte agriculture on our planet's 40% of deserts and degraded land irrigated with salt water,see Fig.21. This global transition may now be inevitable. This paradigm shift will disrupt not only the massive investments in the incumbent agro-chemical industrial complex, but also those in academia, scientific research and the many agencies up to now focused on traditional food, water, health and nutritional approaches. The most effective conceptual breakthrough was the UN's "2013 International Year of Quinoa", Fig. 17,celebrating salt-loving plant containing all the amino acids required for optimal human nutritional sufficiency. Quinoa delivers nutrition beyond the animal kingdom products of today and their negative effects on human health and the environment.[118]

In 2012, our TV show "Investing in Desert Greening" discussed investing in halophyte agriculture with NASA's Dennis Bushnell and Dr. Carl Hodges, Co-Founder of the Seawater Works, and his many practical

[117] New Scientist, "Breeding salt-tolerant plants", October 10, 2017.

[118] AlterNet, " You Will Probably Be Surprised After Calculating the Impact of Your Meat Consumption on The Environment and Yourself", Robin Scher, February 14, 2018.

halophyte projects.[119] In 2014 I predicted in Green Money Journal, that "Desert Greening: The Next Big Thing", would be led by green investors. I'm still waiting for this investment shift from humanity's single minded focus on traditional agricultural crops (glycophytes) relying on the planet's 3% of fresh water. [120] Little shift has been made so far to more sustainable, nutrient-richer, salt loving (halophyte) plant foods, such as quinoa, salicornia, and so many other plants pictured in this report, hundreds of which are described and listed by a group of experts.[121] See ,for example Fig.22 showing halophyte fields in Mexico. Quinoa, the grain-like seed is native to the high Altiplano region in Bolivia and Peru, providing complete nutrition and cultivated by indigenous Aymara peoples for over 3,000 years.[122]

FIGURE 22 BAHIA KINO, SONORA, HALOPHYTE CROPS Courtesy Elizabeth Hodges

[119] See for example the Saltwater Works visionary proposal to restore California's Salton Sea, www.saltwaterworks.com.

[120] Green Money Journal, "Global Transition to Halophyte Agriculture may be Inevitable." Henderson, Hazel, March, 2018.

[121] Panta, S., Flowers, T., Lane, P., Doyle, R., Haros, G., Shabala, S., "Halophyte Agriculture: Success Stories", Elsevier, Science Direct, Vol. 107, November 2014 pgs.71-53.

[122] U. N. General Assembly, Secretary General's remarks at Launch of International Year of Quinoa, February 20, 2013.

Now a costly darling of health food stores, quinoa is hailed as a superfood by Bolivia's President Evo Morales at the Press Conference for the UN's 2013 "International Year of Quinoa". Quinoa is also well-guarded in Bolivia as a national resource since 2009.[123] This has caused international debate on the availability of quinoa for better nutrition in deprived communities and regions.[124] See Fig.23. Vested interests in the vast, incumbent global agro-chemical industrial complex, based on that 3% of dwindling water and glycophyte plants, will still try to prevent such a shift, to quinoa, salicornia and all these halophytes for food, fibers and fuels. See Fig.24. The incumbent industries are as powerful and persistent as those companies in the worldwide fossilized sectors. Corporations, Cargill, ConAgra dominate, along with agro-chemical giants Monsanto, Syngenta, Bayer, BASF, and DowDuPont, selling fertilizers, herbicides, insecticides, fungicides and genetically-modified seeds, as well as those selling farm machinery, Deere, Caterpillar, Yamaha and their thousands of dealers around the world.

FIGURE 23 TASTY QUINOA DISH

Some 60 investors have backed an engagement project to push global food companies to use more non-meat-based proteins, coordinated by FAIRR (Farm Animal Investment Risk and Return), the expected pushback will be global in spite of FAIRR's "Plant-Based Profits" reporting that the alternative proteins market is expected to grow over 8% a year and reach $5.2 billion by 2020.[125]

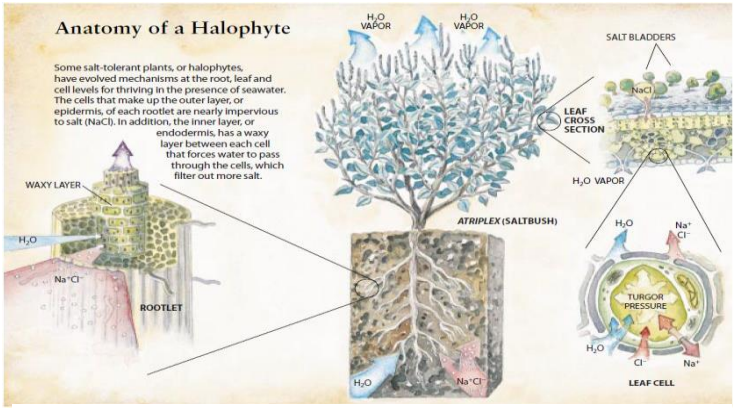


FIGURE 24 ©Scientific American

Industrial agriculture's global scale requires monoculture of a small group of glycophyte food

[123] UN Press Conference, February 20, 2013. www.un.gov.

[124] Hamilton, L., "The Quinoa Quarrel: Who owns the world's greatest superfood?", Food & Environment Reporting, October 14, 2014.

[125] FAIRR, "Plant-Based Profits", www.fairr.org, Mar. 23, 2018.

crops as tradable commodities: corn, wheat, rice, and soybeans, along with cotton and others for fiber, fuel and animal feed. These narrow glycophyte monocultures need ever more freshwater, risk susceptibility to blight, deplete soils while producing high-calorie, low-nutrient diets---exacerbating Type 2 diabetes, heart disease and obesity, as described by endocrinologist Robert H. Lustig in "The Hacking of The American Mind" (2017). This global glycophyte-based agro-chemical industrial complex is reinforced by the vast marketing, branding and advertising sector which influences content of media and consumer choices. Another challenge has emerged to the global industrial food and agriculture system, with start-ups including IndigoAg,Inc.; Ginko Bioworks,Inc., which hope to genetically-engineer bacteria to help plants become more drought-resistant and require less pesticides and fertilizers.[126] The FAIRR investment group founded by private equity investor Jeremy Coller includes Dutch and Swedish pension funds, insurance companies, now exceeds $2.4 trillion.[127] Today's group, such as FAIRR, question whether meat should be taxed and treated like sugar, tobacco or carbon emissions.[128] Rising food activism drives the growing organic market, vegetarian and vegan choices, alternative proteins, vertical urban crops, seaweeds, fresh local growers and farmers' markets.

Researchers continue to examine alternative, healthier human foods, including the sea vegetables, kelp and other seaweeds used widely in Japan, China and other Asian countries, along with traditional uses of many other halophyte crops. Algae, also grown on brackish and saltwater, is a nutritious food as well as a renewable source of fuel, showcased at the April 2018 Algae Industry Conference in Vienna. Markets for algae products are expected to reach $44.7 billion by 2023.[129] Seaweeds are widely used for carrageenan as a stabilizer in many food products, while other researchers see its potential in energy-storage and batteries.[130] Plant biologist Eduardo Blumwald has hybridized rice to grow in salty, brackish water, which is the basis of the rice marketed by Arcadia Biosciences in Seattle.[131]

Other scientists are engineering crops to conserve water and resist drought, part of a Gates Foundation project "Realizing Increased Photosynthetic Efficiency" (RIPE)[132]. Scientists at the University of Alicante, Spain, have designed a system to desalinate and treat water---powered by solar energy for use in rural, off-grid areas.[133] Another approach, from the Salk Institute is Dr. Joanne Chory's $3 million project to utilize the chemical, suberin, found in cork trees which can be hybridized into other plants' roots to enable

[126] Bloomberg BusinessWeek "Less Pesticide, More Bacteria (That's a Good Thing)", April 23, 2018.

[127] IPE, ibid

[128] FAIRR. "The Livestock Levy", Policy White Paper, 2018.

[129] ACI Europe, Ltd., "8th European Algae Industry Summit, April 25-26, 2018, Vienna, Austria.

[130] Science Daily, "Seaweed derivative could be what lithium-sulfur batteries need", June 13, 2017.

[131] Scientific America, "Saltwater Solution", Mark Harris, July 2016.

[132] Science Daily, "Scientists engineer crops to conserve water, resist drought.", March 6, 2018.

[133] Science Daily, "Stand-alone system to produce drinking water by means of solar energy.", February 9, 2018.

them to sequester 20 times more CO2.[134] Yet, disrupting the glycophyte-based agro-industrial complex with a global shift to halophyte foods is still proving as difficult as dislodging the global fossil industrial sectors. Even as CO2 emissions from this incumbent agro-industrial complex now exceed those from fossil-fueled transportation, efforts in the successive United Nations (UN) COP climate summits of the past decades have failed to halt or reverse these trends. More rural areas in African countries are leapfrogging old technologies and adopting the cheaper solar power offered by M-KOPA Solar; based in Kenya --- avoiding the health hazard of kerosene lamps, along with stoves.[135] Fig:25

FIGURE 25 LOCAL OFF-GRID SOLAR, AFRICA

DIRECT CAPTURE OF CO2 FROM THE ATMOSPHERE

The Economist reports[136] that over 100 of the UNPCC's climate models assume that as much as 800 billion tons of CO2 must be extracted directly from the air and sequestered or re-used to keep global warming below 2° Celsius. So far, this direct carbon capturing and sequestering (CCS) is hardly happening at scale anywhere, while "clean coal" capturing of CO2 at power plants was found too expensive and reduces their efficiency by as much as 40%. New Scientist reports on new methods for capturing CO2 and a group of promising startups: including Carbon8 Aggregates creating a building material from waste and contaminated soils; CCm Research which enriches fertilizers with CO2 and coats fibers incorporated in plastics (both in the UK). Covestro is making polyurethane plastics from CO2 and Sunfire, which created a fuel called Blue Crude, both companies are based in Germany. CarbonCure makes CO2 into concrete,

[134] NextBigFuture.com, Wang, B., December 5, 2017, from www.newparadigmdigest.com.

[135] New Scientist, "Catch the Sun", LePage, M., December 23, 2017.

[136] The Economist, November 2017.

based in Canada; US-based Oberon Fuels makes dimethyl ether, a synthetic diesel.[137] California based Solidia Technologies makes concrete from CO2.[138] Global Thermostat also based in the US, is geared to capture CO2 from the air and sell it to users for manufacturing, making cement and also to greenhouses to accelerate plant growth.[139] Economist, Graciela Chichilnisky, co-founder of Global Thermostat was a lead architect of the Kyoto Protocol carbon market and describes the science and methods of direct CO2 capture in carbon-negative power plants.[140] Swedish-based Skymining plans to capture CO2 for making fuel. The KTH Royal Institute of Technology has successfully tested a new material that can be used for cheap, large-scale production of hydrogen from water.[141] The University of Southern California has found a new catalyst that more efficiently converts methane to olefins for manufacturing plastics and pharmaceuticals.[142] The California Institute of Technology chemists have devised a new way of converting CO2 into carbon-based fuels---a step toward making renewable liquid fuels not derived from coal or oil.[143] Chemists in Spain's Instituto de Tecnologia Quimica e Biologica (ITQB) have developed a catalyst to reduce CO2 to carbon monoxide, to develop useful chemicals.[144] The 10th Carbon Dioxide Utilization Summit covered many new methods and companies using CO2 for a range of applications.[145] Scientists from the University of York in Britain re-cycled scrap metal and seawater from the North Sea to create a technology capable of capturing 850 million tons of CO2. This CO2 reacts with the metals to create dawsonite, a solid mineral naturally found in the Earth's crust.[146] Ecological model's now show that 20% more trees in megacities would mean cleaner air and water, with lower carbon and energy use.[147] These projects are far better than the risky geoengineering proposals mentioned, to block sunlight by seeding the Earth's stratosphere with various particles and could have disastrous effects, including on agriculture. One experiment in Switzerland is to try to conserve winter ice and glaciers by wrapping them in white blankets. This does conserve ice---

[137] New Scientist, "From Pollution to Solution", Marshall, M., March 17, 2018.

[138] CSR Wire News, "Solidia Technologies Can Reduce the Carbon Footprint of Cement and Concrete in California by 7.4 million Metric Tons", Media Release, March 27, 2018.

[139] The Economist, November 2017, ibid

[140] Chichilnisky, G., "Carbon Negative Power Plants", May 2011. www.globalthermostat.com She is also on Ethical Markets Global Advisory Board.

[141] Science Daily, "Hydrogen extraction breakthrough could be game-changer", Mach. 5, 2018.

[142] Science Daily, "Reducing the footprint of a greenhouse gas more potent than carbon dioxide", February 5, 2018.

[143] Science Daily, "Carbon Conversion", August 4, 2018.

[144] Science Daily, "Chemistry for a sustainable planet", March 6 2018.

[145] 10th Carbon Dioxide Utilization Summit, Tampa, FL., February 28-March 1, 2018.

[146] Technology.Org, "Sea water, some used kitchen foil and solar power-how that will solve climate Change". December 24, 2017.

[147] Science Daily, "20 percent more trees", January 18, 2018.

reducing melting by as much as 70%. However, large-scale refreezing of Arctic ice may not be feasible.[148] An even more daring approach to the persisting problem of storing and isolating spent nuclear fuel is that of a California-based start-up, Deep Isolation, by two nuclear scientists. They hope to address the 80,000 tons of nuclear waste in the USA stored in 70 above ground pools adjacent to nuclear power plants. The energy companies' $40 billion and US taxpayers' additional billions poured into the Yucca Mountain repository are now wasted, since the US total of nuclear residue is already too large for Yucca to hold. Deep Isolation proposes storing the drums of nuclear waste in the horizontal tunnels drilled by shale-fracking companies--- and utilizing those mined out and emptied of their gas deposits.[149]

NATURE'S WAY OF CAPTURING CO2

FIGURE 26

The best hope for direct capturing of CO2 rests on reforming agricultural and forestry methods---Nature's way of sequestering CO2 in growing global biomass. Monitoring the planet's remaining ecosystems and forests is essential, as well as reforesting efforts through UN programs and private conservation efforts ,see Fig. 26. The UN's Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is a global multi-stakeholder, science-based program for this essential monitoring of the global biomass on which all human life depends.[150] Many global volunteer projects led the protection and restoration of planetary biomass in the 1970s and 1980s including India's original tree-hugging women encouraged by physicist Vandana Shiva, as well as Kenya's Professor Wangari Maathai, who launched the original tree-planting movement, which has spread worldwide. I interviewed Prof. Maathai in Nairobi in 1981 where she pointed out all the vital reasons for maintaining and restoring the planet's forests. She won the Nobel Prize for her leadership in 2004. The Barilla Center for Food and Nutrition publishes The Food Sustainability Index and co-sponsors

[148] Renewable Energy, "Can we refreeze the Arctic? Chelsea Harvey, Climatewire, March 6, 2018.

[149] Bloomberg Business Week, "Keep Digging", March 26, 2018.

[150] Earth Negotiation Bulletin, IPBES-6 Meeting, Medellin, Columbia, Vol. 31, Number 35, March 17, 2018.

a prize with Reuters and a program with the Economist Intelligence Unit.[151] The University of Michigan research on restoring US forests and top soils could sequester 1.3 to 2.1 billion metric tons of carbon---offsetting about 10% of US greenhouse gas emissions.[152] Shifting toward halophyte agriculture provides the largest unexploited way of sequestering CO2, using scrublands now not in use for human food production. Some of the 800 million hectares of wastelands are suitable for halophytes---possibly sequestering 1.6 gigatons of CO2 annually.[153] In 1992 , scientists Edward P. Glenn, Carl N. Hodges, Helmut Lieth, Roger Pielke and Louis Pitelka published a report "Growing Halophytes to Remove Carbon from the Atmosphere "as one of the few available options.[154] Pioneer researchers Hugo and Elizabeth Boyko demonstrated in the 1960's that crops could be cultivated using full-strength seawater, paving the way for later researchers who found that 78 plant species would grow on 100% seawater.[155]

In Shandong Province, China, rice is grown at commercial scale on salty beaches on the Yellow Sea Coast at Qingdao by Yuan Ce Biological Technology and its chief scientist Yuan Longping, who hybridized this salt-tolerant rice. Output of the rice in Qingdao exceeded 4.5 tons per hectare and sells at a premium due to its pleasant taste.[156] Fig. 27. A study from the University of Wisconsin-Madison finds that green spaces and trees in cities also helps store carbon.[157] In Australia, University of Adelaide scientists identified a gene in grapevines that can be used to breed salt-tolerant grapevines.[158] Michigan Technological University researchers contend that tobacco farmers could increase their profits by converting their land to electricity from solar farms.[159] In addition, tobacco leaves could be re-

FIGURE: 27

[151] The Economist, December 23, 2017. www.foodsustainability.eiu.com.

[152] Proceedings of the National Academy of Sciences, USA, February 26, 2018.

[153] Bushnell, Dennis: personal communication with author, November 24, 2017.

[154] Environment, "Growing Halophytes to Remove Carbon from the Atmosphere, Vol 34, Number 3, April, 1992.

[155] Annals of Botany. Op.cit

[156] Next Big Future, "Saltwater resistant rice can boost harvest by nearly 20 percent", Brian Wang., October 15, 2017.

[157] Science Daily, "Green spaces in cities help control floods, store carbon.", March 6, 2018.

[158] Science Daily, "New discovery to accelerate development of salt-tolerant grapevines", November 23, 2017.

[159] Science Daily, "Farm sunshine not cancer: Replacing tobacco fields with solar arrays", February 5, 2018.

purposed as high-protein food crops, as I proposed as a member of the Technology Assessment Advisory Council,. U.S. Congress Office of Technology Assessment, in the late 1970's. Even US Energy Secretary, Rick Perry is now backing a competition for innovation in critical water issues.[160] A review "Water Investing in 2018" highlights the dilemmas of private water investing in the planet's 3% of fresh water.[161] The University of California-Riverside has conducted taste tests on tap water vis-à-vis safely recycled sewage water and bottled water---finding equal acceptance of all.[162] The well know fertilizer Milorganite is one of the oldest forms of recycled sewage, from the City of Milwaukee. At the University of Calgary, Canada, scientist Mayi Arcellana-Panlilio genetically engineered e-coli bacteria to convert human feces into a type of plastic.

Meanwhile the green revolt against industrial foods is growing. A new study of diets of 34,000 people shows significant benefits of diets high in organically-grown fruits and vegetables improve the environment as well.[163] Since 2009 such critiques and activists led by food critics and scientist Marion Nestle at the New York University[164], helped cause some $18 billion loss of market share by the top 25 US food and beverage companies.[165] Start-up firms, including Terraformers founded by former NASA scientist, Ezinne Uzo-Okoro, empower home growers, while they and small scale farms can apply for financing from groups including Investors Circle, Slow Money[166] and many others. Founder Antoine Hubert of Ynsect produces mealworms for restaurants in Dole, France.[167] Bill Gates, Richard Branson and Leonardo DiCaprio are all backing various alternatives to meat.[168] Silicon Valley's animal-free food start-ups, including Beyond Meat, Memphis Meat, Impossible Foods, Finless Foods, MosaMeat, Clara Foods and Perfect Day are testing or producing substitutes for beef, chicken, fish and milk, based on plants, bio-chemical engineering,

[160] US Department of Energy, March13, 2018.

[161] Cornerstone Capital Investment Advisory, March 22, 2018.

[162] Science Daily, "Toilet-to-tap: Gross to think about, but how does it taste?", March 13, 2018.

[163] Frontiers in Nutrition, and Science Daily, "Organic Food Provides Significant Environmental Benefit's" February 9, 2018.

[164] New Scientist, "Food Fighter" (profile of Marion Nestle) by Catherine de Lange, February 3, 2018

[165] Fortune "The War on Big Food, June 2015.

[166] Slow Money Journal, Winter 2016/2017.

[167] Fortune "A Very Grubby Business", April, 2018.

[168] Real Leaders, Thomson Reuters Foundation, "Beyond Meat: The Race to Reinvent The Burger" Mannio, L., March 21, 2018.

fermentation, insects and growing meat cells in petri dishes.[169] All this may disrupt the $200 billion annual sales of meat in the USA. The meat producing livestock industry overuses antibiotics, is a major global polluter and CO2 emitter while hogging millions of gallons of water and acres of land. Cows require 26 pounds of feed for every pound of edible beef, as pointed out by Frances Moore Lappe in "Diet for A Small Planet",[170] see Fig: 28.

FIGURE: 28 TASTY VEGE BURGER

Meanwhile water scarcity is reaching crises points. Cape Town, South Africa, rations water to forestall its running out in August, 2018. By 2025, nearly 3.4 billion people will be living in water-scarce areas including India, where monsoon rains are less reliable due to climate change.[171] The billions of mis-targeted over-investments in the planet's 3% of freshwater cannot prevent dwindling due to melting glaciers and rising use by growing populations. These conventional investments are often in Western industrial countries in sewage and polluted water treatment facilities, desalination, cleaning up and recycling water, irrigation, pipes, and sanitation. Schemes to privatize water and ration it by price are the methods promoted by business and economists.[172] An exception is the creative group of companies and NGOs focused in India, conducted by the Toilet Board Coalition. www.toiletboard.org The most water-scarce area on Earth is the Middle East and North Africa (MENA) a focus of World Water Day, March 22, 2018.[173] Shifting to renewable energy saves millions of gallons of water used to cool fossil-fired and nuclear power plants. China, while facing water-scarcity, hopes to secure its increasingly meat-protein-rich food supplies by its recent acquisition of Syngenta by ChinaChem for $43 billion, so as to raise yields through research and genetic engineering---in spite of Chinese consumers' fear of Western GMO seeds and foods.[174] The Food and Agricultural Organization (FAO) reminds us that 95% of food consumed worldwide comes from the soils, 33% of which are degraded globally. Some 68% of the soil in South America is affected by erosion,

[169] Fortune, December 15, 2017.

[170] Lappe, F. M., "Diet for a Small Planet", Ballantine Books, 1971.

[171] Inter Press Service, "Water Scarcity: India's Silent Crisis", Neeta Lai, March, 2018.

[172] UTNE, "The Dangerous Return of Water Privatization." Sojourners, Maude Barlow and Wenonah Hauter, January-February, 2014.

[173] Inter Press Service, "Water Stress Poses Greatest Threat to MENA Region", Sopho Kharazi, March 15, 2018.

[174] Fortune.com, May 1, 2017.

as 100 million hectares of land have been degraded by deforestation and 70 million hectares have been over-grazed.[175] A 10 year effort to increase yields of maize, rice and wheat by China's 21 million small farms, raised them by more than 10% while cutting fertilizer use between 15-18% and saved $12.2 billion.[176] "Eating As If The Planet Mattered "is the campaign of the NGO Foodtank with advice on steps consumers can take to diets' impact plant species. www.foodtank.com

In addition, crop breeders are racing to find wild relatives of dominant food crops, as well as similar efforts by the US Department of Agriculture (USDA), since all our familiar foods: corn, wheat, soy, rice, pumpkins, tomatoes and apples were once wild. Desertification-reversal efforts include Allan Savory's Holistic Management restoring land by rotating flocks of cattle on some 40 million acres in many countries.[177] Plans for planting trees are envisioned in a Great Green Wall across the African continent to hold back the advancing Sahara Desert.[178] Robots like LettuceBot use AI and machine learning to train huge machines to weed crops on large farms, produced by Blue River, now being acquired by Deere & Co for $305 million.[179] Big data-collecting firms are offering farmers data on prices of seeds, chemicals and crop yields on Amazon's cloud-computing platform, although many farmers are suspicious on how this data will be monetized.[180] A similar algorithm developed by the University of Illinois College of Engineering applies big data to help small farmers schedule hand-picking of food crops---but requiring each picker to carry a smart phone and become tracked on GPS.[181] I criticized these kind of algorithms in "AI + Algorithms = Assumptions" (2017) and "The Idiocy of

FIGURE 29 NEW SCIENTIST BY TOM GAULD

[175] Inter Press Service, "Soil Degradation Threatens Nutrition in Latin America.", Orlando Milesi and Marianela Jarroud, June 16, 2016.

[176] Science Daily, "Agricultural sustainability project reached 20.9 million smallholder farmers across China, March 9, 2018.

[177] Sierra Magazine, March-April 2017.

[178] New Scientist, September 10, 2016.

[179] Bloomberg BW, January 15, 2018.

[180] Fortune, September 1, 2016.

[181] Science Daily: "Algorithm could streamline harvesting of hand-picked crops.", March 13, 2018.

Things" (2017) on our "Latest Headlines". New Scientist also ridicules many of these internet-connected devices, such as the "killer kettle", which can be turned on remotely even when empty --- creating a fire risk, and "smart light bulbs" which can also leak user's passwords.[182] See for example, Fig.29.

Biotech companies promise factory-scale use of microbes for growing food, including from algae. Natural gas can be turned by methane-consuming microbes into high-protein animal feed.[183] Algae grown on salt water in Masdar, United Arab Emirates (UAE) in a project with Boeing, we reported in GTS 2014 yielded aviation fuel more efficient and carbon-neutral than current petroleum distillates.[184] In the "Biomimicry Solutions Carbon Report", Janine Benyus outlines nine initiatives, including Air Carbon which creates plastic from captured methane; perennial Kemza wheat and Zelfo Technology. Circular economy global recycler ECOR upcycles waste into a range of sustainable materials.[185] Ash scooped up from Mount St. Helens in the USA is used to create the new cultured gemstone, helenite.[186] Fig.30. Ethical Markets global standard EthicMark®GEMS only certifies gems not mined from the Earth, since such gem-mining is now obsolete, as well as hazardous to humans and ecosystems and dominated by a global cartel.[187] The disruptive global laboratories worldwide now transform carbon into cultured diamonds, rubies, sapphires and emeralds, indistinguishable from those mined, and are challenging the global gem-mining cartel.[188]

FIGURE 30: HELENITE ©Stauer

[182] New Scientist, "Fix the Holes", Marks, P., March 24, 2018.

[183] New Scientist, November 19, 2016.

[184] Green Transition Scoreboard® 2014.

[185] Full Disclosure: Henderson is technical advisor to ECOR.

[186] See for example, by Stauer jeweler, www.stauer.com.

[187] BDI Newsletter, "Diamond cartel is still alive, coercing the industry and robbing consumers of choices", March, 2018, www.betterdiamondinitiative.org.

[188] Henderson, H., "Beyond Bloodstained Gems: Now Science and Standards", Just Means, 2015 www.ethicmarkgems.com.

All this enormous global investment and R&D to increase human food production, restore its nutritional content while saving fresh water and restoring the planet's 3.9 billion acres of arable land is still blind to the overall shift we also advocate: to halophyte foods and agriculture, fuels from saltwater-grown algae, as well as many fiber and feed crops. Like their obsolete view of fossilized sectors, mainstream finance cannot yet see the risks of stranded assets and mal-investments in this bloated unsustainable global agro-chemical industrial complex. A report by the Climate Disclosure Standards Board (CDSB) underlines these paradigm problems in mainstream finance, showing that there is a gap between the way companies identify climate-related risks and opportunities and how they are preparing to tackle them.[189] Even most trustees, asset managers and consultants who are signatories to the UN Principles of Responsible Investing (UNPRI.org) comprising global pension funds with assets under management of $70 trillion, have not yet examined the opportunities in the shift to halophyte agriculture, direct CO2 captive and plant-based protein diets for their beneficiaries---even though they can invest for the long-term.[190] A Water Security Forum in Scotland, May 24-27, 2018 is convening global experts and may address the need to shift to saltwater agriculture.

Asset allocators steering pension funds, endowments and sovereign wealth funds, as well as consultants, advisors and brokers often still warn investors that these new green investments are "too risky". This overlook and underestimates the risks already lurking their clients' portfolios and 401Ks. As I described in Green Transition Scoreboard® 2014, we humans are still overlooking those four globally-abundant resources for augmenting our food sources more sustainably: the 10,000 varieties of halophyte plants, many already hybridized into replacements for corn, wheat, soy, rice and other vegetable crops we have illustrated in this report; the 97% of water on this planet that is saline; the 40% of scrub and desert lands and all those daily free photons we can harvest from our Sun. (see "Investing In Desert Greening" TV show). Behavioral scientist Daniel Kahneman in Thinking Fast and Slow (2013), calls this cognitive problem, "theory-induced blindness ". Combined with other cognitive biases, including the well-known "herd behavior" in markets, they have contributed over time to the mis-allocation of our agricultural investments, along with media and vested incumbent industries steering research and advertising favorable to retaining control of this crucial global sector.

Yet, today, the new climate crises evident in recent increasingly powerful hurricanes, costly floods, fires and droughts, are signaling that a transition of our food supply from total reliance on glycophytes to incorporating halophytes is ever more urgent. This shift also seems essential if we are to capture enough

[189] Climate Disclosure Standards Board, "Ready or not: are companies prepared for the TCFD recommendations?", March 20, 2018.

[190] UN Principles of Responsible Investing (PRI), www.unpri.org, full disclosure: Ethical Markets is a Service provider signatory.

of the CO2 emissions already in our atmosphere to keep below the 1.5° centigrade temperature rise target in the Paris accords. Even continuing scaling up many of the new promising technologies and companies we cite in this report while necessary, will be insufficient. We can no longer rely exclusively on today's accelerating and robust transition to green renewable energy we have tracked in our Green Transition Scoreboard® since 2009---promising as it is for future generations. We have measured this green transition on its own merits in delivering healthier, sustainable circular economies fundamentally essential for our common future. Continued misuse of our life-supporting Earth is no longer sustainable and further depletion of our forests, lands and soils not only threatens 3.2 billion people cited by IPBES, but may turn these ecosystems from carbon sinks into CO2 sources.[191] Startups in direct capture and use of CO2 are welcome in such events as the 10th CO2 Utilization Conference, we mentioned, in Tampa, FL. in 2018. In addition, Nature's capture of CO2 in growing plants can be significantly increased by expanding use of halophyte foods, already growing and available in 22 countries around the world.[192] Furthermore, as we emphasize, while legacy food crops lack necessary nutritional value due to depleted, over-used soils, halophyte foods crops contain exactly the mineral nutrition vital to human health! Why are we still waiting for this healthier greener food transition?

We are encouraged by all the conferences and projects around the world engendered by the SDGs. These are tracked by the SDG Update, regularly by the SDG Knowledge Hub of IISD at www.sdgs-iisd.org . The Asia-Pacific region Forum on Sustainable Development, March 2018 in Bangkok and the 3R Forum in India, April 2018, covered the transformation to circular economies recycling and re-using all components. Our Green Transition Scoreboard's final total in 2020---beyond the $9.3 trillion tracked to date in this 2018 report, will be an indication that human knowledge has expanded. We will be entering into the Solar Age—our next evolutionary stage of development on our home planet Earth.

[191] Science Daily, 2017.

[192] Dennis Bushnell, NASA 2017.

SECTORS COVERED

The Green Transition Scoreboard® (GTS) tracks private investments growing the green economy worldwide since 2007, totaling in Q4 of 2018 **$9,371,882,308,406.90**. The Green Transition Scoreboard® tracks five sectors: Renewable Energy, Energy Efficiency, Life Systems, Green Construction and Corporate Green R&D.

Governments and investors at all levels are turning their focus to growing greener economies as evidenced by the explosive increase in green bonds worldwide reported in August 2014's GTS report, "Green Bonds Growing Green Infrastructure." At the institutional investment level we have long recommended investing at least 10% of institutional portfolios directly in companies driving the global Green Transition, thus updating strategic asset allocation models – both as opportunities and as risk mitigation. Examples seen in 2015 include Norway which holds the world's largest sovereign wealth fund and CalPERS and CalSTRS, two of the world's largest pension funds held in California.[193] Direct investing bypassing public stock markets is the choice of many high net-worth individuals and family offices with over $4 trillion

Sector	Amount US $
Renewable Energy	$3,864,203,673,121
Energy Efficiency	$2,038,487,667,163
Life Systems	$1,891,555,846,366
Green Construction	$1,072,360,379,757
Corporate Green R&D	$505,274,742,000
Grand Total	**$9,371,882,308,407**

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

such assets in 2017.[194] Government mandated shifts from fossilized sectors happened in part from concern for the environment and in part to mitigate holding stranded assets which will increase as low-carbon regulations are implemented. In the Overview we document new startups in direct CO2 capture, using these emissions to make concrete, plastics and many new uses.[195] The European Union convened its central bankers, overseers and financial leaders in Amsterdam April 6, 2018 to develop its Green Finance policy agenda. A key debate concerned whether to encourage green investments with a "Green Supporting Factor" or instead to impose a "Brown Penalty" on high-carbon investments. The 2 Degree Investment Initiative

contributed an analysis of these two options.[196] The concept of "decarbonization" is giving way to the more realistic view of "carbon productivity", i. e. not wasting or burning carbon, but using or capturing it efficiently. The X Prize Foundation in Los Angeles is offering a $15 million prize for turning carbon dioxide emissions into useful products.[197]

This growing consensus validates models indicating that investing $1 trillion annually until 2020 can scale up and reduce costs of wind, solar and other renewables. Energy and material efficiency, green construction can increase corporate green R&D, sustainable land-use, smart infrastructure, transport and urban re-design globally. Ceres Clean Trillion campaign[198] aligns with a strategy recognized in the 2012 report by Mercer which suggests 40% of portfolios should be in Green Transition sectors.[199] While the GTS tracks highly targeted sectors within the green economy, there are more than $22.89 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.[200]

[194] Henderson, H. Presentation to the Family Office Forum, Zurich, 2017.

[195] ASD Reports, "Carbon Capture & Storage (CCS) Market Report 2018-2028, ASDR-449016, March, 2018.

[196] 2 Degree Investing Initiative "The Green Supporting Factor: Qualifying the Impact on European Banks and Green Finance", April, 2018.

[197] The Economist, "Turning Carbon into gold", April 14, 2018.

[198] Clean Trillion: Closing the Clean Energy Investment Gap. Ceres. Accessed on April 18, 2016, www.ceres.org.

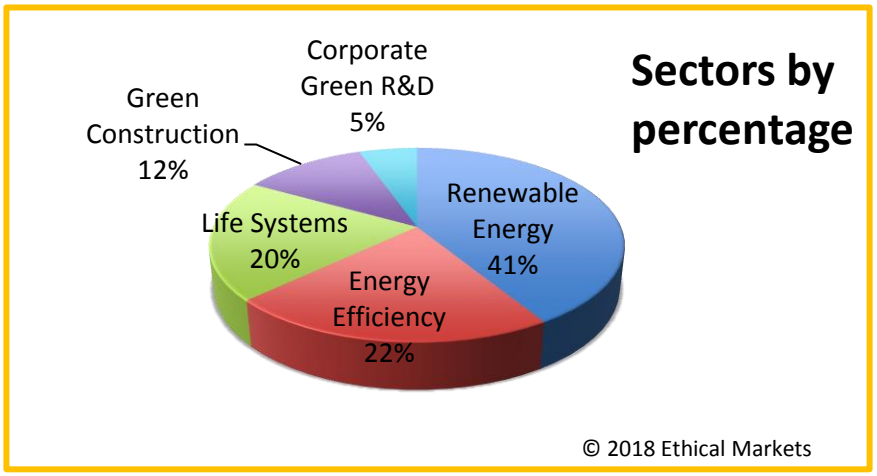
[199] "Through the Looking Glass: how investors are applying the results of the climate change scenario study". Mercer, LLC, New York, 2012.

[200] 2016 Global Sustainable Investment Review, Global Sustainable Investment Alliance, Bloomberg, March, 2017.

WHAT'S INCLUDED

Renewable Energy, Energy Efficiency, Life Systems, Green Construction and Corporate Green R&D represent broad areas of green technologies, covering substantial capital investment in technologies which Hazel Henderson's years of research as a science advisor and which the Ethical Markets Advisory Board expertise indicate are continuing to contribute to a sustainable future.

The sectors evolve as the Green Transition takes hold. GTS added the Life Systems sector in 2015. The information and digitization can best be viewed through a Life Systems lens as detailed in the 2015 GTS Report "Breakdowns Driving Breakthroughs", highlighting the interconnections between energy, water, food, education, health and quality of life. We have deepened this exploration in our 2018 GTS.



Companies, organizations and the sources of financial data are screened by social, environment and ethical auditing standards. Accounting organizations IIRC, SASB, ICAEW, Tomorrow's Company, Long Finance, CIMA Global and others are applying sustainability auditing standards making it easier to value these more comprehensive and rigorous screens. We cover the evolution of these standards in our Overview. Multi-stakeholder research produces innovative plan such as the "Deep Decarbonization in the Northeastern US and Expanded Coordination with Hydro-Québec.[201] Increasingly, we are finding companies which aspire to the even more demanding metrics of the *Principles of Ethical Biomimicry Finance*®. Data can be found in indexes such as Calvert, Domini and Pax World, the PowerShares Cleantech Portfolio, MSCI, 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, Clean Edge and many UN and other international studies, reports such as those from GIIN, SIF, Sonen Capital, Green Alpha Advisors, Zevin Asset Management, and other asset managers

[201] Evolved Energy Research, Sustainable Development Solutions Network and Hydro-**Québec**, April, 2018.

and companies listed free in our public service Ethical Money Directory, and findings from CSRHub and TBLI, as well as individual company reports.

WHAT'S OMITTED

International investments in the GTS tally are reported in US dollars, based on conversions from XE.com on April 2, 2018. Because the GTS focuses on private sector investments, government funded projects and initiatives are heavily discounted. Despite a common misperception, sustainable technologies can stand alone, without government subsidies. Fossil-fuel consumption subsidies worldwide are four times greater than subsidies to renewables.[202] Renewable energy and efficiency are competitive even in this hostile environment. The GTS purposefully discounts government investments so as to bypass the continuing political debate over the allocation of subsidies. Even limiting government funding, the GTS still exceeds $9.37 trillion, showing that green technologies are competitive in today's market and that renewables specifically are already cheaper than nuclear power,[203] Coal and oil are being superseded by natural gas, by current prices, without even including their health and other external costs.

Our definition of 'green' is quite strict, omitting clearly unsustainable sectors as well as certain technologies having unsubstantiated claims, negative EROI or unexplored or untested consequences. For example, nuclear energy is not a sustainable option when EROI from mining, construction, uranium enrichment, processing, transportation, waste disposal and decommissioning costs are taken into account. Even so, many utilities continue to refer to their nuclear-generated electricity as "clean" and "emission-free". Japan has started decommissioning its Monju fast- breeder reactor after decades costing 1 trillion yen ($9.44 billion US). Additional costs for decommissioning are estimated at another 375 billion yen.[204] 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.[205] We report in our GTS 2018 on the current status of nuclear wastes and a startup company proposing another alternative for deep storage.

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

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

[204] Nikkei Shimbun, April 6, 2018 (http://asia.nikkei.com).

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

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. We update research on these issues in the Overview.

- Most proposals for "geoengineering" are speculative with unknown consequences perhaps more dire than the problem they aim to resolve.
- Recognizing nanotechnologies' potential and obstacles, as well as problems like microbeads used in cosmetics, the European Commission is investing in research, financing of responsible innovation and upgrading of the regulatory framework to render it capable of addressing new challenges.[206]
- 3-D printing has enormous potential, however its use to manufacture destructive products such as weapons and drones and the toxicity of its many chemical components require prudent observation and inclusion only on a case by case basis.
- We review artificial intelligence issues in our Overview from biased algorithms to potential job losses.[207] These issues are covered in depth in the report "Formulas for Trouble".[208]
- The internet of things (IoT) is widely lauded for increasing efficiency but security, privacy and future repercussions are still to be seen. For example, already Aetna is using sleep monitoring to "reward" its employees.[209]
- Similarly, we exclude genetic engineering and artificial life-forms.

We omit so-called clean coal, still unproven, given coal carbon sequestration (CCS) reduces the efficiency of coal-fired plants by as much as 30%-40%.[210] Yet as we point out in our 2018 Overview, the IPCC climate scientist are assuming that CCS and direct CO2 capture of over 800 tons in their targets of below 2° Celsius of warming.[211] Despite major government subsidies, in the US there are few

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

[207] The Economist, "AI-Spy" special report, April 6, 2018.

[208] Open MIC, "Formulas for Trouble: Why Smart Companies Must Tread Carefully With Algorithms, April, 2018 www.openmic.org .

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

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

[211] The Economist, "Greenhouse Gases Must be Scrubbed From the Air", November 2017.

demonstration projects.[212] As mentioned in the 2014 GTS report, efforts to set fire to underground coal deposits to capture their methane are even more preposterous.[213] In addition, carbon dioxide 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.[214] Keeping carbon in the ground is the preferred, strategy rather than burning it, and all the innovations we described in the Overview may provide such inputs to production from renewable technologies and sources. Examples include algae for food, plastics, cosmetics and biofuels traded in the Algae Biomass Exchange, April 2018; biodegradable polymers from cassava roots and sugar cane, as well as mushroom-waste sourced butanol fuels.[215]

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. Our 2018 GTS explores more efficient saltwater-grown algae for biofuels and more use of salt-loving (halophyte) plants for human foods. The future of transport is more likely to be electrically powered as lithium-ion and lithium-air batteries and super capacitors which store electricity differently from batteries, are used in electric and hybrid cars to store braking energy. Electric vehicles are seen as the future by most auto companies, as we see in their increased R&D investments.[216] As noted in Life Systems sector, exceptions are made for biofuels from algae or halophyte plants grown on seawater.

[212] 21st Century Tech. "Can Carbon Capture and Utilization Mitigate the Impact of CO2 on Climate Change?", April 6, 2017.

[213] Pearce, Fred. “Beyond Fracking”. *NewScientist*, February 15, 2014.

[214] Brodwin, D. “A Carbon Tax Everyone Can Love”. American Sustainable Business Council, September 1, 2014.

[215] See for example: Algae Biomass Exchange, April 2018; Crystal Equity Research on Biopolymers and Science Daily on mushroom residue for butanol, April 6, 2018.

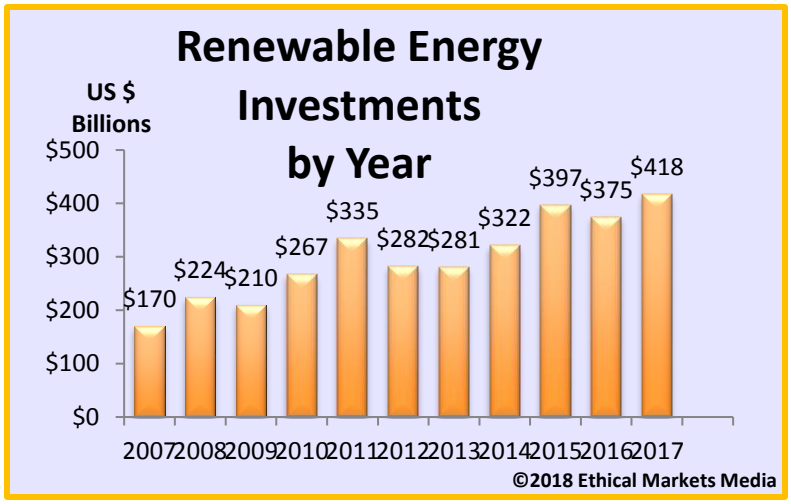
[216] “Exploring Super Capacitors to Improve Their Structure,” www.sciencedaily.com, February 18, 2013.

RENEWABLE ENERGY

RENEWABLE ENERGY	US $	
2007	$	170,200,000,000
2008	$	224,200,000,000
2009	$	209,500,000,000
2010	$	267,300,000,000
2011	$	334,700,000,000
2012	$	282,100,000,000
2013	$	281,000,000,000
2014	$	322,200,000,000
2015	$	397,000,000,000
2016	$	375,000,000,000
2017	$	417,800,000,000
Commitments	$	583,203,673,121
TOTAL	**$**	**3,864,203,673,121**

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 as well as other international studies. This is the largest sector in this report which from 2007 to 2018 reached $3.86 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 daily in our "Latest Headlines" for our 32,000 professional subscribers at www.ethicalmarkets.com and on our Green Prosperity, Energy Efficiency, GreenTech, SRI News, Trendspotting and Earth Systems Science pages. Future commitments include those from US banks such as Bank of America, Goldman Sachs, CitiGroup and Wells Fargo and include green bonds.



Renewables are challenging fossil fuels from unexpected places. Coal faces encroachment from natural gas, hydroelectric, solar PV, onshore wind, biofuels and geothermal which, together with efficiency and other renewables are exceeding forecasts by the International Energy Agency, as we report in the 2017 Overview, from REN21.[217] Massive shifts from coal to locally produced natural gas by US utilities are risky given lower oil costs and price spikes due to lack of pipelines and water shortages from fracking.[218] New geothermal technology designs address intermittency, normally managed with coal or gas, providing flexibility in delivering energy to the grid without imposing significant cost.[219] 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.[220] In our Overview we find examples of these new "virtual powerplant" in Germany and Australia. While investments slowed in 2016, this reflects lower costs,, and increases resumed in 2017.

Walmart, Procter & Gamble, Google, Facebook, General Motors, Dow Chemical, have all signed fixed-priced contracts for wind energy.[221] Existing nuclear infrastructure is losing capacity because many nuclear reactors face "economic abandonment."[222] Reactors in two major US cities, Syracuse and Boston, will close within the decade because, even with their subsidies, it costs more to operate the plants than the revenue they generate.[223]

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[217] REN21. 2017. Renewables Global Futures Report: Great debates towards 100% renewable energy. (Paris: REN 21 Secretariat). ISBN 978-3-9818107-4-5." (www.ren21.net).

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

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

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

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

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

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

Subsidies to fossil-fuel generated energy continue as an obstacle. The IMF estimates petroleum, coal and gas receives $1.9 trillion worldwide through direct subsidies, consumer rebates and avoided taxes on pollution.[224] The IMF agrees that reducing subsidies "can lead to a more efficient allocation of resources, which will help spur higher economic growth over the longer term," as per David Lipton of the IMF.[225] The tremendous waste of capital to fossil-fuel subsidies will continue until energy efficiency and exergy are included in economic models (see GTS 2014 report). Pollution taxes, including on carbon, need to take hold. External costs need to be fully reflected in financial models, corporate balance sheets and national accounts. Egypt has reduced its deficit by making deep cuts to fuel subsidies.[226] India has moved from subsidizing oil to taxing it, taking advantage of low oil prices.[227] Reducing fuel subsidies is also part of China's Greening Financial System plan.[228] China is becoming the global leader in exporting solar panels, wind generators and electric vehicles while cleaning up its cities with electrified mass transit and bicycles.[229] The final report of the UNEP Inquiry on Sustainable Finance, "Making Waves: Aligning the Financial System with Sustainable Development" was released April 20, 2018 and we highly recommend it, as we have been contributors! (www.unepinquiry.org)

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.[230] As mentioned, we include biofuels grown from algae on saltwater, as in the Boeing-Masdar project which yields better quality fuel for aircraft than petroleum distillates (see 2014 GTS report).[231]

As a rule, Corporate R&D is omitted here and reported in Corporate Green R&D to avoid double-counting.[232] Government R&D is discounted in our practice of limiting public investments as part of the tally.

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

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

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

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

[228] "China's Greening Financial System Plan, www.unepinquiry.org.

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

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

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

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

ENERGY EFFICIENCY

Investments in **Energy Efficiency** include conservation efforts and initiatives and products focused on lowering energy needs or using less energy than a comparable product, reaching $1.7 trillion.

Year	Amount US $
2007	$ 85,994,451,247
2008	$ 94,107,749,303
2009	$ 103,011,531,368
2010	$ 112,784,229,050
2011	$ 148,667,945,000
2012	$ 228,240,600,000
2013	$ 233,883,200,000
2014	$ 228,299,000,000
2015	$ 185,107,450,000
2016	$ 201,176,104,750
Commitments	$ 152,372,090,559
TOTAL	**$ 1,773,644,351,277**

Energy efficiency is at the basis of sustainable development and the shift to circular forms of economies that re-use, re-manufacture, recycle and "upcycle" all materials into new products and services.[233] For example, new research will allow zero-waste cellphones and an eventual reduction in electronic wastes.[234] This requires a revolution in finance to create economies based on Nature's principles, such as on Principles of Ethical Biomimicry Finance® and described in our TV special "The Money Fix"". Energy efficiency broadly counts: heat, power, waste to energy; improvements in construction materials

[233] See for example the companies in the Toilet Board Coalition, as well as Ecor and other companies mentioned in our Overview.

[234] Science Daily, "Recycling experts hit milestone in quest for zero-waste phone", April 12, 2018.

such as windows, insulation and lighting; hybrid and electric vehicles and charging stations using only solar generated electricity, as well as waste management, smart grid and supply chain efficiencies. The ripple effect of energy efficiency includes: energy savings, job creation, increased productivity, improved product quality, improved system reliability and optimizing manufacturing processes.[235]

Energy efficiency metrics must include **exergy efficiency**, energy which could have been converted into work but was wasted instead. We use the overall exergy model of system-wide efficiency developed by our Advisory Board member Dr. John "Skip" Laitner.[236] The ACEEE estimates $80 billion of the $156 billion dollars' worth of energy used in production in 2013 was lost through inefficient conversion. Their 2018 Efficiency Bulletin covers statewide initiatives responding to Federal inaction[237] For example, using combustion to heat releases far more energy than is used – exergy inefficient. Another example is shifting from electricity for heating and cooking food and using induction cookers, now widely available.

Smart grid technologies, anything used on the grid that enhances use of renewable energy, largely electrical components and equipment, are included in Energy Efficiency. Researchers have been careful when including Smart Grid investments. Too often, companies sell customer data and cite their cost to increase rates rather than provide the promised lower costs to customers based on improved efficiency, touting instead power reliability, avoided outages and faster restoration times.[238] An advantage of smart grid has been to help emerging markets leapfrog technology for energy infrastructure.[239] Existing utility grids may be re-purposed to carry electronic information.

This sector also includes investments in batteries for electric vehicles and charging infrastructure, new storage technologies such as passive green off-grid buildings and super capacitors. The 2013 GTS report covered many of these innovations in energy storage.[240] Costs of batteries presents a tipping point encouraging households, vehicles and businesses to go off grid and off the pump. This interest has driven up the use and cost of lithium, in lithium-ion and lithium- air batteries, however imperfect and toxic this commodity is. While the focus has been on more efficient vehicle batteries to address "range anxiety" less attention is given to installing solar-powered electric vehicle chargers such as those from Envision Solar.

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

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

[237] Efficiency Bulletin, ACEEE, April, 2018.

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

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

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

These EV chargers avoid fossil electricity, install in minutes in any parking space, require no digging or permitting and are the choice of many cities in the USA.[241]

Widely considered the lowest hanging fruit for investors, efficiency provides remarkable ROI. The EU's efforts toward 20% energy savings by 2020 has already resulted in EU buildings consuming half the energy used in the 1980s.[242] 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.[243] The US Energy Star program has developed a Cash Flow Opportunity calculator to create a sense of urgency for manufacturers to change their processes and the products offered.[244] This innovation is threatened by Trump's cuts to EPA. Meanwhile the American Chemical Society reports that recovering gold, copper and other metals from electronic waste is cheaper than mining for such metals.[245]

In this 2018 GTS Overview we look at the efficiency gains available from more sustainable, agriculture and food systems including shifting from animal proteins to plant-based diets and the many startups in these markets. For example, a large European food company pledges zero-waste, carbon-neutral and 90% organic by 2025.[246] Supply chain efficiency is recognized as a key component of energy efficiency has been noted by McKinsey & Co. since 2009.[247] Companies are realizing the value of providing services specific to meeting this need such as Johnson Controls which is specifically targeting scaling up its program to help small and medium-sized enterprises.[248] The numbers reported by the GTS are certainly understated as these smaller company efforts do not meet our $100 million investment accounting threshold.

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[241] Envision Solar, Press Release, April 2018.

[242] Energy Efficiency, European Commission, https://ec.europe.eu/energy/en/topics/energy-efficiency, assessed April, 13, 2015.

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

[244] US EPA, ibid.

[245] Science Daily, "Pulling valuable metals from e-waste makes financial sense". April 4, 2018.

[246] 3BL Report Alert: "Wessanen Integrated Annual Report 2017., April 9, 2018.

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

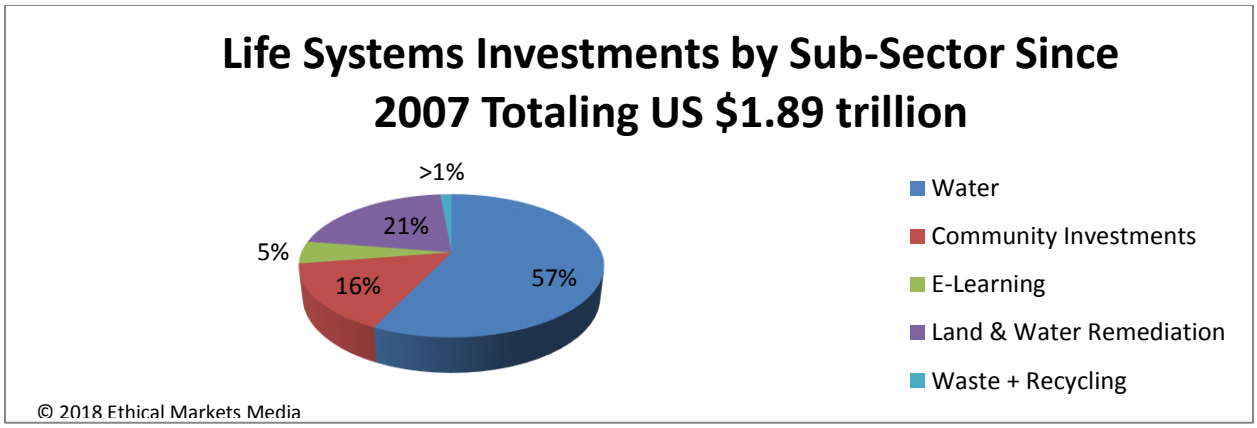
[248] "Johnson Controls teams up to scale energy efficiency in corporate supply chains". Press release, ACEEE, June 11, 2015.

LIFE SYSTEMS

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

Life Systems	
Water	$940,842,946,811
Community Investments	$254,645,600,000
E-Learning	$83,531,355,556
Land & Water Remediation	$346,014,800,000
Waste + Recycling	$23,327,144,000
FinTech VC	$97,694,000,000
Peer-to-Peer Lending	$145,500,000,000
TOTAL	$1,891,555,846,366

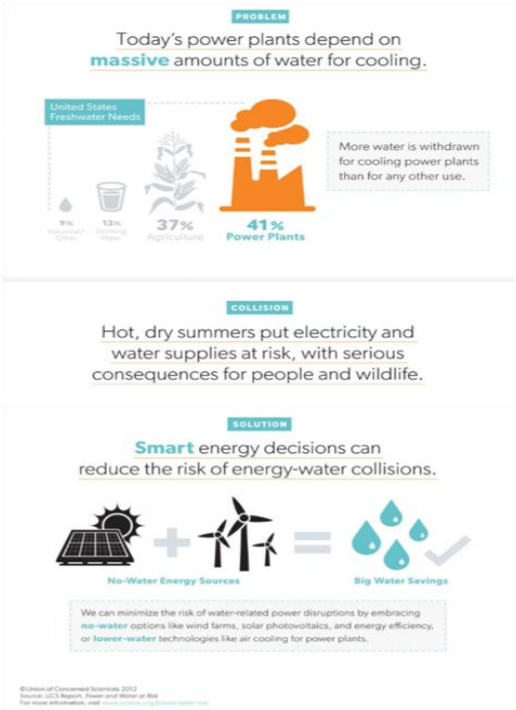
The Green Transition Scoreboard® collects investments in these areas under **Life Systems**. When we started tracking for 2014, Water, Community Investment, E-Learning, VC/PE/M&A, Land & Water Remediation and Waste & Recycling reached threshold minimums for inclusion in the GTS, totaling $876 billion in investments since 2007. In our Overview 2018 GTS, we also examine the efficiency of investments in water, identifying excessive investments in the planet's 3% of freshwater while overlooking the 97% of the planet's saltwater and the 10,000 salt-loving (halophyte plants) which could provide much human food and fuel, as well as remediating degraded lands. In 2015, we added Fintech VC and Peer-to-Peer Lending, including crowdfunding for sustainability, as described further in the GTS 2016 Overview, reaching the new total of over $1.89 trillion invested since 2007.



Water, Land & Water Remediation, Waste & Recycling

Water is the most important commodity for life originating on this planet. The GTS totals private investments in fresh water since 2007 at $940 billion.

Most fresh water infrastructure when working well goes unnoticed for decades. These investments include pipes, valves, filters, membranes, meters and biological systems. We omit the bottled water industry, privatization, large-scale hydroelectric dams. The GTS does count investments by utilities in water and wastewater systems. Given many utilities are owned and operated by various levels of government, a 60% discount has been applied.



Fresh water accounts for only 3% of water on the planet, and it is unequally distributed. Droughts cost billions in lost economic activity, with taxpayers often paying to remedy the resource depletion in a way which falls far short what healthy ecosystem services can provide, with climatologists warning there is worse to come.[249, 250]

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

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

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.[251] A concern based on the enormous waste in mining, including water waste and contamination, led to the creation of Ethical Markets' initiative the EthicMark® GEMS standard seeking to shift consumption from mined gems to lab-created gems now a disruptive movement of small producers challenging the global diamond cartel.[252] For mining deemed "necessary", methods to reduce water use reduce the cost of production as well.[253] Reinjecting spent fracking water into the ground has resulted in many earthquakes in Oklahoma.

In Europe, 44% of fresh water consumption is used in energy production, mostly to cool thermal and nuclear power plants. In the US, a comparable 41% of freshwater used goes to generate electricity, beating out agriculture at 37%.[254] Investments in water include infrastructure and clean drinking water and sanitation. While in 2013 it was estimated it would take over $384 billion over 20 years to ensure safe drinking water in the US, resolving the lead contamination disaster in Flint, Michigan, alone is estimated by Fitch Ratings at $275 billion.[255, 256] The World Water Council and K-Water see "Water and Green Growth" as a new path to sustainability and opportunities for economic growth.[257]

Largely overlooked, saline water constitutes 97% of available supply. As reported in "Plenty of Water" (GTS 2014), enormous opportunities are under-appreciated in desert-greening and in growing food, fiber and biofuels from algae on seawater and from the 10,000 varieties of halophyte (salt-loving) plants which are grown in many countries, on desert lands using solar energy. The UAE is pursuing aquaculture both for biofuel and food security.[258] Our 2018 Overview and TV program "Investing in Desert Greening" reviews the possibilities.

Land & Water Remediation totaled $346 billion and **Waste & Recycling** totaling $23 billion subsectors are reported individually based on specific project financing. Much of the data comes directly from company reports. Site remediation in particular is on track to grow to a $40 billion market led in large

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

[252] Henderson, H. "Beyond Bloodstained Gems: New Science and Standards", 3BL, 2015 and www.ethickmarkgems.com.

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

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

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

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

[257] 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.

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

part by remediation of contaminated land in China and the former Soviet Union.[259] The world's longest water infrastructure for diverting freshwater from South China to Beijing's citizens costing 300 billion yen ($486 US) is deemed by some experts as unsustainable.[260] Yet on the Gulf Coast of the USA restoring marshes and oyster reefs are among the most cost-effective ways to reduce flood risks.[261]

Community Investing, E-Learning and Fintech

Community Investing refers to capital specifically directed to traditionally underserved individuals or communities, totaling $254 billion. A more in-depth look needs to be taken at Latin America and Africa. Traditional markets and GDP-measured economic growth still overlook the millions of cooperative enterprises which employ more people than all traditional for-profit, commercial companies combined.[262]

E-Learning accounts for $83.5 billion in Life Systems. This subsector covers all forms of online and mobile education from MOOCs (massive open online courses) to education platforms to learning management systems (LMS) to for-profit institutions. The GTS research focuses on the first three, avoiding when possible investments in "for-profit" colleges and universities because of the many controversies over government subsidies, predatory lending, enormous student debt, poor graduation and employment results. Free MOOCs and other self-directed learning methods are popular despite low "graduation" or certificate earning rates, instead being self-paced and self-realized, where learners can absorb what is needed to solve local and personal challenges. Growth in the market is estimated at 7% per year.[263]Ethical Markets Exploratorium is our free MOOC for global citizens and lifelong learners worldwide. (www.ethicalmarketsexploratorium.com)

Fintech as a subsector is described at length in, Fintech: The Good and Bad News. Fintech investments have almost doubled since 2016, now totaling $97.6 billion, facilitates the rise of the digital economy, including community investing and peer-to-peer lending. Global VC investments in fintech in 2015 reached 860 deals totaling $12.5 billion in investments.[264]

Peer-to-Peer (P2P) lending, a sector of fintech, grew to $145.5 billion within the overall Life Systems total. Much of its investments came first from VC looking to invest in peer-to-peer enterprises.

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[259] $40 Billion World Site Remediation Annual Market by 2015, news release, The McIlvaine Company,

[260] The Economist, "A massive diversion"., April 7, 2018.

[261] Science Daily, "Nature-based solutions can prevent $50 billion in Gulf Coast Flood damage, " April 12, 2018

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

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

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

Online tools for collaboration, for example, the rise of Airbnb, Uber, Lyft, as well as Task Rabbit, Mechanical Turk for individuals, are included P2P investments and share in the e-learning boom with software development which allows online and mobile collaboration among students and between them and instructors. [265]

Greening financial services which facilitate peer-to-peer investing, cheaper transmission of remittances and reward ecological behavior and projects such as Ant Financial's tree-planting app have been a focus of the UNEP Inquiry on Sustainable Finance. (www.unepinquiry.org) BlackRock bought £12.7 million worth of shares in UK's Funding Circle investment trust.[266] In spite of much optimism, a lack of accountability has led to problems now plaguing social media giants and their business models discussed in our Overview. Adair Turner, former chair of London's Financial Services Authority predicted that peer-to-peer lending losses "will make the worst bankers look like lending geniuses".[267] A positive is that funds transferred via e-remittances are an important component in local investments.[268] The remittance market brings increased transparency and competitiveness, lowering the costs of sending money in part because of online money transfers are now easily done from a cell phone.

Future Sub-Sectors

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

- Agriculture: organics and non-GMO, vertical farming which we cover in the Overview.
- Forest and farmland remediation: natural methods of carbon sequestration, investing in protecting land for intrinsic value and to increase values of adjacent lands for development also covered in our Overview.
- Aquaculture: fisheries, seaweed for food and feedstock, halophyte farming, updated in the Overview.

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

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

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

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

- Healthcare: waste reduction,[269] energy reduction and efficiency,[270] quality of life for patients and healthcare workers [271] The crises in US healthcare are formidable and require a paradigm shift to prevention --- beyond the surgical and chemical interventions which treat symptoms and diseases largely due to dies, sedentary and other lifestyle issues. This US system now accounts for 18% of GDP and produces no better outcomes than other OECD countries spending much less.

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

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

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

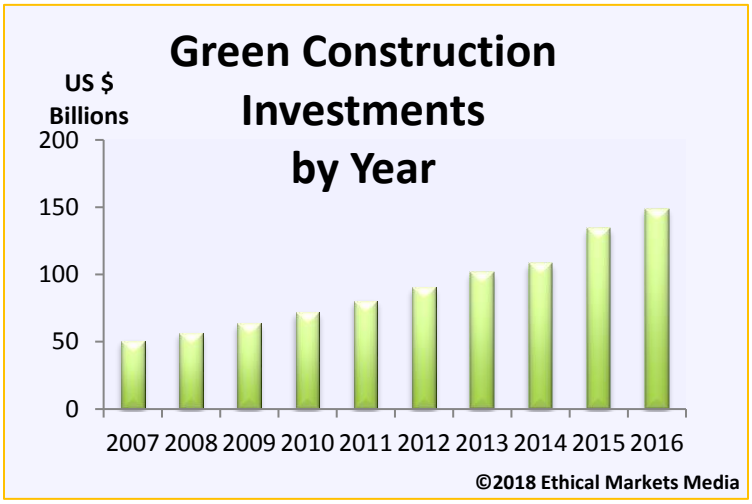
GREEN CONSTRUCTION

From 2007 to 2016 Green Construction reached over 1 trillion in investments and commitments. The sector is divided into current investments by year of funding. Since public-sector information is not reported separately, the total has been discounted to account for government projects.

Green Construction	
2007	$50,464,262,053
2008	$56,701,418,037
2009	$63,709,458,468
2010	$71,583,661,200
2011	$80,431,080,000
2012	$90,372,000,000
2013	$101,688,500,000
2014	$108,375,000,000
2015	$134,300,000,000
2016	$148,750,000,000
2017	$166,005,000,000
TOTAL	**$1,072,360,379,757**

The GTS does not restrict green construction solely to LEED buildings and other certifications, wanting to give credit for effort and to recognize new innovations, given that established standards often experience a lag behind entrepreneurs. Cities are competing worldwide in the C40 Coalition which now numbers 100 cities.[272] Many zero-emission buildings lead the way.

Amounts are calculated using the value of the green construction market, defined as construction built to LEED standards or that incorporate multiple green building elements, structural materials such as timber, steel and other metals, concrete, glass, insulation and green rooftops and broad application



categories of framing, insulation, roofing, exterior siding and interior finishing.[273] Figures include innovations in green roofs, eco-friendly carpets, recycled tiles, VOC-free glues and paints and cement-making that uses CO2. Projected CARG through 2019 is 12.5%.[274]

Green construction also applies to creating greener cities rather than just greener buildings, for example, Guangzhou in China[275] and the long-term symbiosis in Kalundborg, Denmark, which started in the 1970s described in out GTS 2014

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.

Aggregate data on green construction for countries other than the USA are a challenge to compile.

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

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

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

CORPORATE GREEN R&D

The data collected for the GTS is the most comprehensive assessment of **Corporate Green R&D** available. The GTS research team reviews press releases, sustainability reports, and financial statements. The team has identified over 190 corporations and organizations responsible for the green R&D tallied in this report. Our 2018 total is $505. billion.

This $505 billion likely understates by half actual global Corporate Green R&D, considering how much goes unreported for competitive reasons. International companies' R&D does not make it into the media. In most countries, companies are not required to report, and tens of thousands of middle-market and smaller companies have R&D budgets below the GTS reporting threshold.

Corporate Green R&D	
Year	**Amount**
Year	Amount
2007	$ 28,095,739,644.60
2008	$ 29,898,017,369.41
2009	$ 27,902,565,046.63
2010	$ 31,917,584,495.38
2011	$ 41,171,656,740.15
2012	$ 50,810,608,300.73
2013	$ 41,997,727,463.71
2014	$ 48,764,508,337.63
2015	$ 45,089,759,666.49
2016	$ 48,784,093,068.24
2017	$ 34,754,136,866.67
Commitments	$ 76,088,345,000.00
TOTAL	$ 505,274,741,999.65

Investing in green R&D shows that a company integrates sustainability into its core strategy and worldwide, 75% of corporations in a KPMG study in 201 7 are now engaged [276] Another study by PWC found more than 470 companies in 17 countries engage in sustainability reporting.[277] This data helps identify innovative companies ahead of the curve in responding to heightening environmental risks and regulations. According to the Global Sustainable Investment Alliance (GSIA) $23, trillion or 26% of all assets under management in 2016 were in socially-responsible, ESG investments[278] Green R&D serves as a strong indicator to investors, alert to the green transition to the Solar Age, that a company is both long-term and forward-looking[279]. Green R&D provides a competitive advantage, preparing companies for market trends reflecting rising energy costs, water scarcity, demographic changes, and new regulations, as we have tracked in out GTS reports since 2007.

In the GTS 2016 our data showed the automotive industry as the largest investor in green R&D. Volkswagen, Robert Bosch, Toyota, BMW, Volvo and Audi are all RND Investors now embracing electric and hybrid vehicles and battery research. The sector total of $505 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.

Energy generation, conservation and distribution account is also still a large investment input. The bad news is that there is still plenty invested in oil and gas exploration and production. The good news is that the 2017 spending for oil and gas forecasts continued reductions.

In keeping with GTS attention to Life Systems, R&D for water is at $14.1 billion, up over $5 billion in just one year. Life Systems: Water shows in water investments at $940 billion.

Again, battery technology is a hot topic, covered in depth in the Overview Introduction to the 2013 GTS report. The automotive industry for EVs is pushing battery manufacturing, driving up the use and cost of key components such as lithium and cobalt mentioned previously.

[276] KPMG "How to report on the SDGs", April 4, 2018.

[277] PWC, "SDG Reporting Challenge 2017"., April 2018.

[278] The Economist, "Green Tape", Mar. 24, 2018.

Globescan, Webinars Sustainability, March 2018.

[279] See for example: Globescan, Webinars Sustainability, March 2018.

Appendix 1- Positions Held By Principals of Ethical Markets Media

For full disclosure: members of the GTS research team of Ethical Markets Media, LLC, are invested in companies supporting the green transition or mentioned in this report, many of which are privately held, early stage, pre-IPO companies.

As of April 2018

- Apple (AAPL)
- Biomimicry 3.8
- Brookfield (BEP.UN)
- Boralex (BLX)
- Centre for Social Innovation Community Bonds
- ECOR
- EnvisionSolar (EVSI)
- Environmental Services (EVX)
- Equal Exchange
- First Trust Nasdaq Clean Edge Green Energy Index (QCLN)
- Generate Capital
- Google (GOOGL)
- GrainPro
- Green Garmento
- iShares Global Real Estate Index Fund (CGR)
- iShares Global Telecom ETF (IXP)
- iShares 1-10 Year Laddered Government Bond Index ETF (CLG)
- LightPath Technologies (LPTH)
- Munich Re (MURGY)
- Natcore Technology (NXT)
- Philips (PHG)
- PowerShares Cleantech Portfolio (PZD)
- S&P Global Water Index Fund (CWW)
- S&P Global Healthcare Index Fund CAD-Hedged (XHC)
- S&P Global Consumer Discretionary Index Fund CAD-Hedged (XHC)
- SolarShare Community Bonds
- TD Bank (TD)
- Technology Select Sector SPDR® Fund (XLK)
- 3M (MMM)

Appendix 2 – Research Team

Research and Writing

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

LaRae Long, Executive Director of Ethical Markets Media. LaRae began her career in the financial services industry 1981. She gained extensive client service and administrative experience during 33 years by holding positions in many customer oriented and administrative roles. Her administrative experience was enhanced as an Executive Assistant for a major financial brokerage firm. Graduated in 2004 with a Business Administration Degree from North Florida Community College.

Timothy Jack Nash, MSc, The Sustainable Economist and founder of Good Investing. As an expert on socially responsible investing, impact investing, and the green economy, he is regularly featured in publications such as Reuters, Advisor's Edge Report, and MoneySense. He earned his BA in Economics from Dalhousie University (Canada) and his Master's in Strategic Leadership towards Sustainability from the Blekinge Institute of Technology (Sweden).

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Ethical Markets is grateful for the expertise of our reviewers, while accepting full responsibility for the content of this report.

Praise For the Green Transition Scoreboard®

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

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

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

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

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

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

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