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company

Mapping the global transition to the solar age

From 'economism' to earth systems science
SUSTAINABLE BUSINESS INITIATIVE – OUTSIDE INSIGHTS

Hazel Henderson

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ISBN 978-0-85760-940-3

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Foreword

Richard Spencer, ICAEW

Tony Manwaring, Tomorrow's Company

Increasingly, business leaders are acknowledging that we cannot continue doing business the same way while trying to do it better. We have to do things differently: the assumption that society and environment are the variables that need to flex to meet the way we do business needs to be turned on its head and we must recognise that society and environment are now clearly limiting factors to which business models must adjust. This is not just to meet longer-term (and perhaps seemingly more abstract) societal expectations but to adapt to shorter-term and more immediate business risks, although these are of course connected.

Finite planetary resources, a changing global climate, and political and economic instability are all factors contributing to this need for innovative change. We need look no further than the World Economic Forum's report *Global Risks 2014*, which lists among its top 10 risks for 2014 a range of environmental, social, cultural and behavioural issues: structurally high unemployment/underemployment; water crisis; severe income disparity; failure of climate change mitigation and adaptation; extreme weather events; food crises; and profound political and social instability.

Demands are for a 'new-capitalism', a shift to a 'green economy' with countless expressions of what sustainable business should and could look like. Ian Cheshire, CEO of Kingfisher, recently articulated this challenge:

'Infinite high resource intensity growth is simply not possible, and we are already living off our future capital. It may be gradual but most businesses will have to adjust to a very different reality. That reality will still be a version of capitalism, and needs to be a positive vision rather than a doom-laden return to the Stone Age, but it needs to rethink the point of the system. Instead of the goal of maximum linear growth in GDP, we should be thinking of maximum wellbeing for minimal planetary input.'

Yet it is increasingly recognised that most prior assumptions about the solutions for a secure and prosperous future no longer adequately address the immensity of today's questions, nor do they lead to long-term value creation. What does this paradigm shift mean and how do we achieve it?

In this thought-provoking and agenda-setting publication, Hazel Henderson offers a new solution to obsolete frameworks. She advocates a transition to a 'solar age' as a pathway to a more green and sustainable economic future.

Hazel's publication builds on her lifetime of extraordinary achievements. It lays out a road map advocating a paradigm shift for a future through a multi-disciplinary approach. It calls for a changed way of understanding the world through systems thinking, and by the adoption of new values and innovation. It also reassures us that as we stretch the systems of understanding our dynamic relationship with the planet beyond the lenses of economics and GDP we shall not be left 'flying blind'.

It is the ambition of both our organisations to host such challenging and complex voices as Hazel's. In 2009 we published Hazel and Fritjof Capra's essay *Qualitative Growth* and we are delighted to have the opportunity once again to publish Hazel's thinking.

Richard Spencer

Head of Sustainability, ICAEW

Tony Manwaring

Chief Executive, Tomorrow's Company

Foreword

Dennis Bushnell, Chief Scientist, NASA

Currently world views are inherently tactical, near term, evolutionary. If societies were more interested and informed regarding the potential strategic, longer-term nature of several ongoing changes then they would be motivated to move the transition to a sustainable and green economy much faster. These strategic changes include the fact we are currently short some 50% of a planet and thus the entire ecosystem appears to be crashing. As Asians attempt to attain Western living standards we would need four more planets.

We humans have been simply far too successful. Therefore, the economic growth mantra will be and has to be replaced by the sustainability mantra. This will drop standards of living, as will working the debt issues (higher taxes, interest rates, inflation) and the crash of employment due to machine intelligence and robotics as described by Martin Ford in *The Lights in the Tunnel* (2009). The ensuing unrest from all this will be far from pretty. In just one facet of the crashing ecosystem – climate change – we appear to be replaying the Permian period on steroids – some 100 times the CO₂ release rate of the Siberian Trap Volcanoes as Peter Ward outlines in *Under a Green Sky* (2008). The Permian resulted in massive (greater than 90%) species die off due to anoxic Oceans, subsequent overgrowth of cyanobacteria, producing massive hydrogen sulphide which made the atmosphere toxic and took down the ozone layer.

There are several 'killer apps' for green energy including distributed generation/conservation (negawatts), halophyte (salt-loving) plants on wastelands using seawater irrigation to solve land, water, food, energy and climate and, revolutionary problems, but not yet realised to an engineering level, low-energy nuclear reactions – the weak force not the strong force, collective effects not particle physics. These can be added into the mix of the many renewables cited in this paper. All are on an exponential cost reduction course, with several now competitive with fossil carbon sources and the others rapidly gaining ground. Once the economics for renewables is there and fully accounted, the shift will happen quickly. The recent decreases in natural gas prices and increases in supply have very rapidly altered the energy generation landscape. For the tactical, nearer term/conventional sorts, it is all in correcting the economics.

The NASA Earth Science program is part of a worldwide effort to document the planetary atmospheric constituents, conditions, physics and chemistry to discover the dynamics thereof, establish initial conditions for computational forecasting and document the ongoing anthropogenic effects thereon. These efforts are also providing requisite technological inputs to various renewable energy approaches including solar and wind. The needed satellite and in situ measurements are executed by NASA and are being discussed and negotiated in various worldwide and national forums. The NASA Earth Science program is a major NASA Scientific effort with NASA developing, fabricating, deploying and archiving the data from sensors and instruments. This information is used at regional, national and planetary levels to inform policy and determine the current states and rates of change. A notable exemplar of this program is the detection of and solutions for the 'ozone hole'.

Halophytes or salt plants are the yin of the plant world to the yang of glycophytes, the usual fresh water plants. There are some 10,000 natural halophytes, plants that grow on land with brackish to salt water irrigation, water resources. Some 22 nations have at least experimental halophyte farming ongoing and some are exploiting the use of halophytes instead of glycophytes to produce energy from plants at massive capacity and little impact upon fresh water and arable land. Some 44% of the planetary land mass is wastelands and 97% of the water is salt water. Studies indicate it would be feasible, using current technology, and very affordable, to replace all the fossil energy sources with halophytes grown on wastelands using sea water irrigation in the nearer term. This would literally and simultaneously solve land, water, food, energy and climate, as stated, both nearer term and very affordably. Why are we humans not doing this? Evidently, because it is a really big and different idea and involves far too great an alteration in current sources and practices. There are ongoing halophyte energy efforts in Egypt, the UAE, Mexico and other places.

As the multiple strong positive climatic feedbacks kick in as they are doing now, and climate change becomes ever more worrisome, the world may turn to such different solution spaces. These would be far better than serious thoughts of geo-engineering to mitigate the now ongoing rapid changes. Such geo-engineering is extremely expensive and could have untoward consequences. Even state of the art climate forecasting is not capable of realistic evaluations of the many potential effects of such efforts¹.

Dennis Bushnell, FAIAA, FASME, FRAeS, MNAE

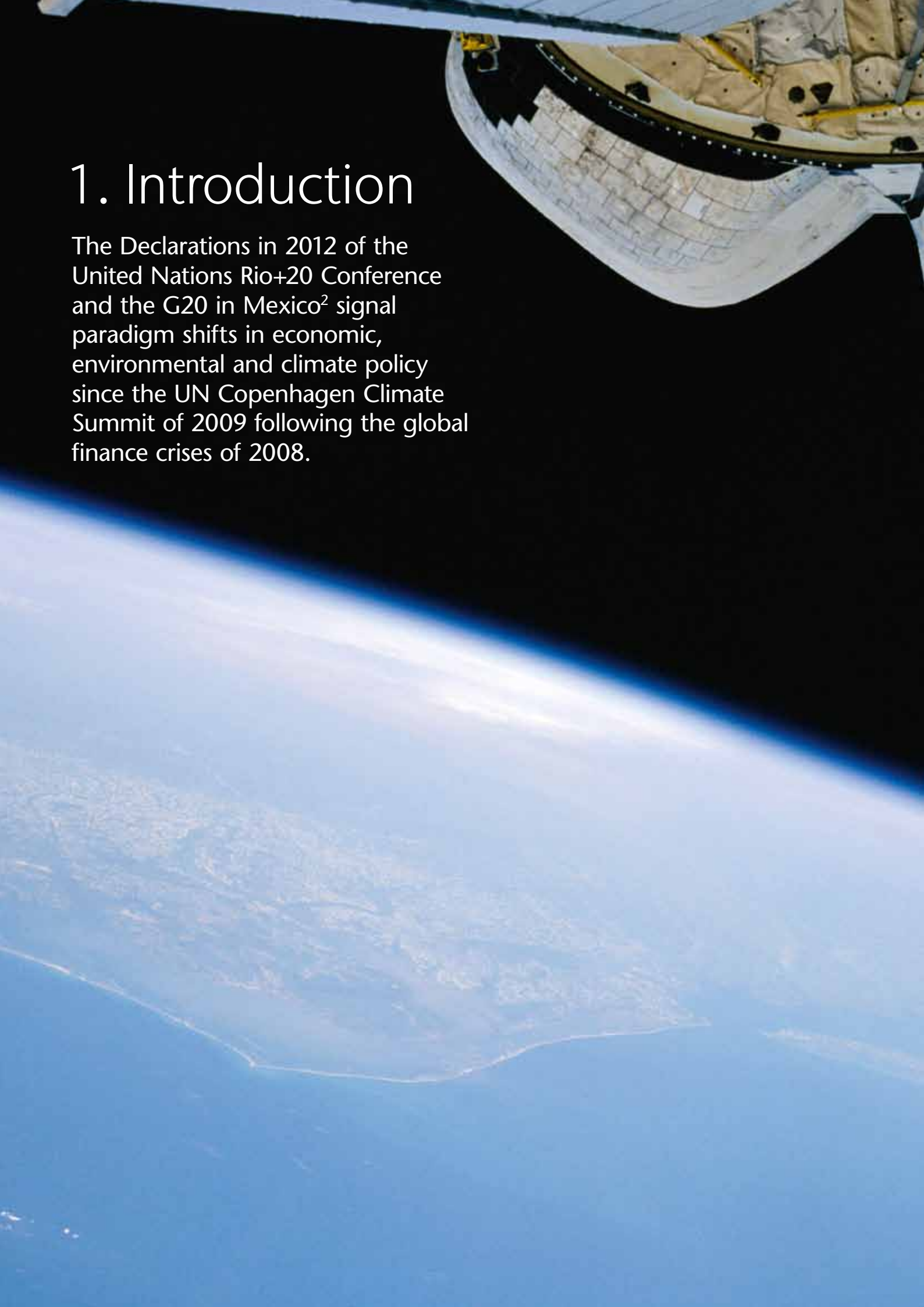
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1. Introduction

The Declarations in 2012 of the United Nations Rio+20 Conference and the G20 in Mexico² signal paradigm shifts in economic, environmental and climate policy since the UN Copenhagen Climate Summit of 2009 following the global finance crises of 2008.



EXPLORING THE SHIFT TOWARDS RENEWABLE TECHNOLOGIES

The Declarations in 2012 of the United Nations (UN) Rio+20 Conference and the G20 in Mexico² signal paradigm shifts in economic, environmental and climate policy since the UN Copenhagen Climate Summit of 2009 following the global finance crises of 2008.

By 2012 it had become clearer to global policy-makers, businesses and civic society that environmental, social and human capital had to be assessed and integrated into financial markets in order to achieve equitable and sustainable forms of development. The UN Millennium Development Goals (MDGs) will be integrated into Sustainable Development Goals (SDGs) and the Sustainable Development Solutions Network has outlined a comprehensive Action Agenda for Sustainable Development (June 2013) which incorporates new knowledge of planetary boundaries. Humanity is now facing global changes since the MDGs goals in 2000 and these are now part of an integrated framework.³

The output of Rio+20 was an unprecedented reintegration of human knowledge resulting in new, globally shared goals and paths transitioning 191 member countries towards low-carbon, cleaner, greener, information-rich economies.⁴ The contrast between the creativity at Rio+20 versus the dispirited Doha Climate Summit of 2012 and its follow-up in Warsaw in 2013 was stark. Doha focused on efforts to salvage the Kyoto Protocol and reforming its widely corrupted carbon trading regime; the missed targets for CO₂ caps; clashes between tier I developed countries versus tier II developing countries; and backsliding on finance for mitigation and adaptation. This rear-view mirror focus ended with a far from adequate re-authorising of Kyoto even though the Protocol now only covers 12% of global emissions.⁵ More fundamental approaches focus on transforming financial markets beyond recent reform efforts. These approaches advocate from fossil fuels,⁶ toward greener and renewable investments, overhauling national and corporate accounting, promoting green bonds⁷ and infrastructure.

THE SUBSIDY BARRIER TO TRANSITION

The significance of this 2012 paradigm shift remains unexamined by mainstream media, while the multiple means, diverse technologies and financial strategies are still being formulated and debated. The 'elephant' blocking more rapid progress has been clearly identified: the powerful, incumbent fossil fuel sectors which finance 10 major US think tanks and media campaigns against green energy.⁸

The resurgent fossil fuels in shale-based natural gas and oil, Canada's tar sands, as well as the nuclear industry (even after Fukushima-Daichi) – all still enjoy outsize subsidies from most governments. Global subsidies to fossil fuels in 2012 exceeded \$520bn.⁹ The resulting incorrect pricing, together with still uncounted negative externalities, continues to drive mis-investing: for example, new coal plants in Europe which are unjustified on both economic and environmental grounds.¹⁰ In the Rio+20 Declaration,¹¹ these subsidies were identified as the key barriers to the level playing field required to fully utilise existing renewable energy technologies and speed the transition to green economies.

Pledges to reduce these subsidies and negative externalities, as well as to shift government tax policies and procurement budgets to greener technologies at Rio+20 were accompanied by commitments to reform finance and its conventional metrics. These included correcting national accounts by reformulating GDP indicators widely favoured by the public in 11 countries¹², and internalising formerly externalised costs at all levels including corporate balance sheets and accounting practices.

The UN report from Secretary-General Ban Ki-moon, 'Happiness: Toward a Holistic Approach to Development' outlines considerable progress by UN agencies, the OECD and many countries to shift beyond GDP to subjective measures of well-being, satisfaction, happiness as well as objective measures of education, health, poverty, social exclusion, adequacy of public welfare and services and environmental quality.¹³

In the private sector, a survey by Novethic found that nearly one-third of institutional investors managing €4.5bn use environmental, social and governance (ESG) metrics for long-term risk management.¹⁴ A group of seasoned cleantech asset managers saw 2013 as an inflection point for the rise of the green economy.¹⁵ A survey of 1,300 US companies in 2012 found growth rates for green business products and services rising faster than conventional goods.¹⁶ The OECD's 2013 'Green Growth Papers' reviewed the rapid progress among its 37 member countries.¹⁷

CONTINUING CHALLENGES

Thus, the battles that I foresaw in 1981 in *Politics of the Solar Age* were joined. The fossil-fuelled industrial era giants fought back with ever-larger political donations, lobbying, funding more research by its intellectual mercenaries, advertising campaigns, and media propagandists. They proclaimed the USA as the new Saudi Arabia of oil and gas and promoted the International Energy Agency's 'World Energy Outlook'. This actually more cautiously cited water shortages, noted that to limit global warming to 2°C, only one-third of already proven reserves can be burned and that massive investments were needed in low-carbon and energy efficiency technologies.¹⁸ This view was confirmed by Carbon Tracker's *Unburnable Carbon 2013* which forecasts that \$6.47tn could be wasted in mal-investments in shale and other fossil fuel extraction.¹⁹

Public and media confusion on the scientific consensus on climate change and global warming has continued since the 1970s. A poll in February 2013 reflected this, since its questions covered environmental threats in the abstract. The results predictably showed declines in public concern at a time when the public in many countries were dealing with austerity, budget cuts, job losses, threats to economic security and uncertain futures.²⁰

However, polls on specific issues of the green economy continued to show favourable majorities, as cited in this paper. Meanwhile, alarm over climate disruption since Hurricane Sandy in the USA in 2012 and the two deadly typhoons in the Philippines in 2013 led global elites into action to accelerate progress toward a global sustainable economy, including the formation of 'The B-Team' led by Sir Richard Branson, Paul Polman, Arianna Huffington, and Mary Robinson among others.²¹

TOWARDS THE GREEN ECONOMY

Clearly the transition to the green economy is already underway but will be highly disruptive to the industrial sectors and massive global apparatus of the fossil fuel and nuclear era. Many companies based on nineteenth and twentieth century technologies will go under and jobs will be lost.²² Bridging strategies using natural gas are already highly contested due to their huge water-use, polluted residues, methane release and other problems.²³ A study by Cornell and Stanford University scientists outlines a plan for 'A Fossil Fuel-Free New York State by 2050' which omits shale gas due to its much higher than advertised methane emissions.²⁴ The consensus reached at Rio+20, G-20 in Mexico and other summits in 2012 included the OECD Global Green Growth Institute, the Knowledge Platform, and 68 global financial institutions. NGOs and governments affirmed commitments to using natural resources in their capital accounting.²⁵ In addition, the \$5.2tn of private investments since 2007 tracked in Ethical Markets' Green Transition Scoreboard® attest to the huge shifts now in the pipeline.

While renewable energy stocks suffered from their opposition's media attacks, contrarians saw opportunities. US investor Warren Buffet's MidAmerica Renewables investments reached \$13.5bn, and the US Department of Defense is now the single most important driver of the cleantech revolution in the USA.²⁶ In 2012 and 2013, nature provided ample evidence of the massive CO₂ emissions' effect in ocean warming and driving unprecedented weather conditions worldwide: floods, droughts, fires, tornadoes, heat waves, all causing huge losses and insurance costs.²⁷

This paper is an attempt to contextualise all these phenomena and explore the future: the new planetary awareness driving these paradigm shifts as we humans 'connect the dots'. This knowledge explosion is now challenging our cultural beliefs about money, wealth, scarcity, abundance and transcending financial models derived from obsolete economics, led in many countries by younger generations connected by social media. The new multi-disciplinary models and metrics reassure us that in moving beyond economics and GDP we will not be flying blind but moving to the many earth systems science models (including those from NASA²⁸) and data from many scientific fields which this paper explores.

2. Global systems shifting

We see a global, whole-system shift underway as societies, corporations, academic and other institutions, face tidal waves of change due to accelerating interconnectedness.



THE 'TITANIC' PHENOMENA

Back in 2012, widespread interest in the hundredth anniversary of the Titanic's sinking offered a deeper metaphor for incumbent industrial giants and paradigms of power. Lessons from brain science illuminated beliefs that the Titanic was 'unsinkable': the same consequences of theory-induced blindness, cognitive illusions, confirmation bias, and herd behaviour we see in many elites.²⁹ Social inequality on board the doomed ship was evidenced in the shortage of lifeboats and the prevention of escape routes for the 700 steerage passengers trapped on the lower decks. Blindness to ecosystem realities made collision with icebergs likely, just as today's science-denying politicians and special interests are leading legacy fossil-fuelled industrial societies toward collision with self-inflicted climate disasters. An influential global NGO, the World Business Council for Sustainable Development used similar themes in its many reports,³⁰ and its founder Stephan Schmidheiny made the same point in *Changing Course* (1992).

Systems analysts term such 'Titanic' phenomena as 'overshoots' where a conventional goal of scaling-up a technology for greater efficiency and economic returns instead creates a dysfunctional dinosaur. Examples include 'too-big-to-fail' banks, oversized nuclear-powered electric utilities' cost-overruns and the latest monster – container ships which require the current \$5bn widening of the Panama Canal, and the Chinese proposal for a \$50bn new canal in Nicaragua to accommodate them – all to handle forecasts of a quadrupling of world trade.³¹

THE SYSTEMS THINKERS' APPROACH

Systems thinkers would examine assumptions and goals, map the changing circumstances and present a range of alternative scenarios to decision makers. They would question the likelihood that world trade shipping around material goods would quadruple in an increasingly information-based global economy. They would calculate ranges of energy and shipping costs; availability of raw materials, commodity prices; the shift from material goods to services (now some 70% of developed economies); changing consumer preferences; possible effects of climate change; pollution taxes and other constraints, including rising prices from likely internalising of formerly externalised social and environmental costs onto their balance sheets. They would also present evidence of re-localisation of production, rising markets and leapfrogging technologies in Asia, Latin America and Africa; disintermediation and downsizing of many twentieth century industries due to the internet, online markets; the rise of onsite distributed renewable energy bypassing centralised electric utilities. I presented such alternatives in 'New Paradigms in World Trade and the Global Economy' at Brazil's SEBRAE trade association of small businesses in 2003.³²

THE NEED FOR A NEW STORY

Most human learning comes from environmental challenges and those crises that are self-inflicted through our behaviours, beliefs and dogmas. These lead to conflicts, repression, injustice or misguided over-exploitation of resources, overshoots and ecological collapse.³³ Exploration of how human struggles for power throughout history are exposed in *Why Nations Fail* (2012).³⁴ I predicted three zones of our current global transition in 1986: breakdown, fibrillation-bifurcation, and breakthrough. Today, the over seven billion member human family has reached another teachable moment. To avoid further disasters, humanity needs a new story of how our still-growing population can live together cooperatively, interdependently, sharing our planetary home with each other and other living species.³⁵ These are the lessons nature teaches. As we learn them, we adopt new values based on the realities of our current situation, envision goals, creating innovations as we transition from the late-stage, fossil-fuelled industrial era to what I have termed the solar age³⁶ (see for example, 'Statement on Transforming Finance Based on Ethics and Life's Principles'³⁷ and Ethical Markets Principles of Ethical Biomimicry Finance™, co-developed with our partner company, Biomimicry 3.8³⁸).

TIDAL WAVES OF CHANGE

We see a global, whole-system shift underway as societies, corporations, academic and other institutions, face tidal waves of change due to accelerating interconnectedness driven by communications technologies, air travel, global networks and infrastructure. More than 50% of humans now live in cities, and our numbers are projected to grow to nine billion or more by 2050. An earlier wave of globalisation occurred during the colonial expansion of European powers in the seventeenth and eighteenth centuries. The second wave went into high gear in the 1980s when the USA and the UK and their leaders Ronald Reagan and Margaret Thatcher embraced laissez-faire economics, deregulated global markets and finance and promoted widespread privatisation of government-led companies and public infrastructure.³⁹ Thus unleashed, market forces spread these changes and led to the financialisation of economies and the domination of money centres, 'too-big-to-fail' banks, Wall Street and the City of London over governments, politicians and local economies worldwide. A UK government report on curbing banking and finance in June 2013 called for new reforms.⁴⁰ Such globally interlinked complexity cannot be modelled or managed with the simple computable general equilibrium (CGE) models of economics, which try to control only for inflation, unemployment, budget deficits and interest rates. See Figure 1: System view of 'vicious circle' economy on page 8. Efforts to re-think economics, such as that led by Wendy Carlin at University College, London, aim to reform curricula, examine what went wrong and re-introduce the history of economic thought. Such laudable initiatives will need to go far beyond the box of economic theory and incorporate all the recent scientific knowledge from other fields into a systems approach.⁴¹

INTERNATIONAL FORA

The first responses to military globalisation were the short-lived League of Nations following the first World War in 1918 and after the second World War, the subsequent founding in 1945 of the UN, which now has 193 member states. The premise was that with all their sovereignty under the Treaty of Westphalia in 1648, nation states were now facing each other competitively in an interconnected world which required them to cooperate, share knowledge and manage access to the oceans, atmosphere, electromagnetic spectrum, Antarctica and outer space.

Psychologist Stephen Pinker's historical global research indicates that violence actually has declined due to five trends in human societies: the expansion of governance, gentle commerce, feminisation, expanding empathy and the escalation of reason.⁴² The Global Peace Index measures trends in 162 countries, ranking them on 22 indicators, costs of containing violence and a Positive Peace Index.⁴³ In spite of the horrors of internal conflicts such as in Syria, major wars between nations have decreased. While their citizens want peace, civilian prosperity and security, military-industrial interest groups lobby for bigger arms budgets, dwarfing those for human needs. Only an international forum, the UN, provides these nations with a venue to gather, negotiate and address the new global issues which no individual country could solve alone. This has led to another teachable moment: countries can pool their sovereignty!⁴⁴

The special agencies of the UN became drivers of new planetary awareness, new memes and norms which spread among member countries.⁴⁵ Since 1945, under UN mandates, treaties and protocols were enacted on environmental pollution, protecting oceans, forests, biodiversity, migrating birds, and curbing the hydrofluorocarbons that created the hole in the Earth's protective ozone layer. Clearly, norms and values were changing. Summits were convened on population, social conditions (poverty, education, health), women's empowerment, promoting human rights, happiness and well-being and on environment in 1972, 1992, 2002 and Rio+20 in 2012.

The Bretton Woods institutions, the IMF, and World Bank were launched in 1945 and later, after many conferences on trade, the World Trade Organization was initiated in 1996. Alas, these institutions were based on the obsolete economic textbooks which allowed 'externalising' of

FIGURE 1

System view of global 'vicious circle' economy (Fast feedback loops)



Copyright © Hazel Henderson 1980/81

social and environmental costs and the faulty scorecard of GDP to measure nations' 'progress.' These obsolete rules⁶⁴ collided with the need to reform finance and cross-border financial flows.⁴⁷ An expanded popular awareness was leading to new approaches. The anomalies of financialisation and 'economism' were becoming clearer. NGOs led debates on transforming finance, the need to examine the politics of money-creation, the role of credit, debt and resource allocation.

The impetus for all the learning and cooperation between countries was also to prevent conflicts and the outbreak of wars. The UN General Assembly in its September 2012 debates illuminated the conflicts between religions, democracy, freedom of speech and respect for cultural diversity. Thus, peacekeeping has always been central to the UN. Its outdated Security Council is now the target of needed reforms: expansion beyond the five permanent members, victorious countries of the Second World War: China, France, Russia, UK and the USA and to abolish their veto.

A useful set of proposals is offered in *The Great Convergence* by Singapore's former ambassador to the UN.⁴⁸ An effort to de-militarise nations and UN peacekeeping was the proposal for a UN Security Insurance Agency (UNSI), allowing countries to follow Costa Rica's lead in abolishing its military in 1946. Nations could purchase insurance policies from this UN agency, guaranteeing a response if the insured country was attacked.⁴⁹ UNSIA was backed by several Nobel laureates, including former Costa Rican President Oscar Arias and debated in the UN Security Council in 1996. The emerging countries of India, Indonesia, South Africa and Brazil need to join the five permanent members on the Security Council, along with Japan. Now that the UK and France are less influential, there is a good case for one seat representing them, and the other countries of the European Union (EU).

The EU is itself an important social innovation: an example of cooperation among 28 formerly warring countries along the lines of the social innovation of the UN. In spite of its limitations and right-wing opposition in the USA, if the UN did not exist, we would need to invent it.

Notwithstanding the problems with its ill-designed currency – the euro – the EU is a key innovation in human affairs and still a model for many other countries. An interdependent world needs social innovations as much or more than new technologies. These associations of nations raise huge issues of which essential functions to centralise and which to decentralise.

AGE-OLD TENSIONS: INDIVIDUAL VERSUS SOCIETY

At the heart of today's human efforts to face our current global issues of governance, there are the deeper issues of individual rights versus the rights of groups, societies, other species and ecosystems. Recent re-visiting of Charles Darwin's *The Descent of Man* and *The Origin of Species* reveals how his research was used in Victorian Britain to glorify 'the survival of the fittest' and competition,⁵⁰ even though the phrase was coined by Herbert Spencer, a writer for *The Economist*.⁵¹ Darwin actually held that humanity's survival was based on our genius for cooperating, bonding and even altruism.⁵²

New research finds that human babies exhibit empathy and even altruism.⁵³ Using DNA samples from diverse populations in the USA geneticist Bryan Sykes at Oxford University finds that virtually all have mixed DNA from Africa, Asia, Europe and indigenous peoples.⁵⁴ Such research is upending older ideas about nature versus nurture and shows there is no biological basis for racism and other prejudices. Our greatest challenge as a species lies in our growing population which continues to rise in those countries where women cannot control their own fertility. One study indicates that if these women had access to cheap solar energy and micro-finance official population projections of 9-10 billion by 2050 could be lowered by some 3 billion avoided births.⁵⁵ Traditional economic models view population growth as essential to economic growth.

Participation in democratic decision making becomes more complex as populations increase and demographics change presenting new challenges as evident in the ideological contests in Europe and the Middle East and driving political gridlock in the USA. Social innovations, in response, include expansion of human rights, the principles of 'subsidiarity' (keeping decisions relevant to every level as close to its affected population as possible) and the 'precautionary principle' (placing the burden of proof on those who seek to change established conventions or introduce pollution or unknown substances into ecosystems). The principle of 'sustainability' was introduced via the Brundtland Commission's 1987 report, *Our Common Future*, in its definition of 'sustainable development'. This needs additional definition since it originally related to intergenerational equity in use of natural resources – a vital issue in climate change. Today, the term has been hijacked by corporations, governments and financiers to serve narrower purposes, eg, 'sustainable economic growth', 'sustainable corporate profits', etc., rendering the term almost meaningless. The social implications of the new post-Cartesian principles: interconnectedness, redistribution, change, complementarity, heterarchy and indeterminacy augured the transitions we see more clearly today.

DEFINING 'RESILIENCE'

A recent buzzword is 'resilience' which also begs for definition: resilience of what? Resilience is an important property of all living, self-organising systems, including humans; however, the term loses the time dimension implicit in the term 'sustainability.' Nevertheless, resilience is certainly a more appropriate condition for optimising many systems and societies, rather than conventional economics' obsession with profit maximisation and narrow sub-system 'efficiency'.⁵⁶

An earlier definition of resilience was that of Gregory Bateson in *Steps to an Ecology of Mind* (1973, 2000) in which he referred to the continual tradeoffs organisms make between adaptation and adaptability. Bateson showed that organisms can lose their resilience if subjected to a rate of change that overwhelms their 'store of adaptability'.⁵⁷ This is now evident in habitat disruption and loss, driving recent species losses and extinctions. Similar approaches to studying self-organising systems, particularly life forms that self-replicate, include research of the Chilean biologists Francisco Varela and Humberto Maturana, which they describe as 'autopoietic' and the phenomenon as 'autopoiesis' and research by MacArthur Fellowship recipient Stuart Kauffman, author of *At Home In the Universe* (1996). They were members of the Lindisfarne Fellowship founded by meta-historian author William Irwin Thompson in the 1970s, bringing together diverse scholars, including Amory and Hunter Lovins, Ralph Abraham, John and Nancy Jack Todd, Lynn Margulis, Paolo Soleri, Paul Hawken, James Lovelock, Maurice Strong, E. F. Schumacher, myself as well as Gregory Bateson, Stewart Brand, Richard Falk, Jerry Brown (re-elected governor of California in 2010) and others.⁵⁸

Other approaches to resilience and adaptability to change were those of Magoroh Maruyama and his concept of two cybernetic systems, the first structurally stable and internally dynamic and the second undergoing structural changes, which biologists term morphogenesis.⁵⁹

Figure 2: Two major types of cybernetic systems, illustrates the key role of feedback: negative feedback damping changes while positive feedback amplifies changes. Rene Thom, the French mathematician, created a non-linear topology to map these phenomena in *Structural Stability and Morphogenesis* (1975, English translation)⁶⁰ introducing the term 'chaos' and modelling seven ways that systems could shift their stable structure to morphogenesis. Thom modelled these seven possible shifts and termed his models 'catastrophe theory.' I became fascinated with these change processes because I had proposed that industrial societies were transitioning from their original fossil-fuelled basis and technologies to the next evolutionary stage I termed the solar age.

I found another key model from biology: 'paedomorphosis,' the process by which a life form evolved into an evolutionary cul de sac could escape by regressing its morphology to its earlier immature form, thus regaining the adaptability to evolve into a new, more appropriate

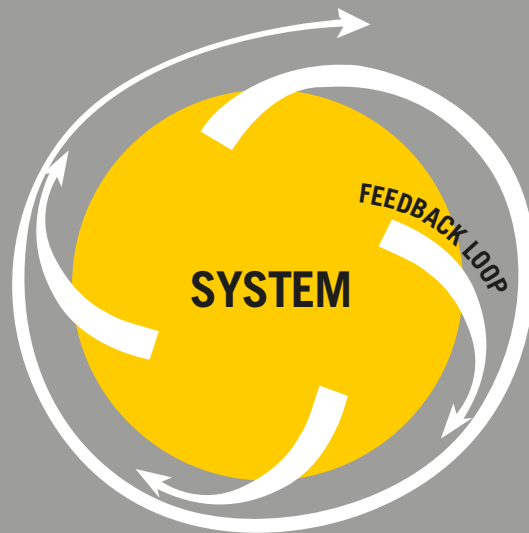
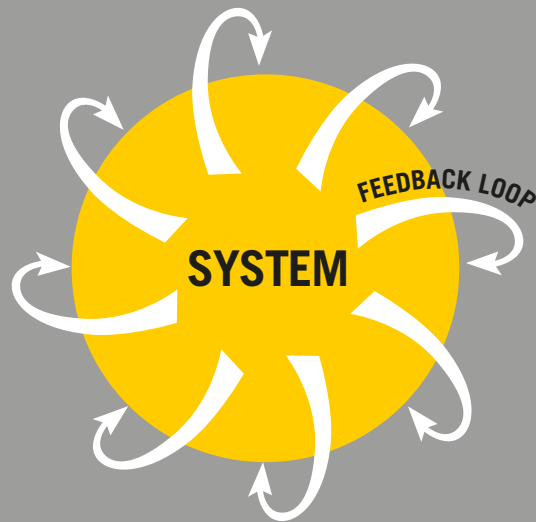
FIGURE 2

Two major types of cybernetic systems

STABLE, EQUILIBRIATING SYSTEM

Morphostatic, structurally stable

Eg: Thermostat-controlled mechanical system
System internally dynamic, but stable structure maintained and governed by negative feedback loops



NEW
SYSTEM
STATE

UNSTABLE, DIS-EQUILIBRIUM SYSTEM

Morphogenetic, evolving new structure

Eg: Living, biological systems, human societies
System internally dynamic and structurally dynamic governed by positive feedback loops which amplify small changes into unpredictably large changes which can alter the whole system

and resilient adult form.⁶¹ I saw an analogy in the decentralisation, back-to-the-land movements in industrial societies, which I described in *Creating Alternative Futures* (1978, 1996) and by my close collaborator E. F. Schumacher in *Small is Beautiful* (1973) and documented in over 6,000 volumes in the Henderson-Kay-Schumacher Library. Resilience in nature is based on localism, redundancy and diversity – key conditions in life’s principles, in Janine Benyus’ studies in *Biomimicry* (1997).⁶²

The late French mathematician Benoit Mandelbrot popularised the concept of fractals in colourful computer graphics showing how a set of simple rules continually repeated produced many complex patterns at different levels – as in nature.⁶³ Former options trader Nassim N. Taleb in *The Black Swan* (2007) cited Mandelbrot’s work as key in surpassing obsolete economics and statistical models, as did economist Paul Ormerod in *Why Most Things Fail* (2005). Taleb coined yet another term in the title of his book, *Antifragile: Things That Gain From Disorder* (2012). In discussing the inherent fragility in human-designed models, markets, technologies and political systems, Taleb targets academics, economists and decision makers he calls ‘fragilistas’ who purport to understand vulnerability and risk from abstract theories – rather than through hands on management and experience. Thus, Taleb goes beyond the concepts of resilience and robustness to biological models such as the human immune system ie, ‘what doesn’t kill you makes you stronger’ and the old saying ‘you must eat your peck of dirt.’

The medical-industrial complex has recently rediscovered the need to continually stress human immune systems and allow some exposure to pathogens. We now recognise our own human bodies as biomes composed along with our DNA of millions of microbes which aid our digestion, immune systems and metabolism.⁶⁴ This new understanding now requires retraining most medical practitioners. Actually, stress is evolution’s tool – as I have pointed out frequently, a lesson from ecologist Eugene P. Odum⁶⁵ with whom I served on the Technology Assessment Advisory Council to the US Congress from 1974 until 1980.

BEYOND SUSTAINABILITY AND RESILIENCE

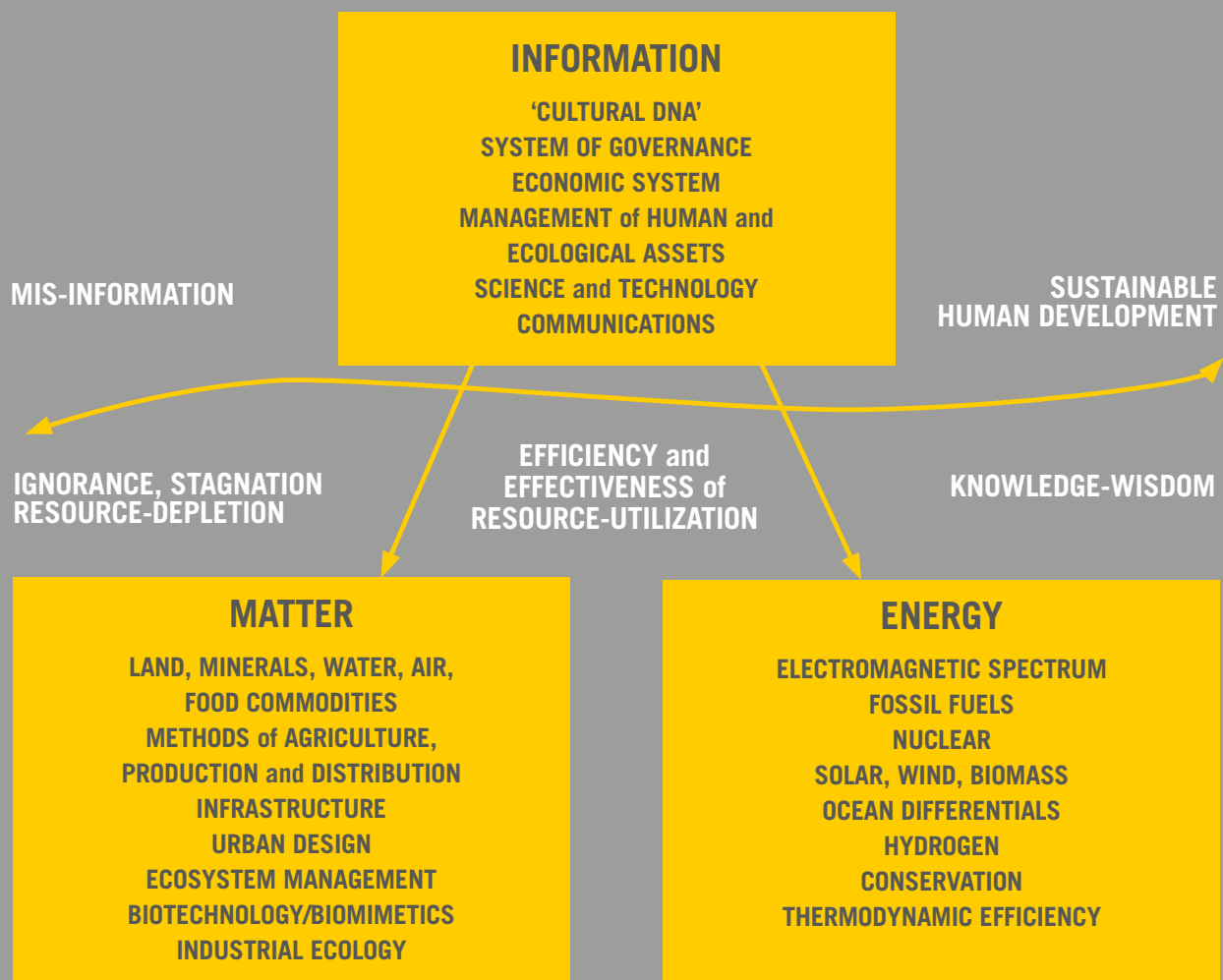
In 1984, the UN convened a seminar in Montpellier, France, to examine the new science of chaos and complexity theory and the ‘dissipative structures’ of Ilya Prigogine, in which I participated.⁶⁶ Prigogine, a Nobelist in chemistry, proposed a new view of thermodynamics as living systems draw energy from the sun and create a more complex order. Thus he termed living organisms as ‘dissipative structures’ creating structure from this energy and dissipating it into the environment. These include humans and our organisations, cities, economic systems and nation states. See Figure 3: Three modes of resource use in national development. In *From Being to Becoming* (1980)⁶⁷, Prigogine focuses on these processes of evolution, that each species waste was an input for another life form in the living biosphere, emerging from a hostile early lifeless planet.

In the same year, the Santa Fe Institute was founded by ex-US Department of Defense scientists in New Mexico headed by George Cowan and Nobelist Murray Gell-Mann. Citibank provided grants, so these complexity theorists could study how to beat stock markets. Since 1984, the Santa Fe Institute has developed agent-based models of the economy. While an advance on computable general equilibrium (CGE) models, traditional economic assumptions about these agents’ behaviour simply re-produced the trade wars, poverty and inequality of the unsustainable economic models, typical garbage-in-garbage-out results. Their recent output has been more nuanced and informed by biology and biomimicry science.

Other examples of broader use of complexity models are those of the Swiss Federal Institute of Technology (ETH), which studies interconnectedness of global corporations and finance and those of the New England Complexity Science Institute (NECSI), which models how financial speculation and ethanol subsidies drive up food prices causing riots.⁶⁸ Biological

FIGURE 3

Three modes of resource-use in national development



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physicist Dr. Mae-Wan Ho presented a circular thermodynamics of organisms and sustainable systems in *The Rainbow and the Worm* (1993).⁶⁹ Her 'Circular Economy in Davos' is an insightful assessment of 'The Circular Economy' report at the World Economic Forum, 2013, presented by the Ellen MacArthur Foundation and McKinsey about how the circular economy can be made more systemic.⁷⁰

DIVING INTO MONEY DESIGN

After the financial crises of 2007–8, which are still devastating millions in many countries, 2012 and 2013 saw further scandals in the global banks' manipulation of LIBOR interest rates and the exposures of dark pools and high-frequency computerised trading.⁷¹ No issues are more important than those of money creation, credit allocation, financial architecture and prudential regulation, monitoring and oversight – including offshore finance, tax avoidance and criminality.⁷² These deeper issues are the focus of many NGOs, including the Public Banking Institute, the American Monetary Institute, The Center for New Economics, in the USA and the Finance Innovation Lab, Positive Money, BankTrack, New Economics Foundation (nef), the Green Money Working Group and others in Europe. Our manual for asset managers, *Principles of Ethical Biomimicry Finance™* is now available for licensing.

Beyond traditional economic textbook definitions of capital, efficient markets, rational actors and property rights, new definitions emerged: social and human capital, ecological assets, amenity rights and recognition of the domains beyond markets, the commons (oceans, atmosphere, biodiversity, culture, information and electromagnetic spectrum).⁷³ Ethical Markets foresaw today's dilemma of structural unemployment due to automation and technology and why this causes collapsing aggregate demand in mature economies, and examined alternative access to purchasing power: guaranteeing minimum incomes, contingent cash transfers, employee stock ownership and cooperatives.⁷⁴ Contingent cash transfers in Brazil and Mexico have brought millions out of poverty and contributed to these countries' recent successes – now leading their youth to demand further social progress.

Some economists adopted ecosystem perspectives and terms from biology, but with little effect on mainstream models.⁷⁵ The UN programme on The Economics of Ecosystem and Biodiversity (TEEB) incorporates ecosystems services into the price system which has engaged the business community.⁷⁶ Global finance was first recognised as a part of the global commons at Bretton Woods in 1945 and subject to international rules and oversight of the IMF, World Bank and later the WTO.⁷⁷ These earlier rules are inadequate to prevent the unregulated risk-taking, exotic new instruments and leverage that led to the financial collapse of 2007–8 and the continuing social devastation it caused.

High frequency trading (HFT) by computers and algorithms will no doubt hasten the next financial blow-up, as discussed in 'Global Finance Lost in Cyberspace,' (2011).⁷⁸

THROWING SAND IN THE GEARS OF FINANCIALISATION

The financial transaction taxes (FTT) I have advocated since 1996 have now been endorsed by the European Commission despite vigorous opposition from financial sectors and are in place in many countries. The most focused approach is as 'cancellation fees' since HFT traders enter many thousands of orders and cancel most of them in milliseconds.⁷⁹ Most types of FTT, all under 1%, are fiercely opposed by market players while their projected revenues to governments mired in budget deficits make them quite popular, particularly among NGOs. These FTTs are a better way to curb the excesses of high-frequency traders than, for example, economist Joseph Stiglitz's proposal that HFT positions in any stock must be held for at least one second!⁸⁰ Computer expert in electronic markets Dave Lauer refutes the claims of HFT traders that their practices improve markets.⁸¹ Meanwhile, NGOs, ATTAC and those promoting FTT as the 'Robin Hood Tax' are joined by Occupy activists and intellectuals including Brett Scott, author of *The Heretic's Guide to Global Finance*.⁸²

3. The bankruptcy of conventional economics

Economics, never a science, has been largely invalidated by its own failures and defunct models now exposed.



ECONOMICS NEW CHALLENGERS

Economics, never a science, has been largely invalidated by its own failures and defunct models now exposed.⁸³ I explored the rise of this discipline and its professional services to the early companies, banks and stock exchanges in Britain as the Industrial Revolution developed in *Politics of the Solar Age*. Markets grew from village greens to national systems of resource-allocation, buttressed by the first political economists from Adam Smith onward. While game theory eclipsed many economic theories, behavioural science delivered the *coup de grace!* Neuroscientists and endocrinologists discovered that economic textbook models of human nature were inaccurate, since they portrayed rational behaviour as that of individual competition for maximising of self-interest. Even though generations of critics have pointed out that humans also enjoy cooperating, sharing, giving gifts and caring for each other,⁸⁴ it took physical scientists to challenge economists.

Brain researchers discovered that humans are not always rational and that we are usually of two minds: with our decisions sometimes made emotionally and instinctively by our 'reptilian' brain, the amygdala, and at other times by our forebrain, the prefrontal cortex which allows us to consider consequences and longer-term issues.⁸⁵ Biologist Bruce Lipton explores these processes in *The Biology of Belief* (2006) and collaborates with Rob Williams, originator of the cognitive tools PSYCH-K® and PER-K® for high-speed mindset change to accelerate human learning.⁸⁶ Advertising, a global \$500bn annual industry, has operated on this understanding and generally targets their marketing to our amygdala, as in 'You deserve a vacation! Just put it on your credit card.' This is why I founded the EthicMark® Awards for responsible advertising that uplifts the human spirit and society. In its eighth year, the EthicMark® Awards honored Philips Electronics' advert for its solar-powered LED village lighting systems and the non-profit Technical University in Peru for its water-collecting billboards using osmosis. World Resources Institute (WRI) Access Initiative, Ten Thousand Villages and other earlier awardees include public service campaigns such as 'The Story of Bottled Water'.⁸⁷ A fair method of curbing the growth of this global advertising industry without interfering with free speech is the Truth in Advertising Assurance Set-aside (TIAASA) proposed in 1997.⁸⁸

HORMONES: HIDDEN DRIVERS OF TRADING AND BEHAVIOUR

Endocrinologists discovered testosterone and how this hormone governs aggression which in excess can lead to violent behaviour, lack of control and excessive feelings of omnipotence and thus risk-taking. Not surprisingly, as financial markets were deregulated, leverage increased and traders took ever-greater risks which led to the blow-ups of 2007–8. Endocrinologists taking cheek swabs of traders in the City of London found elevated testosterone levels,⁸⁹ while many books on these crises reported the same kind of heedless risk-taking by these often self-proclaimed 'masters of the universe.' Studies show that gender-balance improves companies' performance while others conclude that women manage financial assets better and less riskily than men.⁹⁰ Much psychological research shows how aggression, violence and risk-taking are related to males.⁹¹ Economic theory is also male-focused and patriarchal. Many studies link economic and particularly monetary policy to wars. For example, John Maynard Keynes' *The Economic Consequences of Peace* (1919) warned about excessive demands in the Treaty of Versailles for payment of war debts by defeated Germans and Niall Ferguson's *The Ascent of Money* (2008) both document the role of bankers and speculators in wars.⁹²

Meanwhile, endocrinologists were researching another hormone affecting human behaviour: oxytocin, secreted by women in pregnancy and elevated during the nurturing of children by men as well as women (women normally have many times more oxytocin than men, but it increases in men nurturing children). In *The Better Angels of Our Nature*, psychologist Stephen Pinker provides overwhelming evidence of how 'feminisation' of societies leads to more peaceable, better governed and educated, healthier and more prosperous societies. Application of such behavioural research to public policy includes the widely used 'choice architecture' by corporations and governments designing prior 'opt-in' features to defined contribution retirement savings plans. These require employees to 'opt-out,' which leads to many more

contributors staying in these plans. These are based on economist Richard Thaler and lawyer Cass R. Sunstein's work at the University of Chicago. Sunstein joined the Obama Office of Management and Budget in 2009 to oversee regulatory affairs, often relying unfortunately on conventional cost/benefit analysis.⁹⁴

SCIENCE AND NEW EVIDENCE TRUMP ECONOMIC THEORIES

All this new science delivered body blows to economics, while its models were also in tatters due to their failure in financial markets. My interest in exploring economic assumptions grew as I documented the pseudo-universality its models claimed and how the power of its narrow methodologies purported to explain human behaviour and politics. The growing power of economists became evident in academia, dominating discourse in law, sociology and colonising political debates, as I saw in Washington in the 1970s while serving as a science-policy adviser. For example, all legislation under discussion since the late 1970s was made subject to 'economic impact statements' with blatantly biased cost-benefit analysis, omitting impacts on citizens, future generations and the environment.⁹⁵

The textbook models of efficient markets, Pareto Optimality, rationality, Modern Portfolio Theory, Capital Asset Pricing models, Value-at-Risk, even the Bank of Sweden prize-winning Black-Scholes Options Pricing Model, are now all found wanting and challenged by many market players themselves.⁹⁶

From critiques of economics core theories by other social sciences to those from the physical sciences, the economics profession was challenged with new research from both knowledge domains.

Endogenous human-focused conventional research was challenged by psychologists, including Daniel Kahneman in *Thinking Fast and Slow* (2011), highlighting our subconscious biases, cognitive errors and theory-induced blindness, while endocrinologists pinpointed how our hormones drive behaviour and how our forebrains and their higher cognition get hijacked by the 'fight or flight' responses of our reptilian brain amygdala. Paul Zak in *The Moral Molecule* (2012), Robert Axelrod in *The Evolution of Cooperation* (1984) and David Loye in *Darwin's Lost Theory of Love* (2000) show how these new scientific discoveries invalidate economics and financial models of risk.

Exogenous models in physics were similarly challenged by quantum mechanics demonstrating a non-local universe including Bell's Theorem and the work of Robert Nadeau, physicists David Bohm and Fritjof Capra, and in the non-linear mathematics, chaos models I described in *Politics of the Solar Age* (1981).

While macroeconomics was discredited, accounting models at company levels were evolving to embrace broader issues, as described in this paper, including the Value Driver Model, as well as the International Integrated Reporting Framework released in December 2013 which recognises six forms of capital: finance, built, intellectual, social, human and natural. This shifts focus to knowledge and other intangibles and rates the performance of organisations and their business models in value-creation or destruction.⁹⁷

As global issues from hunger, poverty and pandemics to desertification and climate change were debated in many UN forums and NGO conferences, they went unaddressed by obsolete paradigms. Yet another tenet of economic theory came under attack: the supremacy of markets postulated in the Arrow-Debreu model seeing 'progress' as 'market completion' and favouring property rights in governing common resources.⁹⁸ Ever since biologist Garrett Hardin's 'The Tragedy of the Commons' (Science, 1968), policymakers and Hardin himself had become convinced by economists that common resources could best be managed sustainably by converting them into property. I was invited by Hardin and the other faculty of the University of California – Santa Barbara, as a Regent's lecturer in 1976, and challenged these notions.

CHALLENGING ECONOMICS IN THE US CONGRESS

By the 1980s, my alternatives to economics in multi-disciplinary policy tools such as those I helped develop for risk assessment⁹⁹ and for technology assessment, scenario-building, and normative futures research led me to many debates in Congress, testifying at hearings on why Congress needed its own budget research group, which became the CBO.¹⁰⁰ In my hundreds of lectures at business schools, I enjoyed challenging economists, but found few who would with debate me and many who banned my books as too radical. Students continued to invite me and often told how they had bought my books and put them in their college libraries – only to have their economics professors remove them. E. F. Schumacher advised me to ‘stay under the radar,’ advice which I have taken ever since. In ‘New Markets and New Commons’ (1995), I pointed out that a new paradigm from game theory based on ‘win-win’ cooperation was more appropriate than economics’ focus on ‘win-lose’ competition.¹⁰¹

Not until 2010 did the Nobel Economics Committee recognise the work of political scientist Elinor Ostrom with its Bank of Sweden Prize. Ostrom, who died in 2012, had documented many examples of equitable, sustainable management of commons by cooperative decision-making processes.¹⁰² The deeper story is that Alfred Nobel never gave or intended to give a prize in economics, which is a profession, not a science. So, the Swedish Riksbank lobbied the Bank of Sweden Prize for Economic Sciences in Memory of Alfred Nobel onto the Nobel Committee in the 1960s in order to legitimise economics as a ‘science’ as part of the Cold War effort to de-legitimise Marxism and communism.¹⁰³

As economic theories were invalidated from all these directions, the Nobel Committee resorted to giving its Bank of Sweden Prize to non-economists: including Elinor Ostrom, as well as game theorists Robert Aumann and Thomas Schelling, information theorist Herbert Simon, and psychologists Daniel Kahneman and Amos Tversky. I helped expose this intellectual scandal in my editorials and found an ally in Nassim N. Taleb who met with the King of Sweden and called for this Bank of Sweden Prize to be withdrawn or abolished.¹⁰⁴ In 2011, Alfred Nobel’s descendant and lawyer Peter Nobel, after many years trying to expose this misuse of the Nobel Prize name, persuaded the Nobel family to publicly dissociate from the Bank of Sweden and its prize.¹⁰⁵

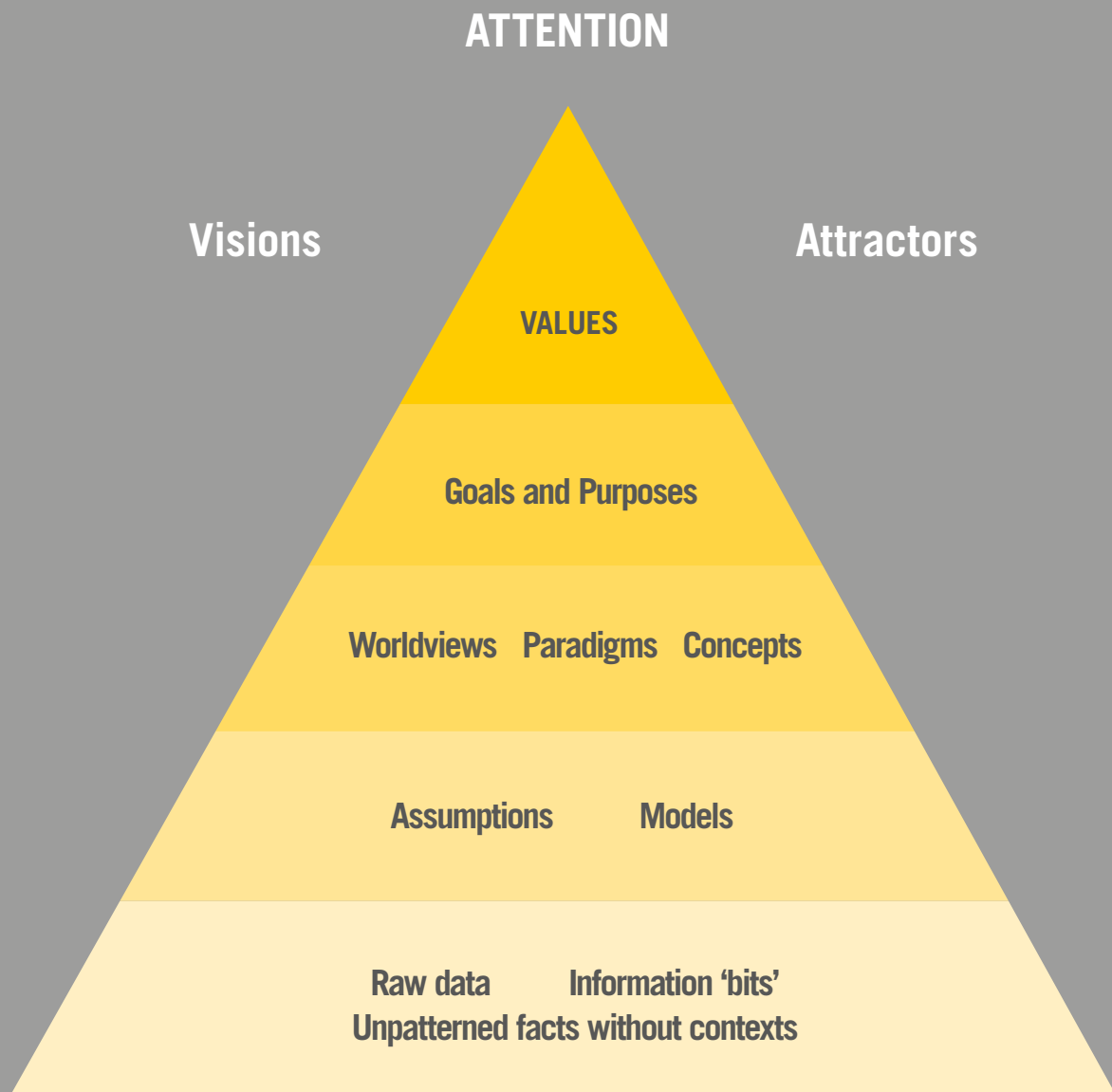
All this largely unreported intellectual history of the economics profession is now necessary if we are to face our current global conditions beyond theory-induced blindness regarding climate change and many other ‘externalities’ caused by the influence of these now defunct theories. The paradigm breakthroughs at Rio+20, other UN agencies, the G20 and others reported in this paper are welcome signs! While economics focuses on competition, the world now needs cooperation at every level and the contributions of other disciplines documenting the full repertoire of human behaviour (conflict, competition, cooperation and sharing). We also see how better information is needed to address our human purposes, see Figure 4: Information quality scale. Indeed, computer scientist Jaron Lanier explores the deeper philosophical and political issues of the pervasive information revolution, its effect on unemployment, inequality in *Who Owns the Future?* (2013) offering deeper, more mature thinking than most of the sophomoric ideas and business models emanating from Silicon Valley.¹⁰⁶ Another internet pioneer Clay A. Johnson shows how watching our information intake is as important as our food diet.¹⁰⁷

Revealing advice given to economists by UK Department of Environment economist, John Corkindale urged them ‘to capture the sustainable development agenda for the economics profession.’¹⁰⁸ This occurred in the skewing of the UN climate conference in Kyoto in 1998 by US insistence on ‘market-based’ approaches which focused on creating the ambitious complexities of designing, *a priori*, the global emissions-trading regime in the Kyoto Protocol. The better approach would have been the simpler market-based approach of pollution and carbon taxes. Pollution taxes are widely popular, as are financial transaction taxes. Instead, the influence of US economists led to the complicated creation of markets for trading carbon

FIGURE 4

Information quality scale

(Meaning of information as relevant to human purposes)



Copyright © 1980 Hazel Henderson Source: *Paradigms in Progress*

permits which were taken over by City of London and Wall Street financial firms, leading to the gaming, fraudulent and corrupt practices that have plagued these markets and the near-collapse of the Emissions Trading Scheme in Europe.¹⁰⁹ I have examined these issues and how traders profit while CO₂ emissions have increased since Kyoto.¹¹⁰

I had pointed out how economists had gained power in academic and political circles as apologists justifying elites and their political control through central banking, monetary policies, mass media and favouring the rise of corporations through their competition, 'free markets,' 'free trade' and property rights paradigms.¹¹¹ The flowering of the Industrial Revolution lauded by Adam Smith in *Wealth of Nations* in 1776 had produced leaps in human knowledge and technological advancement. However, after 2007–8 and a series of earlier financial collapses with orthodox advice for austerity measures,¹¹² rising evidence of the social and environmental impacts in 2012 became the time to move on to more multi-disciplinary systems approaches to today's urgent global problems. This requires a further look at how economics misled us: it's lack of understanding of energy and ecosystems as the basis of human life and survival. I realised this fatal flaw while serving on the Technology Assessment Advisory Council to Congress from 1974–1980. My fellow member James Fletcher, then president of the Midwest Research Institute, who became administrator of NASA, told us that if the US government had subsidised solar, renewables and energy efficiency by equivalent subsidies as those to oil, coal, gas and nuclear power that the USA could have been 100% powered with renewables by 1975. This led to my life-long study of green technologies.

ENERGY-BLINDNESS AND THE ILLUSIONS OF ABSTRACTION

Economic theory favoured energy and resource-extraction from the Earth's crust, following the fossil-fuelled Industrial Era. This led to the technological 'lock-in' and excluded all the earlier evidence of solar-based technologies in many societies beyond the Eurocentric industrial model. Thus, economics ignored the role of energy as a factor of production – subsuming it under 'land'. This is why economics did not fully understand or embrace the laws of thermodynamics, particularly the Second Law of Entropy evident in economists' continuous recycling of the theories of Stanley Jevons regarding the use of coal in the 1850s that purport to show the futility of increasing energy efficiency.¹¹³ Economic models of general equilibrium and prices, elasticity of demand and substitution still see human economies as able to pursue perpetual growth in their money-focused view, as in their cash-flow based GDP model which ignores 'externalities' just as corporate balance sheets have done over the past centuries.¹¹⁴ It took OPEC's oil shocks of the 1970s for economic theories to recognise the primacy of energy, while still ignoring its source: photons from the sun!

As economists embraced mathematics in their aspirations to scientific legitimacy, following the lead of Leon Walras, they also saw the economy, abstracted from its social embeddedness, as an equilibrium system, later buttressed by the Arrow-Debreu Model. This reinforced the mathematical illusion of compound interest – imposed on the real world economies– which has led to inevitable debt-based collapses over the centuries. These debt crises gave rise to the tradition of 'jubilee' – that allowed debt-forgiveness to wipe away theoretical mountains of un-repayable debts,¹¹⁵ most recently in the Jubilee 2000... campaign led by Ann Pettifor, author of *The Coming First World Debt Crisis* (2006), which wrote off HIPC debt in the poorest African countries. Robert Skidelsky, author of *The World After Communism* (1995), recently recommended the need for debt cancellation.¹¹⁶ I drew attention to this mathematical illusion of compound interest:

[Economists] have set up an a priori, positive feedback system (based on the value system of private property and its accumulation), in which the interest earned on a fixed quantity of money (capital) will be compounded and the next calculation of interest added on cumulatively.

But this 'runaway' accumulation process bears no relationship to the real world – only to the value system. However, it has profound real-world effect if enough people believe it is legitimate and employ lawyers, courts, etc., to enforce it!¹¹⁷

Additional theory-induced blindness by early economists regarding the laws of thermodynamics was first scientifically challenged by Nobelist chemist Frederick Soddy in *Cartesian Economics* (1922), when he asked what drove a steam-engine:

In one sense or another the credit for the achievement may be claimed by the so-called engine-driver, the guard, the signalman, the manager, the capitalist, or the shareholder – or, again, by the scientific pioneers who discovered the nature of fire, by the inventors who harnessed it, by labor, which built the railway and the train. The fact remains that all of them by their united efforts could not drive the train. The real engine-driver is the coal. So, in the present state of science, the answer to the question how men live, or how anything lives or how inanimate nature lives, in the senses in which we speak of the life of a waterfall or of any other manifestation of continued liveliness, is, with few and unimportant exceptions, BY SUNSHINE.¹¹⁸

Soddy was ridiculed by the economists of his day, as so many other challengers had been before him.

This blindness of economics was exhaustively examined by Nicholas Georgescu-Roegen in *The Entropy Law and the Economic Process* (1971). He was also ignored and became alienated. Georgescu-Roegen taught at Vanderbilt University and his best-known student is Herman Daly.¹¹⁹ Daly has at last found the following his work deserves. Amory Lovins, Jeremy Rifkin and I¹²⁰ all discovered the entropy problem simultaneously and discussed its implications for our common human future many times in the 1970s and 1980s. I postulated that three basic resources: information, energy and matter were key to human development and that the quality and accuracy of information controlled the efficiency of our economy and our prospect for progress. See Figure 3, page 13.

However, by this time, 'economism' had been entrenched in academia, business schools and most problematically in finance, where it has caused such harm as described by Britain's senior financial regulator Lord Adair Turner and others. At a lecture at London City University Cass Business School, Lord Turner broke ranks and called for an end to allowing private banks to create the nation's money, turning this vital function over to government as money-creator.¹²¹ Politicians and media were caught up in these power politics as Wall Street, the City of London and other financial centres began controlling even the most democratically elected politicians through the power of money and credit creation.

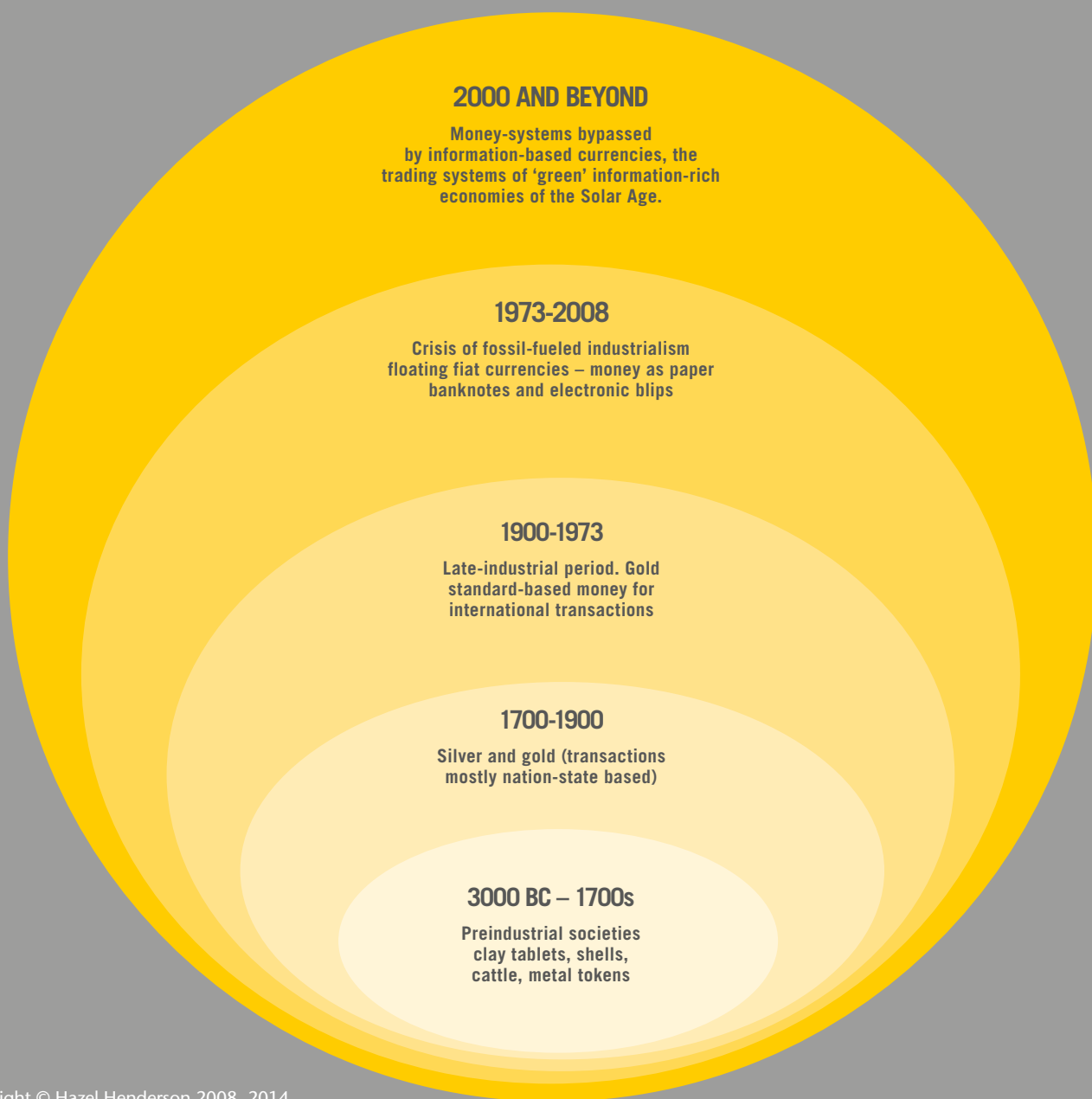
CURRENCY UNITS TRACK REAL WEALTH

Money is a useful unit of account and if well-managed can be a store of value but it became equated with the real-world wealth it tracks and measures, rather than recognising how such units of account have changed over millennia see Figure 5: Evolution of the human understanding of the role of money on page 22. As powerful money-centres grew, financialisation began to trump democratisation as investment banks controlled ratings agencies, helped governments raise bond issues, hide indebtedness with creative accounting and special-purpose vehicles and bail out excessive risk-takers in their banking sectors, while allowing their central banks to create interest-free money to bail out those banks and insurance companies deemed 'to-big-to-fail'.

The latest financial 'products' being offered to investors are infrastructure funds, where distressed cities and states are persuaded to sell or lease public infrastructure built with taxpayer funds, to consortia of investment banks. They then package these public assets eg, toll roads in Indiana, parking meters in Chicago and state-owned public buildings in Arizona, and sell them

FIGURE 5

Evolution of human understanding of the role of money



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based on their income streams from tolls, fees and rent.¹²² Yet new, more efficient infrastructure is vital as societies shift to solar-based green economies.

Promulgating new designs for cities and sustainable infrastructure is the focus of UN agencies and NGOs, including Global Energy Basel, Switzerland. Financiers had forgotten that they do not provide capital, but are intermediaries, serving their clients whose savings they purport to direct to the most efficient uses among borrowers and entrepreneurs. Their failures and conflicts of interests with their clients helped cause the blow-ups of 2008.¹²³ This agency–principal conflict has been studied in corporations but only recently applied to finance, notably by former banker Paul K. Woolley who founded the Paul Woolley Centre for the Study of Capital Market Dysfunctionality at the London School of Economics.¹²⁴

The circle has now closed, as governments assumed private bank debts, compromised the value of their sovereign bonds and imposed often un-repayable levels of debts onto their own taxpayers. As if these betrayals of public trust were not enough, politicians at the behest of their financial sectors then imposed cuts and ‘austerity’ on their taxpayers, leading to today’s widespread revolts and mistrust of government and business elites. As one Spanish protest group complained, ‘we now have market dictatorship!’ Indeed, it is not lost on the worldwide Occupy Movements that in Europe, such appointed ‘technocrats’ in Italy, Mario Monti; in Greece, Lucas Papademos; the Bank of England’s Mark Carney; and the European Central Bank’s Mario Draghi, are all alumni of Goldman Sachs, and this same company provides many US senior officials, including Treasury Secretaries Robert Rubin and Henry Paulson, former New Jersey Governor, then Senator Jon Corzine and many in the Obama administration.

The ‘technocratic’ policies of imposing austerity are mostly driven by financial interests that refuse to take the necessary write-downs on their toxic assets.¹²⁵ They can only survive by enforcing their economic paradigm. This has, so far, worked through invoking fear of even greater cuts to social safety nets, pensions, wages and jobs, combined with threats of national bankruptcy¹²⁶, eroding value of currencies, fears of Chinese creditors, and ‘fiscal cliffs,’ etc. In both the USA and Europe, budget battles are becoming deadlocked by political infighting over such manufactured crises by these ‘scarcity of money’ paradigms. Lord Turner instead proposed that governments can create new fiat money, interest-free, to re-start economies mired in private debt.¹²⁷ Much as Milton Friedman once suggested: ‘throw money out of helicopters for citizens to pick up!’ ‘Helicopter Ben’ Bernanke instead used this idea to throw free money at banks rather than citizens.

POLITICS OF MONEY-CREATION AND CREDIT-ALLOCATION

At last, in 2011, all this theory-induced blindness and the pain it has imposed on average citizens and Main Street economies was exposed by the Occupy Movements,¹²⁸ which began in Europe and spread across the USA, echoed in the student revolts in Chile and elsewhere. These widely diverse movements, often led by the young, finally forced recognition of the inequalities imposed by the 1% and made fairness for the 99% their rallying cry. The politics of money-creation and credit-allocation has now emerged as well as its long history.

The Occupy Movements at last allowed focus on how money had taken over, even in democracies, and the secretive role of central banks and their Bank for International Settlements, often called the central bankers’ central bank. No conspiracy theories were needed, as the role of central banks was clear in bailing out the perpetrators of the 2007–8 and ongoing crises. In today’s Information Age, many TV shows feature currencies rolling off printing presses. Central banks are being forced to account for the trillions they create and have given to prop up their failing big banks. Instead of creating interest-free fiat money, these liabilities are foisted onto taxpayers. In the USA, the \$700bn Troubled Asset Relief Program was a part of the total estimated by the Treasury’s Inspector General at \$23.7tn.¹²⁹ Law suits by Bloomberg and other news groups required the US Federal Reserve to disclose which

banks received the \$16tn it dispensed between December 2007 and June 2010. The General Accountability Office audit listed the largest recipients of this zero interest loan programme: Citigroup, Morgan Stanley, Merrill Lynch (now part of Bank of America), Bank of America, Barclays PLC, Bear Stearns, Goldman Sachs, Royal Bank of Scotland, JP Morgan Chase, Deutsche Bank, UBS, Credit Suisse, Lehman Brothers and BNP Paribas.¹³⁰

With the increase in whistle-blowing, corporate investigating is now big business with firms, including Kroll, FTI Consulting, Corporate Resolutions, Palantir and accounting firm Deloitte and others pursuing corporate, banking and other financial crimes.¹³¹ Offshore tax havens and money laundering are now exposed by civic groups' research. The Tax Justice Network's estimate is \$21tn, among other estimates in the 2013 special *Economist* report which focuses on the US tax havens of Delaware and Nevada and The UK's City of London, as well as the usual black-listed OECD regimes.¹³²

NGO campaigners picket tax-avoiding corporations and others focus on firms speculating in food, while banks fought back.¹³³ The World Development Movement helped Barclays Bank to decide to stop speculating in food,¹³⁴ while BankTrack, Global Financial Integrity and other watchdogs spurred the focus on re-instating public banks, moving money to credit unions and cooperative banks and the coalition Global Alliance for Banking on Values.

In the USA, as in Europe, by 2012, the issues of inequality and the need for fairness exploded across the political spectrum from Republican Congressman Ron Paul¹³⁵ and his Tea Party followers to Democrat Congress member Marcy Kaptor and Independent Senator Bernie Sanders of Vermont. The issue of fairness underlay the re-election of President Barack Obama by more than five million votes. A bill to reform US money-creation has been introduced into Congress by the American Monetary Institute together with a detailed plan and a systemic model by Japanese complexity theorist Kaoro Yamaguchi.¹³⁶ Monetary reformers include the American Monetary Institute led by former mutual fund manager Stephen Zarlenga, author of *The Lost Science of Money* (2002); William Krehm in Canada, founder of the Committee on Monetary and Economic Reform, COMER; lawyer Ellen H. Brown, author of *The Web of Debt* (2007) and *The Public Bank Solution* (2013) and president of the Public Banking Institute; James Robertson, author of *Future Money* (2012); Bernard Lietaer, a former currency trader, co-author of *Money and Sustainability* (2012); Tom Greco, author of *The End of Money* (2009); Australia's Shann Turnbull and New Zealand's Dierdre Kent, author of *Healthy Money, Healthy Planet* (2007), Riane Eisler's *The Real Wealth of Nations* (2008) focusing on gender equality and a new care-based economy; Louis Bohtlink's *Dare To Care* (2012), among others.

INEQUALITY: THE INVISIBLE FOOT'S WINNERS AND LOSERS

To understand why economics overlooks inequality, we need to examine how unfairness is generated by the way money and credit are created by private banks and how tax codes are often shaped to favour special interests. These debates went public in the USA in the 2012 elections. We also see the focus on markets and Adam Smith's belief in an 'invisible hand' whereby individuals striving competitively for their own self-interest benefitted the community and the common good. This theory propagated the view of markets as moral and any government effort to distribute those individual benefits more widely would reduce the market's efficiency.

But, we must ask 'efficiency for whom and over what time frame?' Adam Smith himself was clear that markets could only allocate resources efficiently if buyers and sellers had equal power and information and that no harm from their transactions be imposed on innocent bystanders. Research by political scientist Gar Alperovitz documents the ways in which all individuals rely on groups and society in *Unjust Deserts* (2008), debunking the idea of the usually male 'rugged individual' portrayed in novels.¹³⁷ Yet, the rhetoric in the USA 2012 election still returned to these old debates as 'business' versus 'government'; 'makers' versus 'takers'; 'job creators' versus

'dependents' and which groups were most responsible for avoiding taxes and 'gaming' the system.¹³⁸

Yet the power of this meme of the 'invisible hand' lives on in laissez-faire economics at the Chicago School, in business schools, corporate boardrooms, on Wall Street and in the revolving door 'technocrat' politicians installed in many countries by financial interests. Economic models portray a trade-off between equity and efficiency, reinforcing the theories that any government effort to balance the rewards of their economies is immoral, inefficient and that re-distribution is unfair to the most enterprising and hard-working citizens. Furthermore, these theories see them as the pre-eminent 'job-creators' in their model of trickle-down economics. Some go so far as to say that only the private sector creates jobs, despite widespread obvious evidence to the contrary, that government does indeed create jobs (current government jobs in the USA total 21,862,000¹³⁹) as well as redistribute incomes.

I pointed out the absurdities of these laissez-faire theories and how automation would require new ways of maintaining levels of essential aggregate demand for basic needs in the face of growing structural unemployment.¹⁴⁰ Computer scientist Jaron Lanier documents how the digitisation and automation of retailing, publishing, manufacturing and other sectors of the US economy are driving unemployment, inequality and eroding the middle class in *Who Owns the Future?* (2013). Similar conclusions are found by Adam Arvidsson and Nikolai Peiterson in *The Ethical Economy* (2013)¹⁴¹ and by two courageous MIT economists, Erik Brynjolfsson and Andrew McAfee in *Race Against the Machine* (2011).¹⁴²

INEQUALITY HIDDEN IN OBSOLETE METRICS

Yet these theories are missing in many countries' budget debates since they contradict orthodox economic models. *The Economist's*, June 1-7, 2013 cover 'Toward the End of Poverty,' trotted out research on poverty from the World Bank, the IMF and its own Economic Intelligence Unit. These were all cited in an exploration of various scenarios, 'The Final Countdown: Prospects for Ending Extreme Poverty by 2030.'¹⁴³ Its authors clearly explain its speculative hypotheses and wide range of possible outcomes. All these studies are based on highly aggregated global data and cede that China has contributed most to poverty reduction in the world, using its own socialist market model.

As income inequality grew along with financialisation, globalisation, de-regulation and privatisation, as well as trade deals driven by corporate and financial interests, poverty gaps between and within nations became obvious – even though masked in GDP, which averages incomes. Health, education and welfare statistics began to show the correlations between widening inequality (as measured by GINI Coefficients¹⁴⁴) and declining health, failing education and the rise of soup kitchens, homelessness, crime, suicide and other signs of social distress.¹⁴⁵ The financial blow-ups of 2007–8, rising joblessness, foreclosures, homelessness, poverty, lack of medical care and other social pathologies contributed to alarming rises in inequality in many OECD countries, particularly in the USA as described by Joseph Stiglitz,¹⁴⁶ as well as that continuing worldwide.

IMF, World Bank and official reports using averages, often mask inequality, while it became the focus of some courageous economists and social scientists.¹⁴⁷ These inequality researchers examined how inequality bred instability and resulted in less efficient, less productive societies. Another study estimated the social costs of such instabilities in rising levels of violence.¹⁴⁸ Psychologists Joe Griffin and Ivan Tyrrell of the UK's Human Givens Institute point out the basic conditions for optimal human functionality.¹⁴⁹ The UN 2013 report 'Happiness: Toward a Holistic Approach to Development', by Ban Ki-moon underlines all this research.¹⁵⁰

Economists justifying laissez-faire correctly cited reasons for the jumps in inequality due to globalisation, trade pacts and competition from cheaper labour; or the job losses due to technology and automation.¹⁵¹ Their prescriptions beyond 'allowing the markets to work'

were for re-training the unemployed which assumes that economies are structured for full employment – when clearly they are not. A report on higher education and student loan debt reaching \$1tn in the US in *Bloomberg Business Week* found more than 116,000 college graduates were working as janitors and parking lot attendants.¹⁵² The idea that a whole-system transition was underway has barely entered the debate. Yet, restructuring away from legacy sectors and incumbents from the nineteenth and twentieth centuries was proceeding, and this, along with emerging sectors, was largely un-reported in mainstream media. Similarly, asset allocation models used by security analysts obscured the rise of these new sectors.¹⁵³

The Occupy Movements focused on the 40–50% levels of unemployment among even well-qualified graduates in Spain and other countries. These young people were also often burdened by huge student loans – clearly un-repayable if no jobs were available. Bills in the US Congress based on lawyer Ellen Brown's proposal,¹⁵⁴ similar to that of Lord Turner, would have had the US Federal Reserve Board take these securitised loans onto its balance sheet and forgive them to stimulate the US economy or allow students to borrow at the same 0.75% rate that banks get at the Fed's discount window as proposed by Senator Elizabeth Warren.

An even deeper fairness issue is that unpaid work, usually performed by women, is deemed 'uneconomic' in economic theory and therefore missing from GDP, even though 170 countries pledged to correct this in Agenda 21 Article 40 of the UN Earth Summit, Rio de Janeiro, 1992. The UN Human Development Report estimated this unpaid productive work at \$16tn in 1995, but missing from the global GDP total of \$24tn. An estimated \$11tn was performed by women and \$5tn by men. All these social symptoms of dysfunctional economies are clear indications of the need for a whole system transformation – beyond economic measuring. The 300 years of the fossil-fuelled industrial era is shifting toward a global restructuring of human production, redesigned for the common good and mimicking nature's 3.8 billion years of successful life on Earth powered by the sun. This requires new accounting and asset-valuation models that start with earth systems science and how our planet utilises the regular shower of photons from the sun, processing them through the atmosphere, ocean currents and their harvesting by our living biosphere.¹⁵⁵

4. Global transition from the industrial era to the solar age

This global transition requires, and is generating, innovation based on principles of equity, social inclusion and ecological sustainability. This shift, already underway, will no longer be powered by digging fuels from the Earth's crust but harvesting the sun's rays as our free daily income and is now widely evident: north, south, east and west.



SCALING SOLAR AGE TECHNOLOGIES

Breakthroughs in efficiencies of solar cells now achieve 43.5% conversion to electricity¹⁵⁶ while costs continue to drop – falling by over half in 2013. Much of this innovation occurs outside the official money-denominated GDP measured sectors in the unpaid ‘love economies’.¹⁵⁷ In Figure 6: Total productive system of an industrial society, the two lower layers, invisible to economists, represent some 50% of all production and services in OECD countries and up to 75% in many developing and traditional societies (as above in UNDP Human Development Index in 1995).

Main Street local economies starved of credit and facing a collapse in the domestic money supply are re-building local enterprises with voluntary groups, credit associations, time banking, local currencies, farmers markets, holistic, preventative health cooperatives and constructing community-owned wind turbines and solar collectors.¹⁵⁸ In 2012 the cooperative Mosaic financed three community centre solar rooftops in 24 hours using crowdfunding sites online.¹⁵⁹ Energy efficiency is the fastest payback and thousands of small companies now offer these services to large companies and big retailers, including Wal-Mart, because they also save money.¹⁶⁰ To capture these changes missed in formerly ‘externalised’ costs, accountancy is evolving towards ‘triple bottom line’ and ESG standards¹⁶¹ and the six types of capital used by the International Integrated Reporting Council (IIRC), mentioned earlier, the Natural Capital approach,¹⁶² as well as models by the Sustainability Accounting Standards Board (SASB).¹⁶³ Novethic reports that ‘norm-based exclusion’ from pension and sovereign wealth portfolios reached €2.3tn in 2013.¹⁶⁴ New research finds \$13.6tn of assets now managed by such new metrics.¹⁶⁵ A new method, ‘confidence accounting’ moves from a bookkeeping paradigm toward a scientific measurement using ranges and broader auditing criteria as in the proposal by the Association of Chartered Certified Accountants (ACCA), ICAEW, the Chartered Institute for Securities and Investment, and Long Finance.¹⁶⁶ The UN has hosted several conferences on sustainable stock exchanges and reforms are promoted by the Network for Sustainable Financial Markets (one of our partners). Many foundations and charities are also held to new standards to assure that their portfolios are aligned with their missions. Although this seems obvious, many of these foundation portfolios are still focused on financial returns and hold investments that actually undermine their social mission. The Jessie Smith Noyes Foundation in the USA led by Stephen Viederman pioneered aligning its entire portfolio to its social mission.¹⁶⁷

TRACKING THE GREEN TRANSITION WORLDWIDE

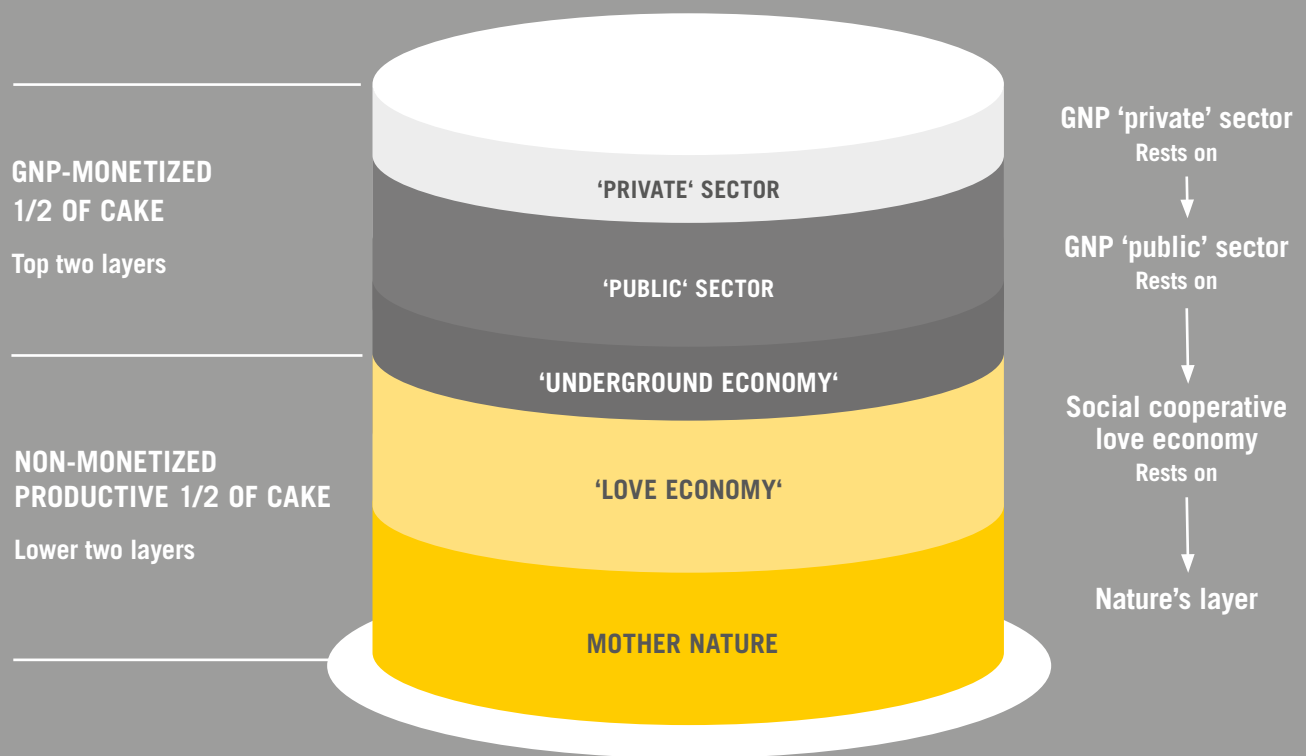
By Q3 2013, the Green Transition Scoreboard® (GTS) totalled private investments in green sectors since 2007 worldwide at \$5.2tn. We intentionally exclude nuclear power, ‘clean’ coal and carbon sequestration and agricultural-based biofuels. Carbon sequestration is best achieved through better land and forest management¹⁶⁸ as well as development of seawater agriculture of halophyte (salt-loving) plants, while biofuels can be made from algae on sea water. We are carefully evaluating nanotechnology and 3D printing and manufacturing, which so far have not been assessed for their social impacts and are still unregulated. Proliferation of drones, especially small ones, often for trivial purposes such as Amazon’s plan for delivering packages, now pose pressing social and environmental concerns. Meanwhile, companies in these fields rapidly develop products with little regard for the public interest.

Our Green Transition Scoreboard®, tracking healthier trends, confirms our view that this transition is on track to reach \$10tn by 2020. The International Energy Agency projects a \$6.4tn total investment in renewable energy during the 23-year period 2012–2035, or an average of \$280bn per year. This \$6.4tn comprises 33% in wind power, 24% hydro, 20% solar PV, 12% geothermal and biomass with another 6% in biofuels, which may be reduced as transport is further electrified.¹⁶⁹

This global transition follows many earlier phases of human societies’ evolution as our technologies evolved from the Iron and Bronze Ages through the energy transitions from

FIGURE 6

Total productive system of an industrial society layer cake



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wood to coal, whale oil to petroleum. This current transition from fossil fuels to greater efficiency and renewable energy and resources is simply the next stage in human knowledge and scientific progress, auguring the post-Cartesian scientific worldview.¹⁷⁰ This has been forecast since the 1970s by the US Office of Technology Assessment.¹⁷¹ John Elkington, co-founder of SustainAbility and Volans Ventures, sees such systemic shifts in his latest book, *Zeronauts* (2012), as does architect William McDonough and chemist Michal Braungart, co-authors of *Cradle to Cradle* (2008) and *The Upcycle* (2013). As OECD Secretary-General Angel Gurría recently stated, 'Green growth strategies focus on ensuring that natural assets can deliver their full economic potential.'¹⁷² The World Economic Forum's Green Investment Report 2013 estimates investments required for water, agriculture, telecoms, power, transport, building, industrial and forestry sectors by 2020 stands at about \$5tn.¹⁷³ The Green Growth Alliance calls for \$700bn for sustainable infrastructure investments annually.¹⁷⁴

Ethical Markets' review of over 100 studies since 2010 was the basis for our recommendation that pension funds and other institutional investors shift at least 10% of their assets to green investments. For example, the European Commission released a draft of its Green Paper to encourage pension funds to shift to longer-term investing.¹⁷⁵ The Dutch pension fund APG announced a \$1bn investment in a wind farm in Mexico.¹⁷⁶ The Mercer Report of February 2011 recommended a shift of 40%: half to hedge against climate and environmental risk and half to capitalise on opportunities in green sectors. Mercer's follow-up survey of 14 asset-owner partners found more than half had already conducted, or were planning, a review of their holdings based on the report's findings.¹⁷⁷ Seattle's mayor Mike McGinn requested the city's two chief pension funds 'to refrain from future investments in fossil fuel companies and begin the process of divesting.'¹⁷⁸ In the USA, students are challenging 250 of their universities' endowments to divest fossil fuel companies from their portfolios and some are now complying. This campaign by NGO 350.org and Bill McKibben is now also emphasising the need to shift these polluting investments to the companies in growing green sectors. Mutual funds, including Portfolio 21 Global Equity Fund and Green Century Balanced Fund, now offer fossil-free portfolios. Norway's Storebrand and Netherlands-based Rabobank now avoid further fossil-fuel investments.¹⁷⁹ Simulations and back-casting by an independent firm, Aperio, showed little or no effect on returns.¹⁸⁰ Analysis at HBSC found that BP, Shell and Statoil could face a loss of 60% of their market value if countries stick to their agreed CO₂ emission targets.¹⁸¹

Since the 2011 GTS report, increased concern by governments and United Nations agencies in promoting the global green transition¹⁸² culminated in the declaration of 191 countries at the UN Rio+20 Summit. Private markets and financial sectors ride roller-coasters and global geopolitical risks, many self-inflicted: from political wrangling in the USA to the failure of EU politicians to address the travails of the euro and restructure budgets. All this fuelled rising civic anger over bailouts of too-big-to-fail banks while imposing cuts and austerity on their citizens, echoed worldwide in the 99% facing the concentrated power of the 1%, verified by ETH.¹⁸³

New levels of concern by institutional investors at the CERES-UN Foundation Investor Summit on Climate Risk and Energy Solutions at the United Nations in New York appear in their report on 'Inaction on Climate Change: The Cost to Taxpayers' released November 2013.¹⁸⁴ Secretary-General Ban Ki-moon commissioned a high-level panel on global sustainability which endorsed his 'Sustainable Energy For All By 2030' initiative in its report 'Resilient People: Resilient Planet: A Future Worth Choosing,' 2012. Ban Ki-moon urged these investors, who represented some \$10tn assets under management, to step up their investments in renewable energy and greater efficiency since governments were struggling with budget cuts 'while there is no lack of capital in the world.' Speakers from Deutsche Bank, Goldman Sachs, GE, Bank of America and other mainstream financiers previously had spoken little about the green transition. A host of new funds using ESG criteria are now offered by Bank of America, Morgan-Stanley, Goldman Sachs, Deutsche Bank and others jumping on the bandwagon. New pledges by signatory companies of the UN Principles of Responsible Investing at Rio+20 evidenced further concern by these institutional investors managing some \$32tn in assets¹⁸⁵. They pledged to include natural capital reporting as 'material' to asset valuation. These terms, 'material' and 'materiality', which crop up in all such reports, betray 'rearview mirror' thinking based on earlier industrial models of

material productions. Today, some 70% of production in OECD countries is services, while in modern corporations some 80% of their asset value is intangible.¹⁸⁶ Private investor members, including AQAL in Germany, launched a €100m pledge fund for green companies,¹⁸⁷ based on its founder's integral investing model.¹⁸⁸

Meanwhile, the global notional value of derivative contracts rose from \$600tn prior to 2009 while GDP was only \$65tn to now \$1.2qn while GDP remains in the \$65tn range.¹⁸⁹ Risks of investments in coal reserves of companies comprising 25% of London's FTSE Index are rising as they are seen less as assets than future liabilities in a carbon-constrained world. A high-level group warned the Bank of England and the European Central Bank that these are now 'sub-prime' assets, posing a systemic risk to pension funds and economic stability.¹⁹⁰ In conventional financial models, risk has referred to financial loss, and therefore maximising financial returns has been paramount. Since the 2008 crises, the focus shifted to overlooked systemic risk. The broader view of risk includes climate, loss of species, biodiversity and ecosystem services (still often unpriced) as well as social risk of ecological refugees, costs of floods, fires, etc., leading to massive insurance losses. A framework for global risk analysis, the Principles for Sustainable Insurance was launched in June 2013 by UNFP FI, endorsed by many global companies based on ESG factors and the UN Principles of Responsible Investment.¹⁹¹ At its November 2013 conference in Beijing, UNEP FI launched its Online Guide to Banking & Sustainability to help bank employees integrate ESG issues.¹⁹²

NEW COURSES FOR ASSET MANAGERS AND DEMOCRATISING EDUCATION

A course on triple bottom line accounting was offered at University of St Andrews in Scotland to retrain asset managers. The course addressed the lag in updating portfolio analysis models still mired in traditional 'efficient markets', 'rational actors', obsolete asset-allocation models and business school curricula, exacerbating agent-principal conflicts of interest and creating an atmosphere of intimidation by portfolio managers and consultants toward asset owners and trustees. Our Ethical Markets Accelerated Learning approach will be widely available in our massive open online course (MOOC) in 2014, part of the worldwide trend to democratise education in these massive online open courses offered by many universities.¹⁹³

While many institutional investors have focused on climate risk (mostly pension funds, endowments and mutual funds), they have now made the leap to seeing opportunities in the global, retooling for the inevitable green transition, estimated by venture capitalists and others as a \$45tn new global market.¹⁹⁴ Thus, our GTS thermometer is calibrated for a realistic annual global private investment of \$1tn until 2020, so as to secure this transition. Shale fossil fuel extraction may involve additional wasted investments (see inside back cover). Natural gas (methane) from shale is still seen as providing a bridge to retiring coal plants – if the process of 'fracking' can control methane release, pollution and be made less destructive to water supplies and the environment.¹⁹⁵ Methane itself is a powerful greenhouse gas and its theoretical claim to produce 50% less CO₂ than coal and oil is now questioned.¹⁹⁶ Extracting oil from shale or tar sands is unjustified on thermodynamic and environmental grounds and, when 'externalities' are fully internalised, extracting these fuels and the unwise investments in more coal plants proves uneconomic, as well as unnecessary. Many of the studies we cite confirm that renewables and efficiency can provide 100% of the world's energy, even as global population increases.

POWER SHIFTING TO ASIA

Meanwhile, global geopolitical shifts rearranged power toward Asia, particularly India, China and Indonesia, and the rising influence of developing countries, especially Brazil, China's major trading partner. Now the world's sixth industrial economy, Brazil is the natural resource-rich 'green giant' and a leader in hydro and wind power as well as flex-fuel cars. The mature economies of Europe and North America have stagnated, all on various forms of life-support from their central banks and rebellious citizens. Japan joined in central bank money-creation

under President Shinso Abe, with predictable rises in its Nikkei Index. Lobbyists and special interest groups maintained their grip on politicians.

In 2013, Asia experienced nature's wrath added to 2012's unprecedented series of crises: Japan, Chile, China and New Zealand suffered earthquakes followed by tsunamis in Japan and Chile and two devastating typhoons in the Philippines, all situated on the Pacific Ocean's Ring of Fire. Pakistan, Thailand and Australia suffered devastating floods, followed by record heat in Australia. The USA also experienced droughts, a wave of destructive tornados, massive flooding along the Mississippi basin and in the Northeast from unprecedented devastation from hurricane Sandy. The global loss of life and disruption of production was massive as were the costs estimated by Munich Re – \$378bn for 2011.¹⁹⁷ In the USA, Hurricane Sandy costs estimated for New Jersey and New York reached \$60.4bn, a fraction of yet to be calculated liabilities for 2012. While sceptics pointed to a slowing of atmospheric warming in 2013, the world's oceans were absorbing the heat, leading to rising sea levels in the Pacific Ocean.

COMING OUT OF CLIMATE DENIAL IN NORTH AMERICA

Those denying scientific consensus on Darwin, evolution and anthropogenic (ie, human) effects on our planet's biosphere (including the 75 members of the US Congress in 2012) have been exposed, as noted on page 3, as largely funded by fossil fuel interests. 350.org found US citizens lag behind 26 other advanced countries in their belief in evolution. Backlash legislation and more 'rebound effect' studies to protect coal and oil interest are still pushed by Republicans in Congress. Meanwhile, the UK Parliament launched the Green Investment Bank, and the Environmental Audit Committee began its inquiry on green finance to explore institutional investors' decision making; to what extent a 'carbon bubble' exists and how to re-direct finance toward green sectors.¹⁹⁸

Media and public debate is now surfacing in the USA and Canada on the need to shift to a more ecologically sustainable, socially just, cleaner, greener economy. Coverage of the heat waves, fires and storms, finally caused wider public recognition of global warming's effects.¹⁹⁹ The influential Center for American Progress' 'Fulfilling the Promise of Concentrating Solar Power' and the US Department of Energy's Sun Shot programme urge ramping up solar CSP.²⁰⁰ Canada's Conservative government is challenged by new opposition groups. Geothermal energy, long overlooked, is now growing as a clean alternative, promoted in the USA by the Geothermal Energy Association.²⁰¹ The reporting in our GTS still comes as a surprise to most mainstream media and public opinion driven by advertising revenues from incumbent fossil-fuelled sectors. At last, a high-profile US TV series 'Years of Living Dangerously', arrives in 2014,²⁰² as well as the new SeeGreen® app based on the PBS TV series 'Earth: the Operating Manual'.

Emerging economies, led by China, India, South Korea, Brazil and many other countries, are advancing apace in shifting to greener economies.²⁰³ A report now shows how little land is required in developing countries such as, Indonesia, Madagascar, India, Mexico, Morocco, South Africa and Turkey, to provide 100% of their electricity with solar at utility scale ie, able to provide across larger areas and grids.²⁰⁴ The Asian Development Bank–UNESCAP report sees Asia emerging as a green economy leader now reflected in China's new five-year plan moving toward a circular economy able to provide electricity nationwide on a large-scale.²⁰⁵ Research by Pew found that among the G20 the USA still lagged far behind.

Momentum for the global green transition was accelerated by the OECD group of 37 advanced economies. Their Towards Green Growth reports²⁰⁷ (and many others) indicated greater efforts to 'de-carbonise' their economies and grow green sectors simply to modernise, create jobs and invest in more energy and resource efficiency.²⁰⁸ Also, the International Monetary Fund's working paper: 'Who's Going Green and Why?' appeared in December 2011 and the global Katerva Awards have identified through their scientific networks many brilliant

new technologies and approaches to sustainability.²⁰⁹ A leading research group's list of 'Top Emerging Technology Companies in 2012' is replete with cleantech companies in solar, grid storage, bio-based materials, energy efficiency as well as health, wellness and infrastructure.²¹⁰ The world's cities now compete on these new metrics, including the C-40 group of over 63 cities worldwide sharing knowledge, led by New York City's former Mayor Michael Bloomberg in partnership with the William J. Clinton Foundation.²¹¹ London already has 300 diesel/electric buses with a further 600 delivered in 2013 and 1000 electric car charging stations.²¹² Companies Tesla, Envision Solar and others sell EV chargers widely in the USA. This green progress is tracked in the USA by the US Metro CleanTech Index.²¹³

THE NEED FOR NEW METRICS

Mainstream financial markets confronted with reports from Carbon Tracker²¹⁴ show that mal-investments in fossilised energy sectors and reserves again illustrate the need for new metrics, not only to internalise externalities in prices and investment models, but also to correct GDP²¹⁵. Such metrics include the Ethical Markets Quality of Life Indicators pioneered with Calvert in 2000 and the OECD's Better Life Index. Many countries are now shifting beyond GDP to such more comprehensive indicators. The Sustainable Society Index (SSI) 2012 takes a similar broad approach.²¹⁶ A new Inclusive Wealth Index (IWI) was launched by the United Nations University at Rio+20, June 2012.²¹⁷ The UN Report 'Happiness: Toward a Holistic Approach to Development' calls explicitly for a new development paradigm.²¹⁸ Since 2008, large majorities in 22 countries agree that the move to renewable energy is critical to prevent climate change.²¹⁹ The Green Growth Knowledge Platform, launched January 2012 by OECD, UNEP and the World Bank, will help governments design and implement green growth policies.

In 2012 impetus for green growth also came from the United Nations. Its 193 member nations submitted their plans for the green transition and 191 signed the Declaration at Rio+20. Only two countries remain sceptical about this global transition to a green economy: Venezuela and Bolivia. Both see it as a capitalist takeover of environmental resources to commodify them for private profit. The Green Economy Coalition (GEC) is the largest global coalition of NGOs tracking these definitions of the inclusive global green economy.²²⁰ Agricultural land is described as the newest 'asset class' in an April 2012 conference for hedge funds, sovereign wealth funds and other institutional investors. The US pension fund TIAA-CREF and Sweden's AP2 are developing standards for farmland investing.²²¹ Ethical Markets believe that food should not be traded as an 'asset class,' since speculative positions have caused prices of staples to rise around the world, causing unnecessary hunger.²²² In particular pension funds should refrain from holding long positions in commodities futures and ETFs. US subsidies to ethanol produced from corn proved environmentally harmful and were reduced in 2012 but are still mandated in gasoline. They divert so much agricultural land and resources from food production that this also contributed to higher prices.

Wide debates continue in 2013 seeking to define the green economy from the report of the Green Economy Coalition to those in the UN General Assembly in 2013.²²³ Pakistan, Mexico, Ghana, Egypt and Argentina expressed reservations that poor people and the social dimensions of development would be short-changed while Costa Rica has become a green economy leader. Meanwhile, 27 EU countries increased their share of renewable energy consumption from 11.5% in 2009 to 12.4% in 2010.²²⁴ A GlobeScan survey of experts found 72% saying that the green economy was the right theme for Rio+20 while 76% agreed that socially responsible investors would be the most important influencers, along with NGOs (69%) and labour unions (57%).²²⁵ Closer focus on the successes of standards of energy efficiency and requirement for feed-in tariffs and renewable energy percentages for electricity utilities show that such government mandates are effective, as are labelling of appliances, products and building projects. Eco taxes, pollution and carbon taxes can keep any 'rebound effects' to a minimum, as well as a tax on financial transactions, all now on agendas in many countries.²²⁶

LEAPFROGGING OLD TECHNOLOGIES

The developing countries of the southern hemisphere have specific advantages in the race to green the world's economies.²²⁷ UNFP FI reports on financing renewable energy in developing countries focus on Africa²²⁸ where countries are rich in solar resources. Here, infrastructure can be designed to support green, inclusive sustainable development as outlined in 'Infrastructure for a Changing World.'²²⁹ These countries have fewer legacy and incumbent industries in fossilised sectors, less obsolescent infrastructure and fewer stranded assets (eg, aging nuclear plant decommissioning, mal-investments in proven fossil-fuel reserves which are unlikely to be recovered for multiple reasons: net energy costs, prices, additional pollution, etc.).

Transmission lines may shift from AC to DC and grids may be more regionalised and localised in many countries. The DESERTEC project is planned by 12 EU companies to bring electricity from solar facilities in North Africa over a high-voltage transmission line under the Mediterranean into Europe's grid. Another shift is occurring in electricity and transport in the USA and Europe which reverses the assumptions of big power plants that renewables (solar and wind) are too 'intermittent' and cannot be integrated into base-load generation.²³⁰ The new paradigm is that renewables are developing to bypass or 'leapfrog' big plants and are growing locally via micro-grids, rooftops and cooperatively owned and municipal generators. All this is making 'big project finance' unprofitable.²³¹ By 2011 the boom in solar installations was driven by cost reductions rivalling coal plants and utility-size solar projects are close to grid parity. Bloomberg estimates that such projects will cost \$1.45 per watt to build by 2020 – half the 2013 price.²³² A 2013 report finds that 100% renewable energy could be closer than we think – particularly in coal-rich Australia.²³³

Thus, the 'technological leapfrog' strategies are preferred, particularly by China, Brazil, India and many other emerging giants, including those in the DESERTEC initiative. This 'leapfrog' takes many forms eg: mobile phones, leapfrogging costly landlines; distributed, local solar, wind, geothermal, low-head hydro leapfrogging wasteful national grids and costly centralised power plants; more energy and resource efficiency leading to re-designing of cities for pedestrians, cycles and mass transit, LED-municipal lighting and locally sourced solar and wind generators. As noted in many studies,²³⁴ not only do developing countries now have these leapfrog advantages, costs are lower, allowing the 1.6 billion people who live far from electricity grids to enjoy simple solar electricity thanks to such innovators as Philips, mentioned earlier, Swiss-based DT Power²³⁵ and others.

Most developing countries cannot afford nuclear power or big central power plants and grid systems. However they are abundant in solar and renewable resources and culturally attuned to conservation and efficiency. For example, India uses its domestic coal inefficiently. Its future choices concern whether to increase imports and build more costly coal plants, or to ramp up renewables, particularly wind and solar.²³⁶ Nuclear power's future is cloudy even in industrial countries, due to huge cost over-runs even after massive government subsidies and the disaster at Fukushima-Diachi which spurred a shift to renewables and Japan's plentiful geothermal energy sources.²³⁷ As the *Financial Times* special report shows,²³⁸ the idea of rich countries funding development in poor countries is becoming a thing of the past. Emerging markets are as much sources of cash as they are recipients, especially the sovereign wealth funds of China, Singapore and OPEC member countries. Many employ public development banks, such as the Brazilian Development Bank – BNDES, which finances innovation in all sectors. Others fund domestic entrepreneurs with community-based banks such as Grameen and BRAC in Bangladesh and ACLEDA in Cambodia.²³⁹

BIOMIMICRY

The most efficient technologies are those employing the science of biomimicry (as for example, computer optimisation for solar power plants, *The Economist*).²⁴⁰ These new technologies mimic nature's designs for producing materials, conserving energy – optimised over 3.8 billion years of experimentation! See Figure 7: Leading-edge technologies mimicking nature. Globally,

FIGURE 7

Leading-edge technologies mimicking nature

TECHNOLOGIES – AIRPLANES	NATURE’S MODELS – BIRDS
<p>Cameras Artificial intelligence...Expert systems Biotechnologies...Genetic engineering, cloning ...Monoclonal antibodies, interferon, insulin ...GMOs, hybrids ...Luciferase ...Chemical attractants, biological pest control ...Protein-based catalysts, assemblers</p> <p>Energy: Ocean thermal, tidal and wave generators ...Biomass energy conversion ...Dams, hydropower ...Solar photovoltaic cells ...Osmosis, fuel cell membranes ... Solar arrays and sails ...Fusion reactors</p>	<p>Eye Human Intelligence, knowledge DNA, RNA codes, viruses, bacteria ...Human immune system ...Plants, wild species ...Fireflies ...Insects pheromones, microbes, fungi ...Amino acids, microbes ...Viruses</p> <p>Oceans and other global processes ...Natural decay processes, fermentation ...Gravity ...Green plants chloroplasts ...Living cell membranes ...Insect wings ...The sun</p>

Copyright © 2001 Hazel Henderson 1987; Source: *Paradigms in Progress*, 1991, 1995; 2006

companies are turning towards biomimicry methods in production.²⁴¹ Biomimicry is helping re-design many industrial methods and products such as dyeing fabrics using CO₂ instead of water.²⁴² Global clothes manufacturer H&M partnered with WWF to convert its suppliers to reduce water use.²⁴³ Long overlooked agricultural technologies, pioneered by the Savory Institute²⁴⁴ include the restoration of grasslands; the most efficient way to sequester carbon. In addition, innovations pioneered by The Land Institute in perennial plants and eco-restoration. Seawater farming in desert lands using halophyte plants for human and animal food.²⁴⁵

Helping companies re-tool offers safe biomimicry alternatives in many areas. These natural methods are distinguished from the more questionable 'artificial life' methods including genetically-modified organisms for producing transport fuels and those using nanotechnologies which have not yet been assessed for their possible social and environmental impacts.

OUR INVOLVEMENT

Ethical Markets Media, a Certified B Corporation in the USA and Brazil, is deeply involved in the accelerating green transition and, for full disclosure, our principals are also personal investors in many green and biomimicry technology companies.²⁴⁶ We are also partnering with Biomimicry 3.8 in furthering its research on ways to embed this new science in products and services (offered as a two-year Masters degree). Biomimicry 3.8's scientists, Ethical Markets Media, LLC, and our financial team also developed, *Principles of Ethical Biomimicry Finance*TM.²⁴⁸ This manual of protocols and criteria for investors in biomimicry-based companies includes those in sustainable agriculture, forest and fisheries.

In 2012 we co-hosted with Biomimicry 3.8, Harvard-based Wyss Institute, the San Diego and Zurich zoos, the European Biomimicry Innovations and Finance Conference, Zurich, August 2012. We are members of the Green Economy Coalition and contributed to the Rio+20 process, as well as reviewing OECD 'Towards Green Growth' reports. Useful overviews include *Cleantech Nation* by Ron Pernick and Clint Wilder (2012) and 'State of Green Business 2012',²⁴⁹ covering all the key sectors and new start-ups, including the emerging 'mesh' generation of young companies, some for-profit, others non-profits. In *The New New Deal*, Michael Grunwald explores the much vilified \$787bn stimulus programme enacted by the Obama administration to avert the economic collapse looming on his inauguration in 2009. \$70 billion went to green sectors and created two million jobs.²⁵⁰

THE POTENTIAL FOR ENERGY EFFICIENCY

Energy efficiency and reducing material throughput in all national economies target the lowest-entropy goals. For example, there is the potential in 120 million buildings in the USA to triple or quadruple their energy productivity with an average return of 33%.²⁵¹ Projections by the US Department of Energy, based on best available technology, show reductions in primary energy consumption are possible by 2030. 'The 3% Solution: Driving Profits Through Carbon Reduction' found that the US corporate sector can drive up to \$190bn in 2020 and the net present value between 2010–2020 could be as high as \$780bn.²⁵² Demonstrable progress has been made in many countries and the potentials for huge efficiency improvements still exist worldwide. While some think tanks and economists still oppose energy efficiency, citing Stanley Jevons' 'rebound effect' from externalities allowing increasing consumption, this effect overall is reported at only 11%.²⁵³

THE DECLINE IN ENERGY USAGE

The American Council for an Energy Efficient Economy (ACEEE) and the European Council for an Energy Efficient Economy (ECEEE) and the US Energy Information Administration's 'Annual Energy Outlook: Early Release Overview 2012' see energy use per capita declining at an average rate of 0.5% per year from 2010 to 2030.²⁵⁴ A positive note on the advance of energy and materials efficiency is 'Long-term Efficiency Potential' report²⁵⁵ which compares the 2050 USA energy-use forecast of 220 quads with an advanced scenario using only 70 quads²⁵⁶ and the super-efficient Phoenix Scenario using a mere 50 quads which requires deeper 're-design.' These offer a net savings of \$255bn per year and net 1.3 million jobs in the Advanced Scenario and net 1.9 million jobs in the Phoenix Scenario. All these advances are documented in *Cleantech Nation* (2012)²⁵⁷ and in 'Renewables Global Future Report' (2013) from Ren21.²⁵⁸

INFORMATION TECHNOLOGY SECTORS

Another little-reported transition is the evolution of unpaid, voluntary, open-source sectors, based on sharing, cooperating and working for intrinsic satisfaction and personal development.²⁵⁹ These information age sectors are joining the traditional gift and love economy sectors of caring for families, elders, community volunteering, hitherto ignored in economic models and GDP statistics. Canadian Don Tapscott describes these new trends in his *Macrowikinomics* (2011). The rise of barter, sharing and peer-to-peer production, lending and recently crowd-funding are covered on the Ethical Markets website in our Wealth of Networks, Crowdfunding and Community Development Solutions pages, as well as in our TV programmes and by the P2P Foundation. These movements are expanding rapidly, and we follow the many continuing experiments to bypass fiat money circuits with local currencies, credit networks, cell phone banking and digital currencies, including bitcoin, qoin, ven and others. Designs for currencies based on kilowatt hours from renewably generated electricity are in development by the Green Money Working Group as its conference in Split, Croatia, July 2012.

SYNERGISTIC ENERGY-EFFICIENCY AND INFORMATION TECHNOLOGIES

Energy-efficiency and information technologies are closely-related, not only in monitoring use and smart grids, as analyst Jeremy Rifkin describes.²⁶³ Gartner Research notes that 'power consumption will become more and more critical.'²⁶⁴ A useful tool is the Green Electronics Survey which reports progress in reducing energy waste in computers and server farms.²⁶⁵ The competition between Intel and British upstart Advanced RISC Machines (ARM) seeks to increase the energy-efficiency of computer chips and the server racks housed in computer server farms.²⁶⁶ Their inefficiency has been likened to giant refrigerators full of racks of hot ovens! ARM technology chips are less powerful than Intel's but use 1/10 of the power of current server systems and cost 60% less.

We applaud recent efforts to reduce waste as detailed in the report 'Data Center Operational Efficiency Best Practices.'²⁶⁷ Since many electronic products require rare earth elements, no longer produced in the USA, the Congressional Research Service's 'Rare Earth Elements: The Global Supply Chain,' released in September 2011, examines the current global dependence on China.²⁶⁸ Naturally, a key variable in energy and resource consumption is population growth – but as studies show, continuing the 'dematerialising' and delinking of energy and material consumption from GDP and population growth is even more critical going forward. Ashok Khosla, President of India's Development Alternatives, as mentioned earlier, cites the computer model indicating that providing the world's poor women with inexpensive solar electricity and cook stoves, thus allowing them to self-develop, could result in up to three billion avoided births.²⁶⁹ Progress in US electric efficiency in 2010 saved 112 TWh, enough to power over 9.7 million homes for one year while avoiding 78 million tons of CO₂ emissions.²⁷⁰

BREAKDOWNS AND BREAKTHROUGHS

Clearly, in spite of recessions caused by the financial crises, these breakdowns are also driving breakthroughs hastening the global green transition from conventional finance in fossilised sectors. China is now the global market leader in solar, wind and other low-carbon technologies in which they include nuclear. In spite of this, China provides a positive scenario for stabilising the global climate beyond the disappointments of focusing only on carbon emission reduction. Both China and India are still heavily reliant on coal – a huge challenge to scientists of the IPCC, highlighted in the failures of Kyoto Protocol trading regimes at Doha and Warsaw. Trading carbon on financial markets has proved inefficient in removing or preventing further CO₂ emissions, as described in 'From Riggid Carbon Markets to Investing in Green Growth'.²⁷¹

At Ethical Markets, we favour pollution taxes, including carbon, to curb externalities. Many economists see taxes as superior in correcting prices, as well as ending subsidies to fossil fuels and nuclear power, and returning these billions to taxpayers. The role of governments is also vital – now acknowledged even in the USA. The UN and the IPCC now promote the green economy²⁷² as well as focusing on other pollutants such as methane and soot which can slow global warming more cheaply and quickly while bringing positive health benefits.²⁷³ Renewable energy and efficient alternatives to coal-dependent countries are vital, particularly in India and Australia which have both introduced carbon taxes. In 2013, Australia's new conservative government repealed these carbon taxes after heavy pressure from their coal industry. Both countries have abundant solar resources (prices for solar cells fell 51% in 2011 to 88¢), so signs of transition are becoming evident. Although the rapid drop in prices of solar panels caused a shakeout in the USA and Europe, it shows that this maturity of the solar industry has been beneficial to solar panel installers and expanded their markets. Investors are joining the renewables industry leaders in calling for more green bonds, dependable production tax credits (not subsidies), innovative energy real estate investment trusts (REITS), Master Limited Partnerships, more renewable power purchase agreements, and local and public ownership of renewable electric utilities.²⁷⁴ In 2013, issuance of green and climate-related bonds exploded, according to the London-based Climate Bonds Initiative.²⁷⁵

EARTH SYSTEMS SCIENCE BASIS OF INFORMATION-RICH GREEN ECONOMIES

Thus, our Green Transition Scoreboard® 2013 current total of over \$5.2tn clearly shows how this global trend is accelerating. With worldwide interest and concern from citizens, NGOs, trade unions, academia and corporations, we fully support the UN's many efforts over the years to promote sustainability, more ethical corporations through the UN Global Compact and financial firms through the UN Principles of Responsible Investment of which Ethical Markets is a signatory member. Even the US Department of Defense and the Director of the National Intelligence Council are now persuaded about the global green transition. The Council's 'Global Trends 2030: Alternative Worlds' sees megatrends of individual empowerment, diffusion of power and demand for food, water and energy growing with population and all interlinked with other game-changing scenarios²⁷⁶ – truly an integrative paradigm shift! We applaud all the efforts worldwide up to 2013 and beyond. Rio+20, the G20, the Sustainable Development Solutions Network and all other groups with global commitments public and private may well prove to have contributed to a tipping point in the great transition from the fossil-fuelled industrial era to the cleaner, greener solar age. Humanity's satellite 'eyes in the sky' will continue to be our real-time monitors of how our planet is faring in this new anthropocene age.

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American Council for an Energy-Efficient Economy
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ECEEE European Council for an Energy-Efficient Economy
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Ask Nature
www.asknature.org

Biomimicry 3.8
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Carbon Tracker Initiative
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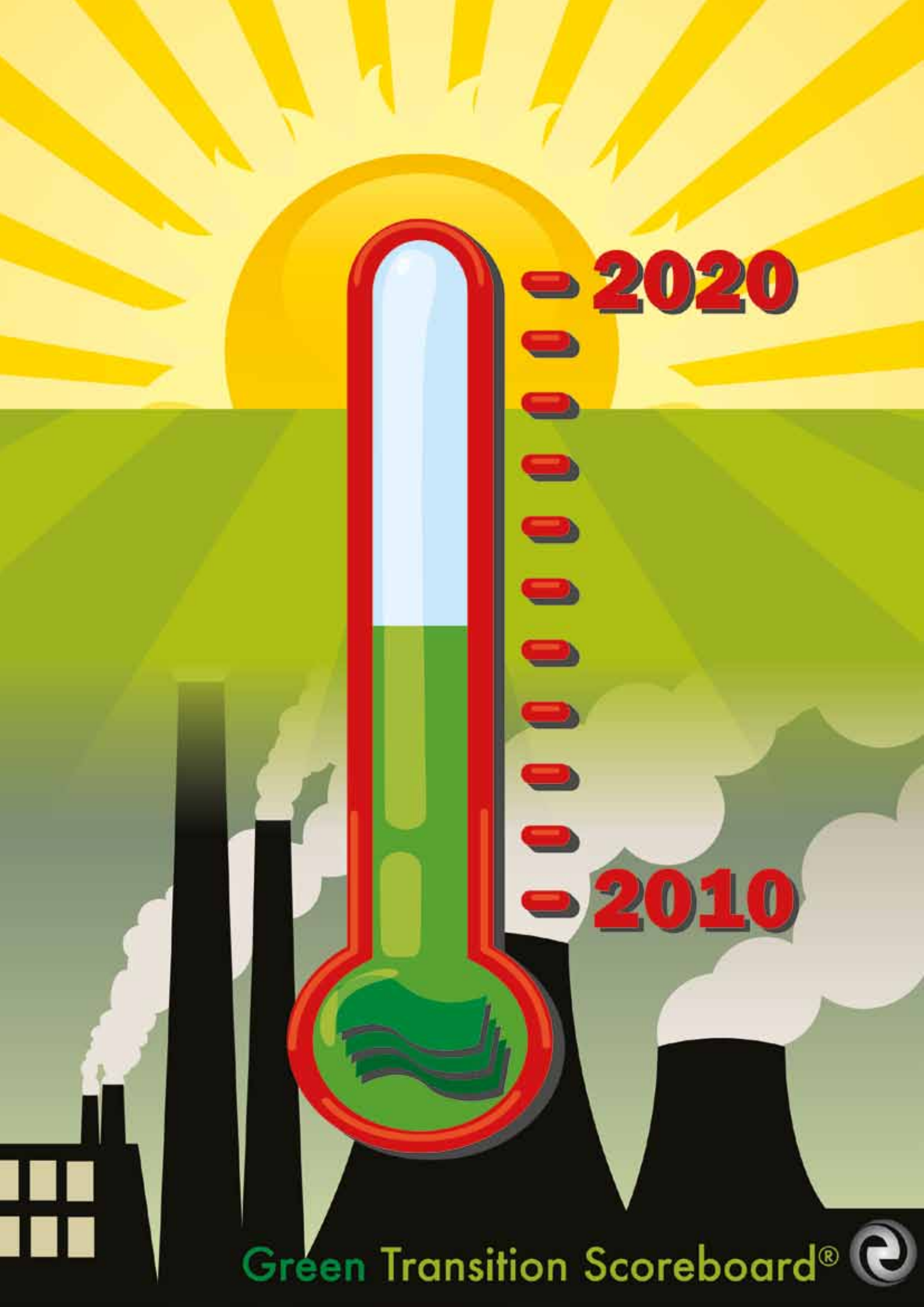
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


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