From a Public Lecture

Factor Five—Towards Global Sustainability through Doing Much More with Much Less

Cheryl Desha

This is a revised text of the third lecture of the 2014 public lecture series, "The Path Toward a Global Civilization" hosted by the Institute of Oriental Philosophy on October 2 in Tokyo. Dr. Desha is research principal of the Australian team at the Natural Edge Project which published *Factor 5: Transforming the Global Economy through 80% Increase in Resource Productivity* (2009) in collaboration with Dr. Ernst Ulrich von Weizsäcker.

Introduction and Acknowledgements

'YOROSHIKU-ONEGAISHIMASU'! (Japanese greeting) Good evening, I am honored to be here talking to you about such an exciting topic. I am inspired by the title of this year's IOP's lecture series "The Path Toward a Global Civilization", which stresses the importance of directed action in a whole of globe approach.

(While showing the picture of the blue earth) This photo is one of my favourites, taken in 1972 by the crew of the Apollo 17 mission to the moon—this is our common home, it contains our common past, and our common future. When people ask me where I am from, I tell them 'Planet Earth'—My father is Indian by blood, born in Mauritius; my mother is English by blood, born in Wales; my sister and I were born in Mauritius, and our family migrated to Australia when I was five years old. I have lived in Australia for 33 years, including a one-year exchange to Japan—in Aomori city—when I was 14. There I lived with a family who owned a farm in Hirosaki, and celebrated the seasons and food of this beautiful country.

I chose my life and career direction when I was still in primary school, experiencing environmental pollution in Mauritius. On New Year's Eve in 1987 I was walking with my family on one of the island's most beautiful beaches. The following morning we went for the same walk but the experience was very different. The beach was covered in

Figure 1. "Understand - a - scope", courtesy of Mr. Michael Leunig, author of this cartoon

rubbish, from cans to bags and food. There were piles of rubbish next to a few bins that lined the beach, but clearly these were not enough. Stray dogs and cats picked through the waste, and the out-going tide carried this chaos onto the precious reef. In that moment at age 11, I knew that what I was experiencing was not right. People loved their environment to death through not understanding the impacts of their ways. I studied environmental engineering at university for my undergraduate degree, then rapid curriculum renewal for my doctoral studies.

This cartoon is one of my favourites also (Figure 1.). It depicts someone trying to understand what is happening around them, using an "Understand - a - scope", which is a made up device that looks like a telescope, but provides understanding and insight when you look through it, rather than magnification. It reminds us of the need to use many different lenses to understand what we are observing.

When I finished my studies at the turn of the century, I joined an engineering consultancy. During this time I met a group of other engineers and scientists who were also passionate about doing things differently, and who were struggling to find meaning in their work places. These new friendships led to the formation of a research group called "The Natural Edge Project", which has spent the last decade looking through our own 'understand-a-scopes' to publish books on the emerging consensus for sustainable development and what is possible to mainstream such practice globally.

This has included interacting with many 'legends' of the field who

have spent decades developing powerful frameworks and precedents for change. We have been honored to document such ideas and bring them together into textbooks that professional practitioners and decision makers can use to make informed and timely decisions. Our focus on engineering and design stems from our personal training, and the request of one of our mentors Dr Amory Lovins from the Rocky Mountain Institute in America, who early on asked us to emulate India's Mahatma Gandhi in contributing to the "non-violent overthrow of bad engineering"! My interest in Japan continues to span personal and professional connections. Indeed, there are amazing examples of sustainability champions and initiatives in this country that the rest of the world hears too little about. The team from Japan for Sustainability (JFS) led by Ms Junko Edahiro have made great inroads into translating —in and out—of the country, such stories of opportunity.

This presentation builds on many previous discussions, dialogues and presentations by Professor Ernst von Weiszäcker, and the publication '*Factor 5*', led by Professor von Weiszäcker, published in 2009. I am one of the contributing authors to this publication who wrestled with how to provide a suitable follow-on from *Factor 4* which discussed opportunities to double wealth while halving resource use. We aimed to give the original message further energy and momentum in light of significant world events over the following decade and substantial advances in information technology.

Our team is grateful to Professor von Weiszäcker for his patience, mentoring and energy throughout the three-year writing process, including time drafting the structure of the manuscript at the University of California's Santa Barbara campus in 2006. *Factor 5* has subsequently been translated into German, Russian, French, Chinese and most recently this year into Japanese, helping to realize our aims for global access to this critical conversation. Professor Yoshitsugu Hayashi of Nagoya University has been kind enough to write a preface for the Japanese translation, for which we are truly thankful.

With this context in mind, tonight's lecture is not about delivering the audience facts and figures on what is possible for humanity—they are readily available when you need to access them, online or in the book! The rationale for change has been thoroughly and rigorously presented in a number of recent works by UNEP, OECD, the IPCC, and individual authors such as Lester Brown, Al Gore, and David Suzuki to name but a few. Neither is this lecture about detailing the 'doom and gloom' which compels us to do much more with much less—you can find that in the media! In contrast, tonight's lecture is about detailing a 'to-do list' for

our global civilization. It is not the only 'to-do' list for humanity, but it has the potential to make a significant contribution towards a prosperous existence for all.

So, what is Factor 5? It means 'doing much more with much less', in the order of either: 1) achieving the same result using only one fifth of the intended resources, or 2) achieving five times more with the intended resources. This means an 80% productivity improvement.

Reflecting on the 2010 IOP address on 'Global Environmental Problems and Ethics', participants were challenged by the need for immediate, coordinated, wide-ranging, humane efforts to address the core challenges facing 21st Century humanity. This includes harnessing opportunities provided by science and technology together with effecting critical changes in economics and politics. Although our visions and plans for global sustainability are human-centred, with it we carry a responsibility for many other organisms and species that rely on current global environmental conditions. Indeed, our survival relies on many of these other species surviving—and thriving—in the 21st Century.

Tonight's presentation will build on IOP Founder and SGI (Sokagakkai International) President Ikeda, and Professor von Weizsäcker's special series "The Challenge of Global Transformation—Humanity and the Environment", a dialogue on building a sustainable global society published in the *Journal of Oriental Studies*. It will be in three parts: firstly outlining a prioritized 'to-do list', considering global challenges for a global civilization, secondly considering how a 'Factor 5' approach can drive action in this list, and thirdly highlighting the critical role for education to create conditions conducive to Factor 5 type solutions.

By the end of tonight's lecture I hope to have inspired you in two ways: firstly to think differently about what is possible, and secondly to take at least one action in your personal or professional lives that involves 'Factor 5' type change in doing more with less. So let's begin!

A Global Challenge for a Global Civilization

Since the industrial revolution, populations have increased dramatically, and they have moved towards urban environments. By mid-century—in little over 30 years time—the United Nations predicts cities will comprise about 70% of the world's population of approximately 10 billion people. Indeed, the 21st Century is being referred to as the age of the city, with a common global challenge of achieving an affluent life

without jeopardizing our planetary air, water and earth systems. Perhaps, if our planet was three times larger, our conversation regarding the impacts of such changes would be quite different! As it is, our global consumption of approximately four times the amount the planet can provide is unsustainable.

Over the duration of this century, humanity will use its knowledge and skills to change the way it interacts with the environment, or else the environment will change the way it interacts with its inhabitants. In this scenario, it is not the 'end of the world', but certainly the end of an era for this beautiful blue planet.

Considering the imperative to act, and thinking with the mindset of a global civilization, we have a clear priority to-do list to tackle the following complexities:

1. Address population pressures: Deal with the complexities of urbanizing populations, concentrated growth in developing countries, and aging demographics in a number of countries.
2. Address resource constraints: Deal with the complexities of finite supply, pollution of supply, landfilling of potential resources, and expanding materialism.
3. Address our impacts on ecosystems: Deal with the complexities of our human impact on local and global ecosystems, and the impact on their integrity and services they provide
4. Address food and water allocation: Deal with the complexities of providing enough and sufficiently nutritious food, for all, and access to clean water.

These challenges call for solutions that are interdisciplinary, intercultural, and intergenerational, as highlighted in the United Nations 'Beyond-2015' development goals. To action this list, we need sophisticated understanding in areas such as physics, chemistry, engineering, biology, commerce, spatial science, business and governance to bring to bear on the challenge of dramatically reducing our pressure on the environment.

At this point there are two diagrams that I would like to introduce, to provide the foundation for our discussion. The first is called the 'Waves of innovation' diagram (Figure 2), inspired by economists Nikolai Kondratiev and Joseph Schumpeter who considered the way innovation unfolds in society. This diagram highlights for us the ability of our species to adapt to change on grand scales, very quickly. As you can see from Figure 2, we suggest in *Factor 5* that we are at the dawn of a sixth 'wave of innovation', which has the opportunity to address this priority to-do list with unprecedented speed and success, if we can direct its

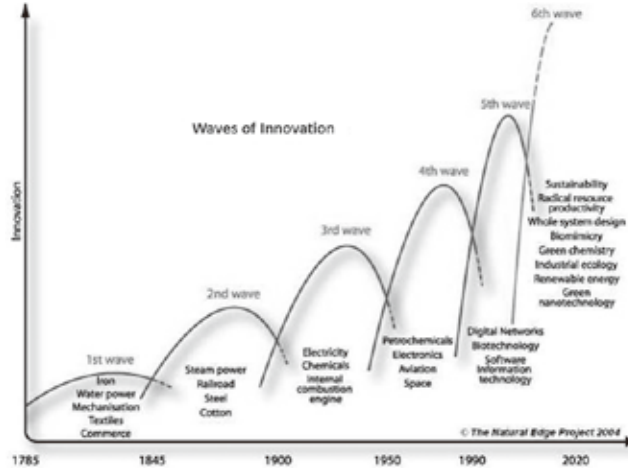

Figure 2. Waves of Innovation Diagram, courtesy of The Natural Edge Project (Hargroves and Smith, 2005)

enthusiasm. Looking back to Japan's evolution for example, railway construction was followed by road construction and the use of the motor vehicle after World War II. This was followed by the construction of large-scale waste disposal facilities and airports. The next wave of innovation will be marked by another period of increased innovation and the kinds of technologies that it brings with it, providing opportunity—and imperative—to direct efforts towards sustainable development.

The second is called the 'Decoupling' diagram (Figure 3), which illustrates the potential to decouple—or separate—economic growth from negative environmental pressure. This refers to continuing the positive aspects of economic growth (i.e. prosperity), while leaving associated environmental pressure behind. Furthermore, we see from the bottom line, the opportunity to recouple—or join back together—economic growth with positive environmental pressures, for example reforestation, aquifer recharge, and soil fertility.

We can look to the past for examples of decoupling led by governments around the world, which demonstrate precedent for action. For example, democratic states such as Japan, the USA and Canada, and the West European states overcame initial industry resistance to implement pollution control legislation, through banning some substances, filtering exhaust gases, cleaning waste waters, and finally redesigning some processes. After just 25 years, industrial agglomerations such as the Ruhr in Germany, Osaka in Japan, or Pittsburgh in the USA were performing with vastly reduced pollution levels, and commitments to

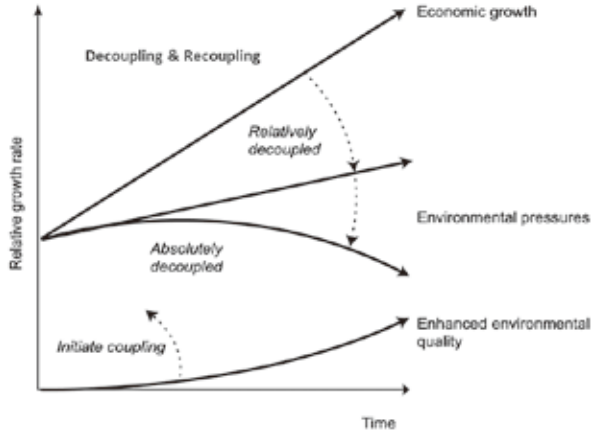

Figure 3. Decoupling Diagram, courtesy of The Natural Edge Project (Smith *et al*, 2010)

cleaner production. These outcomes surprised many who had explained the cause of the problem to be 'economic growth'.

Unfortunately, looking ahead, impacts such as climate change, resource shortages, and biodiversity losses follow very different logic from pollution control. In reality, it is the "rich and clean" countries that are the biggest cause of such impacts, with carbon footprints generally growing with increasing prosperity. The situation gets much worse for the rich if historical carbon emissions are also counted, and if global supply chains are considered for the products consumed. Furthermore, many countries have out-sourced energy and carbon intensive segments of the supply chain to countries like China, which grow their carbon footprints in the service of others.

Considering such complexities and scale of the decoupling challenges going forward, decoupling from 21st Century pollution requires different and large-scale approaches. It is not our team's purpose to point to capitalism as the ultimate evil, but we join critics of capitalism to a certain extent. Some features of deregulated financial markets have been disastrous and demand careful re-regulation. Furthermore, considering the ecological state of the world, we urgently need regulation to prevent profiting from destructive industries, and value activities that restore ecosystem services. In the *Factor 5* publication, we support Achim Steiner's (UNEP's Executive Director) description of a "Global Green New Deal" to hasten progress towards addressing the priorities for our planet. The idea of a Green New Deal is to spend public money to create jobs for the public good of a sustainable environment. The idea emulates Franklin D. Roosevelt's New Deal in the early 1930s, which

helped pull the USA out of the deep depression after the 1929 Wall Street financial collapse. A 'Global' Green New Deal is meant to coordinate the most important economies of the world to give the Green New Deal sufficient impetus and volume.

Considering the Role of a 'Factor 5' Approach

Within this context, we shift our 'understand-a-scope' device to now consider the role of a 'Factor 5' approach in addressing the challenges we have highlighted. In short, it is about ensuring the best use of science and technology in contributing to the solution, most of which has already been discovered or invented but not yet mainstreamed. The great news is, as Amory Lovins from the Rocky Mountain Institute states, "If it exists, it is possible"! Within this context, the concept of 'Factor 5' has several components, which we will now briefly visit.

Doing Much More with Much Less

As we covered at the beginning of this lecture, Factor 5 means 'doing much more with much less', in the order of either: 1) achieving the same result using only one fifth of the intended resources, or 2) achieving five times more with the intended resources. This means an 80% productivity improvement.

As an engineer standing before you, the problem statement is straightforward but dual-purpose, spanning anthropogenic and environmental needs. As citizens of the planet, we must find and follow pathways to: curb consumption to within that which our planet can provide; and achieve health and wellbeing—for ourselves and the health of this planet. This includes dietary practices that are excessive with food waste in developed countries well-surpassing global food aid programs. It also includes improving the well-being of individuals who lack sufficient nutrition or quantity of food.

In our writing, we have tried to show how this is possible, with examples from around the world across many key sectors of society including residential and commercial buildings, transportation and agriculture. We found that each sector has its own particular technological, social and political context for engaging Factor 5 type approaches, which require exploring and understanding before progress can really be made. This is critical to know, as using appropriate examples and framing conditions are critical in converting case studies to mainstream practice.

Resource Productivity rather than Labour Productivity

This refers to the encouragement of economies to use human resources more while saving resources. In market places and governments where employment levels are key performance indicators for progress, it makes sense to make the most of human resources where they are available, saving on physical resources.

For example this could include 'food sovereignty', providing land to those who suffer from food shortages, to grow their own food. This echoes Dr E. F. Schumacher's philosophy of the "TLC" factor (Tender loving care), which promotes motivation and self-employment to improve yields and farm health.

President Ikeda and Professor von Weiszäcker have also discussed the need to achieve both social and environmental justice, ending 'market fundamentalism' and devising alternatives to GDP (gross domestic product) in measuring wealth. These are admirable objectives and should be a focus of enquiry and discussion. However, given the timeframes that I have briefly outlined above, it is clear that in the meantime, we must work within the global market systems that operate now, with the indicators that governments are using now. Within this decade and the next, the task is global in scale, addressing the human desire to produce and consume beyond what we need.

Towards Sufficiency for All

Professor von Weiszäcker notes the difference between the term 'productivity' and just 'efficiency'—we must think holistically about achieving such improvements, to avoid unintentionally increasing production or consumption of resources. Together with 'productivity', in *Factor 5* we advocate 'sufficiency' (using just enough for what we need), to ensure that our per-person consumption and resource use are really being curbed globally.

We need rules of constraint or insights into other forms of satisfaction than the maximisation of monetary throughput, or GDP. Indeed as Professor von Weiszäcker reflects, '*communism collapsed because it was not allowing prices to tell the economic truth, and that capitalism may also collapse if it does not allow prices to tell the ecological truth*'. Markets steer efficient allocation of resources and stimulating innovation, but do not provide other services such as public order and law, moral standards, basic education, and infrastructures. Neither do they protect the commons or steer innovation into a *long-term* sustainable directions.

Whole System Approach

As the predecessor to *Factor 5*, in *Factor 4*, the authors focused on individual technologies that can be used to improve resource productivity. In *Factor 5*, we have redefined those technologies as combined systems to drastically reform society or change the framework of education, politics and economy. For our writing team, the purpose of *Factor 5* was to inspire hope through holistically reforming systems. Furthermore it was not sufficient to present a highly theoretical picture of how technology could save the world. We wanted to present practical examples of whole systems of technologies, infrastructures, legal rules, education, and cultural habits interacting to produce economic progress while conserving a healthy environment. The examples described advocate the harmonization of economy with resources, energy, environment with frameworks that can be readily applied now by nations, companies and households to achieve Factor 5. Spanning topic areas such as 'biomimicry' (innovation inspired by nature) and 'biophilic urbanism' (nature-loving cities), cleaner production, lean thinking (lean manufacturing), green development and many others, opportunities arising from a systems approach to innovation are only bounded by our imaginations.

Pathways to Factor Five

Now that we have visited the intentions of Factor 5 to address the challenges of our time, we turn to briefly consider how such intentions can be realized, drawing on the waves of innovation diagram, and the decoupling diagram introduced earlier. Achieving a Factor 5 transition is as much a technical challenge as it is a social one. Renewing education systems and curricula, fostering sustainable behaviour, developing policy and mechanisms to allow commerce and economic development, will all be crucial components.

Indeed in Japan we can see a microcosm of global issues being played out including a projection that in 2050, seniors over the age of 65 will comprise 40 per cent of the population. Within these challenges we find some very interesting examples of innovation to create new types of cities and communities. The Japanese government is developing an environment-friendly "FutureCity" Initiative (FCI), now in its third year. It is being promoted by the Cabinet Office, and 11 cities have been authorized as "Future Cities" as of March 2014. The Cabinet Office has also been promoting the Eco-Model City initiative—and subsequently

the FutureCity Initiative—to realize low-carbon cities.

Quickly but Smoothly

For our green 'wave of innovation' to really take off, we need strong states and engaged citizens working together to create good legal and moral frames for the markets. Moreover, citizens, nation states, and the international communities of states and of citizens need to act in those markets, as consumers, innovators, workers, guardians against destruction, and for sustainable technological and civilisational progress. In contrast to the pioneers of the IT revolution who did not really need favourable framing conditions to make their technological advances a commercial success, this newest wave of innovation will need leadership to create contexts conducive to the type of change we want to see. The second part of *Factor 5* publication addresses the politics, economics, and psychology of framing conditions to help mainstream new efficiency and renewable energy technologies that are emergent.

The process of redesigning, as radical as it may be in terms of a new philosophy, can be a gradual and smooth one within the realm of science and technology, encouraged by prudently designed and predictably changing framing conditions. This does not have to include losing much physical or financial capital invested, rather avoiding investing new money into outdated and destructive operations and technologies.

Committing to Education

Believing in the infinite possibilities of humanity, it is still imperative to provide access to knowledge and skills to bring about the complex changes discussed earlier and by others in the field. We are challenged to keep pace with emergent opportunities and ways of thinking, embedding this within our existing institutions, in addition to the new institutions such as Sokagakkai emergent around the world. We need to embark on a cross-sectoral, inter-generational education agenda, which empowers our current and future workforce with knowledge and skills to enact the ideas we have discussed here today.

For a smooth transition, we certainly need an educated workforce, educated consumers, a new generation of researchers, engineers, marketing people, investors, and politicians. We also need to enable our senior part of society to "Re-Tire"—using a car metaphor—to put on a new set of tires and keep going! In these 'urgent' and 'challenging' times, we see the challenge as multi-pronged, to short-circuit the types of perverse decision-making and actions being taken today, and to correct the historic failure of designers, engineers, architects and

technicians to take a whole system approach to the identification and implementation of resource productivity opportunities. This spans the spectrum of education in our society, including:

1. Continued professional education for existing decision makers and work force
2. Postgraduate education, spanning coursework, masters, and Ph. D.
3. Undergraduate education
4. High-school education
5. Primary school education
6. Kindergarten and day-care education

Such education should be: grounded in hope and the possibility of a globally prosperous civilization in harmony with nature; locally contextual to global challenges; encouraging a systems approach to thinking, enquiry and action; and addressing formal (paid) and informal (unpaid) employment opportunities to make a difference. In Japan I can point to three initiatives that are leading in their approaches to such capacity building:

– ProSPER.Net is an alliance of leading universities in the Asia-Pacific region that are committed to integrating sustainable development into postgraduate courses and curricula.
– Jonan high school in Fukuoka prefecture is an example of a 'Super Science High School Program' initiated by the Japanese government to connect high school students with international experts in Universities about any scientific topic including sustainability and environmental science.
– The University of Tokyo's "Graduate Program in Sustainability Science—Global leadership Initiative" is an example of a globally regarded immersive program for university students, considering the complexity of challenges and real-world problem solving opportunities.

Conclusion

In arriving at the end of tonight's lecture, I hope that I have demonstrated the need to think differently with regard to the role of science, and technology in contributing to significant societal change. As Einstein's famous words caution, there is no point anticipating a different result as long as we continue to use the same approaches. The author team of *Factor 5*, under the leadership of Professor von Weiszäcker, has compiled a set of ingredients and a method conducive to creating something transformational: 80% improvements in the way

society can go about delivering activities products and services for the betterment of humanity.

We have a timely opportunity for embarking on such action now, considering the works of Kondratiev and Schumpeter who highlight the cyclic nature of innovation by our species, particularly since the industrial revolution, and the potential for the next new cycle—the one we are living into now—to be green. Furthermore, as President Ikeda notes in his 2013 dialogue with Professor von Weizsäcker, "*to borrow Dr. Schumacher's words and express this idea in contemporary terms, we must devote the utmost tenderness, love and care for the environment, and by striving to protect nature and the ecosystem, lead a life in which our own humanity shines its brightest*".

As discussed this evening, the challenges in harnessing this next cycle of innovation for sustainability are multiple and complex, considering: population growth and aging profiles, consumption patterns, and the impacts of pollution from past waves of innovation particularly since the industrial revolution. Fortunately we arrive at this unprecedented challenge with a similarly unprecedented level of access to communication and spatial information about our planet. Decision making, planning and design can be accelerated, grounded in reality and transparent, considering a vast range of variables rather than being estimated or based on the subjective opinions of a few.

In *Factor 5* we present many precedents for achieving significant improvements from around the world, spanning a number of critical sectors to national economies. Indeed online we have additional case studies to complement the publication. We also stress the need for technological innovation within the context of the need for sufficiency. There is no point for our long-term viability as a species, to improve the efficiency to which we use our resources, if the end result is that per person consumption increases for people who already have enough.

In conclusion, enabling a sustainable and prosperous existence for up to 10-billion human beings on planet Earth is the 21st Century challenge for humanity. Of course this involves creating an environment conducive to life, which reaches beyond human needs to substantial improvements in well-being for many earth systems. Mainstreaming the types of innovations discussed in *Factor 5* is a critical component of the solution in addition to timely economic and political leadership.

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