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Perspective

Beyond Science and Technology: Creating Planetary Health Needs Not Just 'Head Stuff', but Social Engagement and 'Heart, Gut and Spirit' Stuff

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Abstract: I have been involved in studying and working within what is now called the Anthropocene for almost 50 years, and in all that time, not only have we failed to make much progress, but the state of the Earth's ecosystems has generally worsened. Yet somehow we must create a world in which everyone on Earth has good health and a good quality of life—a matter of social justice—while living within the physical and ecological constraints of the one small planet that is our home; this is the focus of the new field of planetary health. Our worsening situation is not due to lack of knowledge, science and technology; in broad terms, we knew most of the challenges and many of the needed solutions back in the 1970s. Instead, the challenges we face are social, rooted in cultural values, political ideologies, legal and economic systems, ethical principles and spiritual/religious beliefs. Therefore, we have to move beyond science and technology and address these broader socio-cultural issues by engaging in economic, legal and political work, complementing and supplementing 'head stuff' with 'heart, gut and spirit stuff', and working from the grass roots up.

Keywords: planetary health; Anthropocene; climate change; biodiversity loss; ecological crisis; cultural values; political ideologies; legal and economic systems; ethical principles and spiritual/religious beliefs

1. Introduction

In the past decade or two, both the scale and rate of the growing ecological crisis have become increasingly apparent. This is most obvious for climate change, but in fact there are multiple human-induced global ecological changes underway that threaten the health and wellbeing of the human—and also the non-human—population and indeed the very survival of modern civilization. This situation has given rise to the concept of planetary health—"*the health of human civilization and the state of the natural systems on which it depends*", with the report of the Rockefeller-Lancet Commission on Planetary Health noting that "*far-reaching changes to the Earth's natural systems represent a growing threat to human health*" [1]. Indeed, the current situation has been described as constituting an existential threat (Text Box 1).

Box 1. An existential threat.

> "Human activity is putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted."
>
> *Millennium Ecosystem Assessment, 2005* [2]
>
> "Climate change is the defining issue of our time—and we are at a defining moment. We face a direct existential threat . . . If we do not change course by 2020, we risk missing the point where we can avoid runaway climate change, with disastrous consequences for people and all the natural systems that sustain us."
>
> *U.N. Secretary-General António Guterres, 2018* [3]

In the face of this threat we need to understand:

(a) the scale and rapidity of the ecological challenges we face;
(b) the ecological and social injustice inherent in our current dominant economic model and socio-cultural system;
(c) the variety and range of social change strategies we need to employ;
(d) the emotional and spiritual dimensions of the challenges we face and the responses we need;
(e) the potential and importance of local action.

These are the topics I explore in what follows.

2. Welcome to the Anthropocene

We have initiated and are entering the Anthropocene, a new geological epoch in which humans—and especially humans in high-income countries—have become a force of nature, creating massive and rapid global ecological changes. These changes, which will be present forever in the geological record as a marker of our presence, are already having an impact on society and on human wellbeing, and this impact will grow dramatically in coming decades. There is an excellent 4-minute 2012 video that graphically describes the Anthropocene, that is still well worth viewing [4].

As this suggests, the Anthropocene can be understood in at least three distinct ways: As a geological phenomenon, as a set of inter-related global ecological changes, and as a sociological phenomenon.

First, it is a geological phenomenon; the Anthropocene is being considered by the Anthropocene Working Group (AWG) of the International Commission on Stratigraphy as a potential geological epoch characterized by human-driven geological and ecological changes. In May 2019, the AWG voted 88% in favour of treating the Anthropocene as "a formal chrono-stratigraphic unit" with a base "around the mid-twentieth century of the Common Era" [5]. Geologically, it is marked by the deposition in sedimentary layers of uniquely human-made materials (e.g., concrete, plastic, glass, pure aluminium) and chemicals (e.g., elevated levels of carbon dioxide, persistent organic pollutants, radioactive isotopes from atomic blasts), and a shift in fossil assemblages. In the future, palaeontologists will see that humans make up about one third of the mass of land vertebrates, with about two-thirds being our domesticated species—cattle, pigs, sheep, goats, chickens and so on, while wild animals now make up less than 5 percent [6,7].

Second, the Anthropocene is shorthand for the massive and rapid global ecological changes we have triggered across a wide range of fundamental Earth systems [8]. These changes—which are occurring all at the same time—often interact, usually in ways that amplify their effects. They include:

(a) climate change (which has taken up much of our time and focus);
(b) the related phenomenon of ocean acidification, which threatens the viability of many marine species and coral reefs;
(c) widespread pollution of air, water and soil;
(d) the contamination of entire ecosystems and food chains with persistent organic pollutants —a phenomenon known as ecotoxicity and manifested in our own bodies (as top predators on

many food chains, we are born with and then accumulate a body burden of dozens of these chemical, which can disrupt our genes, our brain development and our hormonal, reproductive and immune systems);

(e) the depletion of both renewable and non-renewable resources, especially those involved with food production, such as ocean and river ecosystems, fertile soils and freshwater, but also forests; and finally,

(f) species extinctions and loss of biodiversity—we are tearing apart the great web of life (of which we are a part) in a sixth great extinction.

Third, the Anthropocene refers to us; we are the anthropos (the Ancient Greek word for human) in the Anthropocene, as I will discuss in the next section. These human-driven global ecological changes—all of which have important and almost entirely negative impacts on health [3,9]—are well captured in three key indicators—with the caveat, based on George Box's comment about statistical models that "all models are wrong, but some models are useful", that because these indicators show only part of the picture, and also because the data are incomplete, they are wrong; they are; however, useful (unlike GDP, which is both wrong and not useful, as discussed later).

2.1. Planetary Boundaries

We are now approaching, and in some cases have crossed estimated planetary boundaries that constitute the margins of a 'safe operating space' for humans. As seen in Figure 1, we have moved into a zone of high risk for two of ten key Earth systems, are in a zone of increasing risk for three others and do not know the boundary of risk for three others; only in two systems we are in a safe zone [10]. This concept of planetary boundaries contributes to a new approach to economics, as also discussed later.

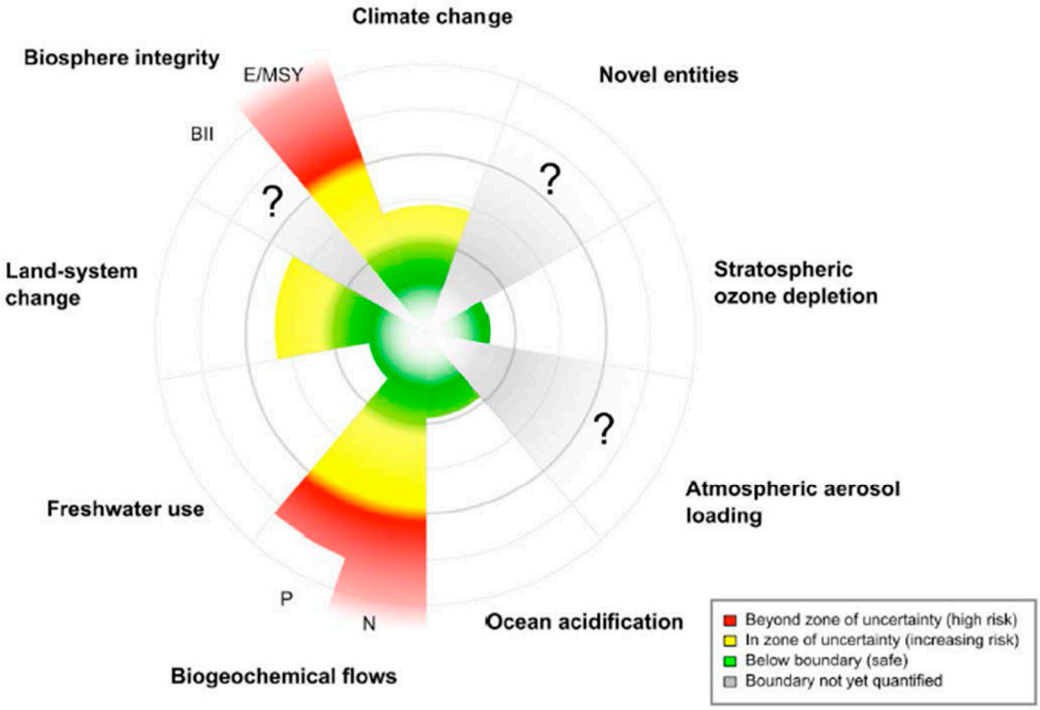

Figure 1. Crossing planetary boundaries, from Steffen, Richardson, Rockström et al. Reprinted with permission from AAAS.

2.2. The Ecological Footprint

The ecological footprint expresses human resource demands and waste production as a common metric—the number of hectares of bio-productive land it would take to replace the resources we use or absorb the wastes we produce each year. We surpassed the Earth's bio-productive capacity in about

1970, and by 2014 [11], humanity as a whole used about 1.7 Earth's worth of biocapacity, with about half that global EF due to carbon emissions (Figure 2). This is despite the fact that world biocapacity has increased by about 27 percent in the past 50 years, because humanity's footprint increased much more—by about 190% over the same time period [12].

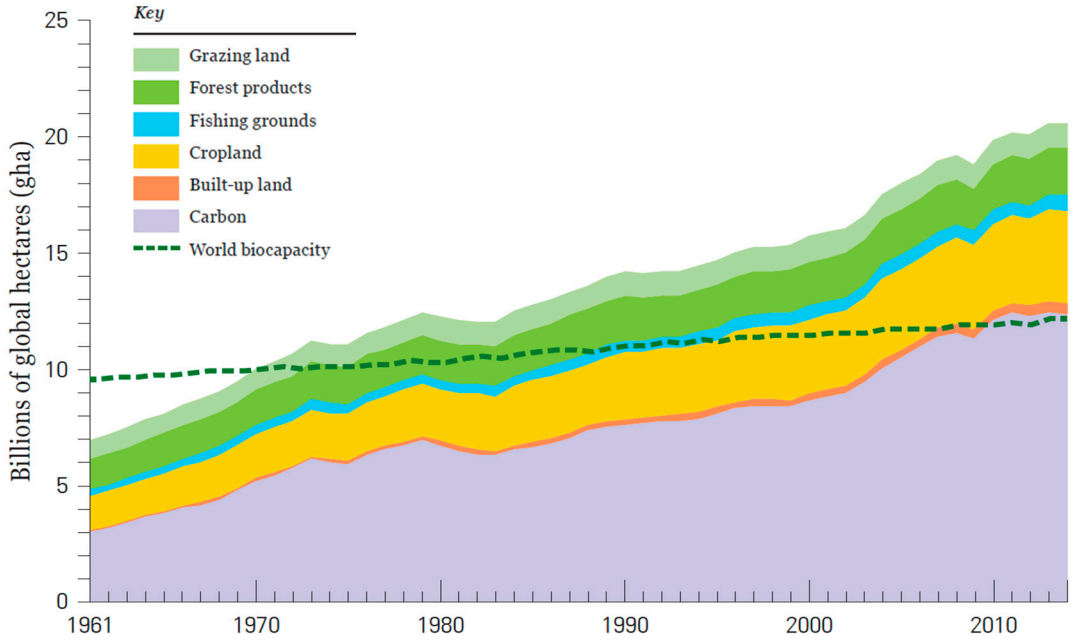

Figure 2. Global Ecological Footprint, 1961–2014. Source: WWF—World Wide Fund for Nature (2018) Living Planet Report—2018: Aiming Higher, © 2018 WWF—All rights reserved.

There are two ways to reduce the ecological footprint of humanity: reduce the per capita footprint by reducing resource use and waste production, and to reduce the population. While the latter may occur as we undermine the Earth's biocapacity and trigger crises, or because of a combination of social and economic development—which leads to smaller families—and family planning and birth control policies, no credible people or groups are suggesting a deliberate policy to reduce the population by increasing mortality rates.

2.3. The Living Planet Index

Produced every 2 years by the World Wide Fund for Nature (WWF), the Living Planet Index (LPI) measures trends in the populations of vertebrate species (mammals, birds, reptiles, amphibians and fish) in terrestrial, marine and freshwater ecosystems around the world. Their 2018 report, with data only up to 2014, covers 16,704 populations of 4005 species. It shows an overall global decline in the abundance of monitored vertebrate populations of 60 per cent between 1970 and 2014 (Figure 3)—a mere 44 years! Even worse, an astonishing and frightening 89% decline in the overall LPI was reported for the Neotropical zone (Central and South America), while an equally alarming 83 percent decrease was found for freshwater ecosystems worldwide; in the neotropical zone this reached a quite terrifying 94% [12].

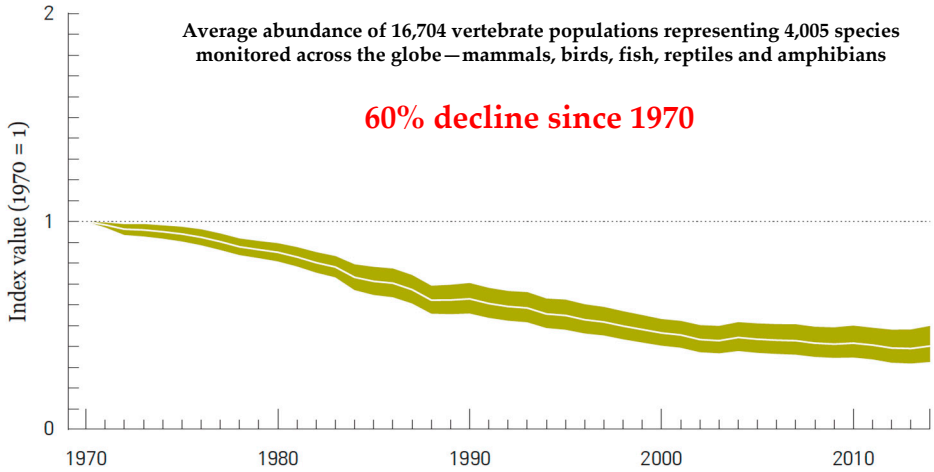

Figure 3. The Living Planet Index. Source: WWF—World Wide Fund for Nature (2018) Living Planet Report—2018: Aiming Higher, © 2018 WWF—All rights reserved.

It is not only the scale of change that characterises the Anthropocene, but the rapidity of that change, as the growth in the Ecological Footprint and the decline in the Living Planet Index since 1970 show. While there are several start dates suggested for the Anthropocene, dating back to the beginning of the age of coal and steam in the late 18th and early 19th centuries [8,13], and some even earlier, there seems to be a growing consensus around a start date of 1950 [5]. There has been a 'Great Acceleration' since then, with rapid social and economic change driving rapid ecological change [8,13]. As a result, many of these dramatic changes have occurred within a single lifetime, which is an astonishingly short time in ecological or geological terms.

2.4. "We Knew in '72"

I have been involved in understanding and addressing what is now called the Anthropocene for almost 50 years, ever since I began reading *The Ecologist*—a fairly radical ecological magazine—in about 1971, while in medical school, and followed the lead-up to and follow-up from the first UN Conference on the Environment in Stockholm in 1972. Sadly, there is not much we are discussing today in terms of either the ecological crises or the technical solutions that we did not know back in the 1970s, if not earlier. For example, the greenhouse effect was quantified by Arrhenius in 1896 and given that name by Ekholm in 1901 [14], while Rachel Carson had warned of the dangers of pesticides and what we later came to call persistent organic pollutants and ecotoxicity as far back as 1962 [15], and our present concern with low-meat, low carbon diets was addressed by Frances Moore Lappé in her 1971 book *Diet for a Small Planet* [16], in which she argued that meat was environmentally damaging and we should move to a vegetarian diet.

Several important books were published as contributions to that 1972 Stockholm Conference, including *Blueprint for Survival* [17], *The Limits to Growth* [18] and *Only One Earth* [19]—the latter anticipating the current 'One Planet' thinking of Bioregional [20,21] and the WWF [12], of which more later. These documents laid out the case for a dramatic shift in our way of life because of the damage we were inflicting on the Earth's natural systems, ravages that were apparent even then, and whose trajectory was apparent.

The opening couple of sentences of the introduction to *Blueprint for Survival* said it all and said it well:

> *"The principal defect of the industrial way of life with its ethos of expansion is that it is not sustainable. Its termination within the lifetime of someone born today is inevitable—unless it continues to be sustained for a while longer by an entrenched minority at the cost of imposing great suffering on the rest of mankind."* [17]

Written as it was almost 50 years ago, it was uncannily prescient—note the use of the term 'sustainable' and the concern with inequity, matching the concepts and even the language of some of the leading thinkers, researchers and documenters of the Anthropocene today. It was not alone: the *Limits to Growth* report was equally prescient [18]. Using a World System computer model, a group of system scientists at MIT investigated five major trends of global concern—accelerating industrialization, rapid population growth, widespread malnutrition, depletion of non-renewable resources, and a deteriorating environment. The first of their three general conclusions was:

> *"If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next 100 years. The most probable result will be a sudden and uncontrollable decline in both population and industrial capacity."* [18]

Why am I delving into this history? Because we need to recognise that the challenges of the Anthropocene are not suddenly upon us, but were clearly identified 50 years ago. To be sure, the extent and rapidity of climate change was not well understood, the 'hole' in the ozone layer had yet to be found (that was in 1985), and ocean acidification has only recently been recognised as the threat it is [22]. However, the rest was known, at least in broad outline. In addition, the trends are broadly on track, and continuing to worsen, for everything except the depletion of the ozone layer—which at least shows that we can act and achieve positive results, if we decide to do so.

For example, with respect to the *Limits to Growth* report, while the authors were widely attacked for their conclusions, their 20-year review [23] found the trends relatively unchanged. They stated that they would re-write their first basic conclusion as follows:

> *"Human use of many essential resources and generation of many kinds of pollutants have already surpassed rates that are physically sustainable. Without significant reductions in material and energy flows, there will be in the coming decades an uncontrolled decline in per capita food output, energy use, and industrial production."*

Almost 20 years after that, in 2008, Turner looked back at the original Club of Rome scenarios and the actual record since then [24] and concluded that:

> *"Thirty years of historical data compare favorably with key features of a business-as-usual scenario called the 'standard run' scenario which results in collapse of the global system midway through the 21st century."*

He later updated his examination of *The Limits* and concluded again that the business-as-usual scenario "aligns well with historical data that has been updated in this paper" [25].

Yet, despite all we knew then, and have learned since, we have failed to act upon that knowledge. Instead, in less than a century—indeed, within my lifetime (see below)—we have radically transformed the Earth, threatening not only the survival of many other species but also the survival of our own species, or at least the survival of civilisation as we know it. While this might come as a huge relief for the Earth and all those other species, it will be lethal or harmful for millions if not billions of humans.

Clearly, none of this is good news, in fact it is terrible news. So why dwell on it, is it not too depressing? Will it not just send people into a slough of despondency and lead them to give up? Well, it might, but as a physician I see a clear analogy to a diagnosis of cancer. There may have been a time when it was considered good practice to hide the diagnosis from the patient, but those days are long gone. We recognise not only that patients have a right to know, but that knowing will better equip them to make decisions about their future—and that we have to provide both a realistic assessment and some sense of hope, a point I will return to later.

3. We Are the Anthropocene

We have some very important decisions to make about our collective future, so we had better know the facts and understand the choices we face; perhaps then we can make some decisions that

will indeed lead us to a healthier future for all within the natural limits of our home planet. However, simply knowing the facts will not be enough; we need to recognise that "*We have met the enemy and he is us*", as Pogo (a comic strip character created by Walt Kelly) put it almost 50 years ago, in a 1970 anti-pollution poster for Earth Day that was repeated a year later in the daily comic strip.

We are the Anthropocene and we have to change. So I want to bring the Anthropocene down to a personal level, and also think about who is 'we' when it comes to the 'anthropos' in the Anthropocene. Massive ecological, social and economic change has occurred in a single lifetime—mine!

As it happens, I was born in 1948, so in a sense I am the Anthropocene; a 70-year old white male from a high-income country (born in England, lived mainly in Canada), with all the privilege—plus being a physician—that this confers, and all the impacts that implies. I drive a (small) car, eat meat (but avoid beef and try to be more vegetarian), fly to speak at conferences (although I do pay carbon offsets) and in other ways exceed a One Planet footprint, so I too need to change. Table 1 shows the changes I have seen just in my lifetime (and the changes are in fact more than is shown here, as this data goes only to about 2010 or 2012, and in some cases the baseline data does not reach back to 1948 or 1950).

Table 1. My life in the Anthropocene. Changes in key socio-economic and Earth system indicators since 1948 or thereabouts (my year of birth) to about 2010 or 2012 (unless otherwise indicated).

1. Socio-Economic Trends	
Population	2.73×
Real GDP (2005 US$)	11.1×
Urban population	4.74×
Primary energy use	5.14×
Fertilizer consumption	14.4×
Large dams	5.85×
Water use	3.28×
Paper production	5.38×
Transportation (vehicle #s)	7.23×
Telecommunications (billion landlines and subscriptions)	>9000×
International tourism arrivals	37 ×
2. Earth System Trends	
CO_2	+26%
Methane	+59.5%
Global surface temperature anomaly (°C) v 1961–1990	+0.471 v − 0.036
Ozone loss (2012), Peak loss (1994)	50.8%, 66.9%
Ocean H ion	+18%
Marine fish capture	+4.6×
Nitrogen flux to coast	4.26×
Tropical forest loss (compared to 1% in 1700)	27.66% v 15.65%
Agricultural land % of total (0.08% in 1750)	0.38% v 0.31%
Terrestrial biosphere degradation (2.8% in 1700)	28.6% (2000) v 14% (1950)

Based on great acceleration data—Global (October 2014). Source: International Geosphere-Biosphere Program: http://www.igbp.net/download/18.950c2fa1495db7081ebc7/1421334707878/IGBPGreatAccelerationdatacollection.xlsx.

3.1. We Are the Anthropos in the Anthropocene—But Who is 'We'?

While it is true that we are the Anthropos in the Anthropocene—'anthropos' being the Ancient Greek word for human—the concept of 'we' needs some elaboration and some specificity. It is not all of humankind, collectively, that is mainly responsible for our situation, but a particular subset of humanity—high-income countries and high-income people. This is best documented for climate change, but is applicable more broadly to all aspects of the Anthropocene. For example, in the 2014 Living Planet Report [26], which looked at inequality (with data up to 2010), there was a dramatic difference in the Ecological Footprint and Living Planet Index between high-income and low-income countries.

Since about 1970, the EF of high-income countries, as a group, has been between 5 and 6 global hectares per capita (gha/cap), while for low-income countries it has been just over 1 gha/cap; meanwhile,

world average biocapacity per person has declined from just under 3 to just under 2 gha/cap (Figure 4). Clearly, high-income countries are getting on average about 3.5 times their fair share, while low-income countries are getting less than their fair share; middle income countries are getting about their fair share (one planet's worth of biocapacity), which suggests they may be models for future development.

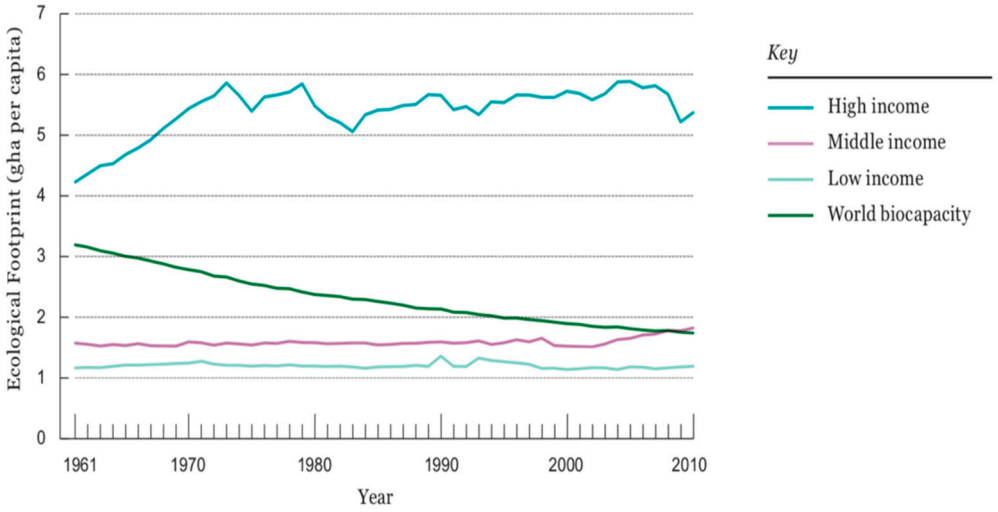

Figure 4. Inequality in the ecological footprint, 1961–2010. Shows ecological footprint per capita (gha/cap) in high-, middle- and low-income countries. The green line represents world average biocapacity per capita (Global footprint Network 2014, World Bank 2013. Source: WWF—World Wide Fund for Nature (2014) Living Planet Report. © 2014 WWF—All rights reserved.

The Living Planet Index shows an even more dramatic degree of inequality. It actually increased by 10% in high-income countries between 1970 and 2010—meaning they were recovering some of their lost vertebrate populations—while it declined by 58% in low-income countries (Figure 5). Some, perhaps much of that decline is likely due to high-income countries exploiting the biocapacity and resources of low-income countries, and taking advantage of their usually lower environmental standards, weaker enforcement and lower wages to do so cheaply.

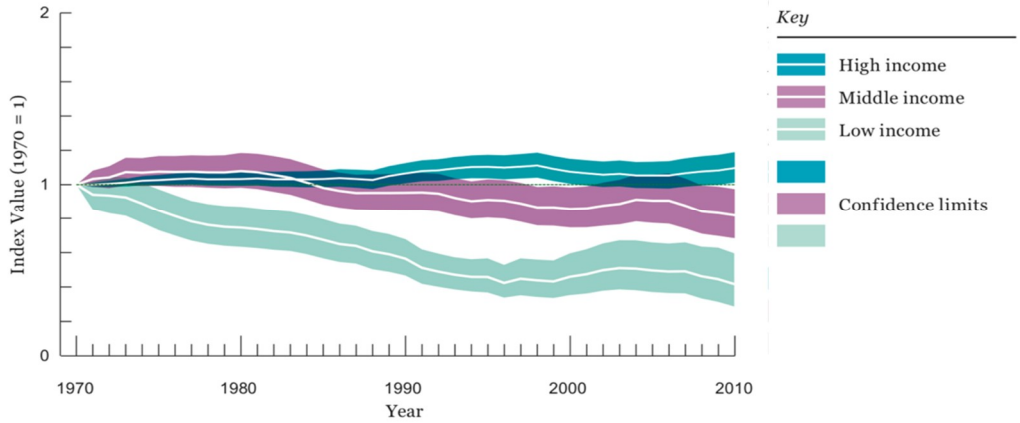

Figure 5. Inequality in the Living Planet Index, 1961–2010. LPI and World Bank country income groups (2013). Source: WWF—World Wide Fund for Nature (2014) Living Planet Report © 2014 WWF—All rights reserved.

With respect to climate change, the scale of the inequality in emissions is vividly demonstrated in a 2015 Oxfam report on extreme carbon inequality [27]. Oxfam estimated "the poorest half of the global population—around 3.5 billion people—are responsible for only around 10% of total global emissions attributed to individual consumption", while "50% of these emissions can be attributed

to the richest 10% of people around the world". This latter group "have average carbon footprints 11 times as high as the poorest half of the population, and 60 times as high as the poorest 10%. The average footprint of the richest 1% of people globally could be 175 times that of the poorest 10%" [27]. This inequality is historical in nature. Over the period from 1850 to 2012, the USA was responsible for 22% of total CO_2 emissions and the European Union (EU) for 18%; China, Russia, India and Brazil were responsible for 13, 6, 5 and 4 percent respectively, with the rest of the world being accountable for 37%. It is estimated that by 2100 the USA and the EU will have contributed almost half (45%) of temperature increase resulting from overall Kyoto GHG emissions [28].

3.2. Ecological Insanity AND Social Injustice

"*Social injustice is killing people on a grand scale*." WHO Commission on Social Determinants of Health, 2008 [29].

Forty years ago, I wrote about what I considered the fundamental principles of public health and came up with two: ecological sanity and social justice [30]; today we might say sustainability and equity. Sadly, what we are getting today is the very opposite: both ecological insanity AND social injustice, and they have worsened in the almost 40 years since I developed those ideas.

As noted above, there are dramatic inequalities with respect to the use of the Earth's biocapacity and resources and the resultant damage to the natural ecosystems that are the ultimate determinants of our health. Clearly, the USA and the EU have both an historically important and an ongoing and future responsibility to address global climate change and its consequences, since they have benefited disproportionately—indeed inequitably—from the burning of fossil fuels.

More broadly, they have benefited disproportionately from the industrialised economic system they have created and spread around the world, and within them a corporate and political elite (the 'one percent') has benefited disproportionately—and again, inequitably—from a neo-liberal ideology they have embraced and deployed that has largely left capitalism unfettered.

This has dramatically increased the wealth and power (but not, it seems, the sense of responsibility) of the 'one percent', while at the same time diminishing—or at least failing to proportionately equally increase—the incomes, wealth and power of the other 99 percent. For example, the *2018 World Inequality Report* [31] noted that since 1980 "the global top 1% of earners has captured twice as much of [global income] growth as the 50% poorest individuals".

As the report wryly notes, because unconsumed income can be transformed into wealth, "today's income inequality becomes tomorrow's wealth inequality". So not surprisingly, in its annual report on wealth inequality, in 2018 Oxfam [32] noted "the richest 1% continue to own more wealth than the whole of the rest of humanity" and that "82% of all wealth created in the last year went to the top 1%, while the bottom 50% saw no increase at all". Boyce put it succinctly:

> *"When people who could benefit from using or abusing the environment are economically and politically more powerful than those who could be harmed, the imbalance facilitates environmental degradation. In addition, the wider the inequality, the more the damage. Furthermore, those with less power end up bearing a disproportionate share of the environmental injury".* [33]

This is ecological injustice, and is clearly rooted in economic and social injustice. We can see this very obviously at the local level. One of my Healthy City 'mantras' is that the poor live downwind, downstream, downhill (unless the hills are dangerous, when they live uphill), on marginal lands subject to flooding, near landfills and industrial sites, in poor quality housing in neglected neighbourhoods, where they do the most unhealthy and dangerous work (if they work at all). It is small wonder their health is poor.

It is economic, social and cultural forces that drive ecological change, but those ecological changes are already starting to have significant social and economic impacts [34] that will only grow. However, those impacts will be experienced most by the most vulnerable, thus further widening the gap between rich and poor nations and rich and poor people. This has important implications for addressing the

challenges of the Anthropocene and at the same time the challenges of poverty eradication, by which I mean the eradication of absolute poverty, the lack of "the set of resources a person must acquire to maintain a minimum standard of living for survival" [35].

Thus, the ecological and the social go hand-in-hand; we need to recognise that the ecological is social and the social is ecological, that we need an eco-social approach.

Since the wealthiest nations and the wealthiest people have received a disproportionate benefit they bear a disproportionate responsibility—indeed a duty—to take the lead in setting things right. They (we) are going to have to consume a lot less, and pollute a lot less, so that others can have their fair share of the Earth's limited biocapacity and resources. However, this will require a change in what has become a destructive world view and a harmful ideology; modern neoliberal approaches to economic and social policy that prioritise greed and economic growth and value the individual over the community.

4. Beyond Science and Technology: Social and Political Change

The crucial point to extract from what I have written thus far is that it is not knowledge, science or technology that we lack. We have known about most of the problems we face for decades, we have monitored them as they have gotten worse, and—while I have not gone into it here—we have mostly also known for decades the technological solutions we need to develop and deploy.

It follows that if our failure to act on what we know is not a failure of science or technology, then the solutions lie beyond the realm of these natural sciences. The challenges—and the solutions—are very human, and thus they lie in the realm of the social sciences, the humanities and the arts; in business and community, law and ethical principles of justice, politics and economics, faith and philosophy.

We need a world view, a philosophy and a way of life that are fit for purpose in the 21st century; that purpose being, I would submit, to ensure everyone in the world has access to the resources they need for a good quality of life and good health, within the natural limits of the Earth—which makes the challenge of the Anthropocene very much a matter of social justice, as discussed above.

However, because the challenges we face are not for the most part questions of science and technology, we should not be too surprised that the provision of information and education (what I would call 'head stuff') will not fix the problem. The evidence that evidence creates good policy is thin, especially when it comes to the environment, or even to human health. If you do not agree, look how long it took to take action on smoking, or explain why the evidence on climate change has not led to much better climate policy than we have today.

Rather, as I discuss below, the block is not lack of information, but ideology and interest, and what has been called a 'culture war', which leads politicians and others with a particular ideology or a strong financial and power interest to wilfully ignore the evidence, an act that has been called 'ignore-ance'. So we will need to employ economic, legal and political tools to address the power imbalances that lie at the heart of the problem.

There can be a tendency to address this somewhat simplistically: "We know what needs to be done. The policy proposals are there. Only the political will is lacking" [36]. Would that it were so simple. However, political will is not just about politicians deciding to do something; it is deeply rooted in and driven by the deep cultural values that underpin the dominant economic, social and political beliefs and practices that have led to the global ecological changes that constitute the Anthropocene, and these are what we need to change. Therefore, to the extent that we need more science, it is implementation science and the science (and art) of social and cultural change that we need.

However, cultural change is not really the province of the natural sciences, although the development and deployment of technologies such as motor vehicles and the Internet clearly have massive if often unanticipated and unintended consequences. However, if we want to bring about a change in people's fundamental worldviews and beliefs, we will need to engage with their humanity. We need to reach people emotionally, pluck at their heartstrings, affect their gut instincts, help them find a sense of reverence and awe for the natural world; I call this 'heart, gut and spirit stuff', and it is

largely the province of the arts and humanities in all their forms and faith and spiritual communities. I discuss these different approaches in the remainder of this article.

4.1. Information, Ideology, Interest and 'Ignore-Ance': Culture Wars and Planetary Health

One of the major errors many scientists and academics make is that they seem to believe that if they just present the facts, the data, the science, then people will act rationally and make the right decisions. However, if that were the case, we would have had good climate policy a couple of decades ago, and many other policies that would be moving us towards a more sustainable future.

Carol Weiss, a social scientist, wrote many years ago about what I have always called the three 'I's that go into decision-making: information, ideology and interest [37]. The failure to get good climate policy is a wonderful illustration of this.

First, there is 'interest'; a great many people, and a great many powerful corporations, make a huge amount of money from the current economic system and especially the fossil fuel-based energy system. So they have little interest in changing the system, and indeed have worked hard to undermine the science of climate change and to sow doubt, taking a lesson from the tactics of the tobacco industry, as noted later. They use their power and wealth to shape public discussion and influence the political debate.

There is another form of interest, which we have seen recently on the streets of Paris, and that is the interest of the 'small people', who see carbon taxes as just one more tax they have to bear at a time when they have seen their wages and wealth stagnate while the 'one percent' get richer. Undoubtedly, their concerns are in part shaped by the interests of the powerful, who will welcome (if they are not already encouraging and supporting) such a public backlash.

Second, there is 'ideology'. These same powerful forces, for the most part, have a clear ideological perspective that encompasses neo-liberal economics and politics, an ideology that is the bedrock of Republican politics now in the USA, and similar political leanings elsewhere. So it should not come as a surprise that views on climate science break down largely on political lines. A report from the Yale Program on Climate Change Communications [38] found a very clear gradient of views across the political spectrum, with quite dramatic differences at each end of the spectrum (Table 2).

Table 2. Views on climate change and political ideology, USA, October 2017.

	Overall	Liberal Democrat	Conservative Republican
Global warming is happening	73%	95%	40%
Global warming is caused mostly by human activities	59%	84%	26%
Worried about global warming	66%	88%	30%

Source: Leiserowitz et al., 2017. [38].

These ideological differences are not confined to the USA. In Canada, where I live, a recent poll [39] found a similar split along ideological lines:

- Overall, 66% of voters agree "climate change is a fact and mostly caused by human activity", but while 85% of past NDP (social democratic) voters and 81% of past Liberal (centrist) voters agree, only 35% of past Conservative voters agree.
- Conversely, 21% of Conservative, but only 5% of Liberal and 3% of NDP past voters agree that "climate change is a theory that has not yet been proven".

Andrew Hoffman, the Holcim Professor of Sustainable Enterprise at the School of Business, University of Michigan, argues that the discussion on climate science has become a culture war [40] based on a "cultural schism" [41]. In his 2018 book *How Culture Shapes the Climate Debate*, Hoffman notes that we "*develop worldviews that are consistent with the values held by others within the groups with which we self-identify*" and that as a result we "*gravitate towards opinions that fit with those of the people with whom we identify*".

As a result, "*our cognitive filters reflect our cultural identity*" and our "*cultural identity can overpower scientific reasoning*", leading us to ignore information that does not fit with our ideological views and cultural identity. So if wealthy and powerful individuals and corporations that have a strong self-interest in preserving a fossil fuel-based society are also shaping and funding conservative and neo-liberal causes and politicians, it is not hard to see why climate science is ignored and climate policy fails.

The question, of course, is to what extent this ignoring of evidence, particularly by political leaders, can be understood and explained as simply the result of their cultural identity and to what extent it is wilful. I believe we are faced not only with a culture war but with what Ellsworth [42] called 'ignore-ance', which she defined as "an active dynamic of negation, an active refusal of information". Such ignore-ance is based not just on ideology but also on interest—the undue influence of wealthy and powerful individuals, which cannot be accepted or excused in a truly democratic society.

There are many approaches to combatting such 'ignore-ance', including of course fact-based reporting and investigative reporting leading to media exposure of falsehoods, influence peddling and corruption (the graft that goes with greed and growth), but I will focus on four key strategies with which I am most familiar; changing social norms and using legal, economic and political approaches.

4.2. Changing Social Norms

A social norm is "*a shared expectation of behaviour that is considered culturally desirable and/or appropriate*". While not a rule or regulation per se, "*people come to act in conformity with the norms of their society*" [43]. For many decades, smoking was a social norm, allowed anywhere and marketed as a high-status activity; other health-related social norms used to include spitting in public and drinking and driving. All of these social norms have been challenged and changed.

There are important lessons to be learned from the fight against tobacco, where we succeeded in 'de-normalising' smoking behaviour and the tobacco industry as a whole, leading to markedly reduced rates of smoking. At first, much of the emphasis was on public education, but that approach enjoyed limited success. The turning point began with the advent of the non-smokers rights movement in the 1970s, which became quite passionate and powerful. While fact-based, it was largely an appeal to people's sense of their human rights being violated by smokers, which began to make smoking socially unacceptable. That in turn led to a social consensus that enabled governments to raise taxes, bring in strong regulation of the industry, and ultimately to both successfully sue them for damages and bring them to court and convict them for violations of the law [44].

It is noteworthy that all this was accomplished despite a campaign by the tobacco industry that was described as follows:

> *"The tobacco industry's extensive campaign to counteract these forces through marketing, public relations, political influence, and creation of doubt about the scientific evidence on tobacco is now well documented through the industry's internal documents. The industry used its influence to thwart public health action at all levels and fraudulently misled the public on many issues. Undoubtedly, these actions slowed progress in tobacco control." (US Surgeon General, 2014, p 34* [44]*).*

This will sound familiar to many climate change campaigners and scientists, so it is hardly surprising that the *Centre for International Environmental Law [CIEL]* [45] found close ties between the tobacco and oil industry, stating "the oil companies have benefitted from the tobacco playbook in their fight against climate science". CIEL adds "*Our research in the more than 14 million documents of the Tobacco Industry Archives reveals compelling evidence that the relationship between these two industries is neither coincidental nor casual. The ties between these industries date back nearly a century and are surprising in their scope, their intimacy, and their specificity*" [45].

So perhaps we need to use the tobacco control playbook in our fight against the fossil fuel industry, and more broadly against the entire economic system and the social and cultural values, norms and behaviours that underlie and create the Anthropocene. As noted above, three powerful government

tools—taxation, regulation and prosecution—can be used to support a shift in social norms. The first two in particular can support a basic health promotion principle—we have to make the healthy choice the easy choice [46], while the third can undermine the social legitimacy and the 'social licence' of a corporation.

- An important principle in taxation is—or should be—that we tax the things we do not want, and we do not tax the things we do want. So there should be no taxes on clean energy or energy conservation materials, for example, but increasing taxes on fossil fuels (a carbon tax, or more precisely, carbon pricing), or increasing taxes on larger homes or cars and tax breaks on smaller ones.
- Related to taxation are subsidies, which include tax breaks; all subsidies should be withdrawn from the fossil fuel industry and re-directed to the energy conservation and clean and renewable energy industry, for example, or from meat and dairy farming and re-directed to vegetarian agri-food systems.
- Regulation is already used to manage the energy efficiency of buildings and products, the pollution emissions of industries and many other activities of corporations—or the behaviour of individuals; all of these and many others could be strengthened. One of the more powerful weapons in the fight against tobacco was to ban marketing and sponsorship; how might that be done with companies that market high-speed cars or large trucks, for example?
- Just as the tobacco industry was successfully sued for the harm it did and for knowingly hiding that harm and its knowledge of that harm, so too we might sue the fossil fuel or the pesticide for industries, among others, for ignoring or downplaying the impact of their products and covering up their knowledge of that impact. Indeed, the first suits by local governments against the industry are now underway [47].

While in broad terms anything that moves us towards 'one planet living' should be encouraged as the social norm, and anything moving us in the opposite direction should be de-normalised, there are larger underlying social norms, deeply embedded in our way of life, that also need to be challenged and changed.

In the context of the Anthropocene, high-income countries have established—and have largely 'sold' to the rest of the world—a set of social norms that are no longer fit for purpose in the 21st century. These include a belief in that economic growth is the same as progress, that the acquisition of wealth and stuff is a sign of success, that bigger and more is better, and that the environment is separate from us and exists simply for our use. These and other related social norms must be changed if we are to have any hope of creating good health and a good quality of life for all within the ecological and biophysical constraints of the Earth.

4.3. Legal Approaches: The Right to a Healthy Environment and More

As noted above, one of the key strategies used by tobacco industry opponents was to go to court, and this tactic is already being used against the fossil fuel industry. However, we need to pursue a more profound range of legal remedies to ensure a healthy and sustainable future, including putting in place the right to a healthy environment—and not just for people alive today, but the right of future generations to a healthy environment, which incurs a duty on us today; the right of other species and indeed entire ecosystems to exist, and finally we need to consider creating the offence of an 'environmental crime against humanity'.

First suggested at the First UN Conference on the Environment in Stockholm in 1972, the right to a healthy environment is now included in some form in the constitutions of 149 out of 193 nations, according to David Boyd, now the UN Special Rapporteur on human rights and the environment. In 144 nations, the Constitution includes a duty of environmental protection, while in 98 nations the constitution recognizes that "citizens have a substantive right to live in a healthy environment".

Troublingly, the 44 nations that have no such rights or duties include the USA, the UK and 27 former British colonies, including Canada and Australia [48].

Then there are inter-generational rights—we have a duty to future generations to ensure their right to a healthy environment. We might follow the example of Wales, which in 2015 adopted a Well-Being of Future Generations Act and established a Future Generations Commissioner for Wales [49]. The Act recognises that "*Sustainable development is about improving the way that we can achieve our economic, social, environmental and cultural well-being*" and places a legal duty on all public bodies, including Ministers, to carry out sustainable development, including setting and publishing wellbeing objectives, which they must pursue. They are also required to publish annual progress reports and respond publicly to recommendations from the Commissioner.

Accountability is further ensured by requiring Ministers to set national indicators and report publicly on progress. Finally, the Act requires Ministers to publish a 'Future Trends Report' within twelve months of an election containing "*predictions of likely future trends in social, economic, environmental and cultural well-being of Wales*", taking into account "*the UN's sustainable development goals and the impact of climate change on Wales*" [49].

In addition to the right of people to live in a healthy environment, we need to also consider the right of other species—and indeed entire ecosystems—to exist. Boyd [50] reports that courts in some countries have recognized that "*endangered species have the legal right to exist*"; while New Zealand has granted legal recognition as persons to both the Whanganui river—the third-longest in the country—and the Te Urewera region—previously a national park. The 2014 Act that established Te Urewera states it "*has all the rights, powers, duties, and liabilities of a legal person*", with those rights "*exercised and performed on behalf of, and in the name of, Te Urewera by Te Urewera Board*".

Finally, it is noteworthy that in a 2016 Policy Paper the International Criminal Court announced "*a shift in focus toward assessing crimes that result in 'the destruction of the environment or of protected objects'*" [51], although there is doubt as to whether the court has jurisdiction over environmental damage other than in the context of war [52]. Nonetheless, we may be at or nearing the point where there may be a case to be made that in continuing to ignore the evidence on climate change and instead promoting the fossil fuel industry, our political leaders may be guilty of an environmental crime against humanity. In fact, Professor Jeffrey Sachs, Director of the Center for Sustainable Development at Columbia University, recently suggested exactly this [53].

4.4. An Economics Fit for Purpose in the Anthropocene

> "*Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist*"—Kenneth Boulding, a former President of both the American Economic Association and the American Association for the Advancement of Science. [54]

The noted environmental writer George Monbiot has recently written [55]:

> *"Our choice comes down to this. Do we stop life to allow capitalism to continue, or stop capitalism to allow life to continue?"*

For this and other reasons, our current free enterprise capitalist economic system is not fit for purpose in the 21st century. This of course raises the question—what is the purpose of the economy, which in turn raises the question—what is the purpose of society and government? The central question is this: what sort of economy can meet the goal of achieving good health and a good quality of life for everyone, while living within the biophysical and ecological constraints of this one small planet that is our home?

However, we have forgotten that the economy is simply a human construct, a tool that should help us achieve our goals. Instead, we have got things back to front; rather than the economy helping society and government, it seems that the purpose of government and society has become growing the economy, and more generally growing the stock market and the GDP.

There are many reasons to critique the current model. For one thing, as already noted, it has created ecological destruction, increased inequality and harmed health. In part this is because the model has a very narrow concept of capital—only produced (material) or monetary capital counts. However, there are at least three other forms of capital (Figure 6) [56,57].

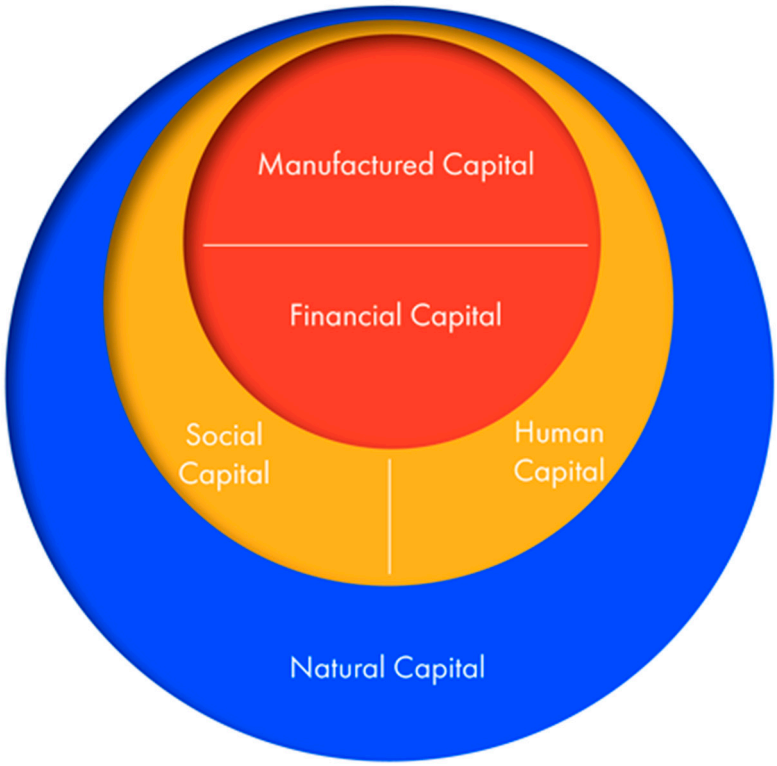

Figure 6. The Five Capitals model. Source: The Forum for the Future. The Five Capitals Model. Available online: https://www.forumforthefuture.org/the-five-capitals.

- ecological or natural capital—the Earth's biocapacity and resources, both locally and globally;
- social capital—the capital that is vested in the way we relate to other people through informal networks of association, formal programs of social welfare and 'invisible social capital' that regulates our peaceful co-existence through political, judicial and constitutional systems;
- human capital—the knowledge, skills, health and wellbeing and capacity for caring, love, creativity and innovation of individuals.

It is the latter two—human and social capital—that we must work to maximize, within the constraints of natural capital. In the ideal world we seek, our economic system will grow by supporting the growth of these other forms of capital. However, today these forms of capital (and some would add cultural capital to this list) are generally considered to be externalities and are ignored. So in the current model it is acceptable to degrade these other forms of capital, as long as produced or monetary capital increases.

Secondly, the focus of economic policy has become GDP growth, which is the main indicator used by governments and the business sector—and widely used in the media—to gauge a nation's progress and success. This is despite the warning to the US Congress in 1934 by one of its leading creators, Simon Kuznets, that "the welfare of a nation can scarcely be inferred from a measure of national income". Perhaps the biggest fault in the GDP—and there are many—is that it fails to distinguish between beneficial and harmful economic activity. Thus, all the activities of the tobacco industry—and all the activities of the health care system in treating tobacco-related diseases—add to GDP; so too do oil spills, house fires and other disasters, because of the clean-up, repair and replacement costs.

Finally, the entire notion of economic growth—which generally means growth in consumption of resources, production of pollution and degradation of ecosystems—as desirable is ridiculous, as the opening quote from Kenneth Boulding points out. Fortunately, there are alternative ways to think about and construct an economy.

- First, we can expand our concept of capital, as noted above [57]. Even the World Bank [58] has considered this worth doing; more than 20 years ago they estimated that only some 20% of the world's total wealth was to be found in economic capital, a further 20% in natural capital and the remaining 60% in a combination of social and human capital (they had trouble distinguishing and separating these two) [58], although Coleman [59] does make a clear distinction:

  "Social capital is distinguished from human capital in that it does not exist within any single individual but instead is concerned with the structure of relationships between and among individuals."

- Second, if we adopt this wider understanding of capital, then we can conceive of forms of growth that are beneficial; we want to grow human and social capital and 'grow' (restore, protect) natural capital, while stabilizing and then reducing material capital growth. Thus, we can redefine what it means to be a successful capitalist; the real capitalists are those who simultaneously increase all forms of capital. Increasing material and monetary capital at the expense of other forms of capital is false capitalism.
- Third, we can find better measures of progress to replace GDP. One such measure is the Genuine Progress Indicator (GPI). Originally known as the Index of Sustainable Economic Welfare [60], this index modifies the current GDP in several ways: it adjusts for inequality, deducts "the undesirable side effects of economic progress" such as pollution or motor vehicle crashes, as well as depletion of natural capital, and adds in "the non-market benefits associated with volunteer time, housework, parenting, and other socially productive time uses" [61]. The difference between GDP and GPI is dramatic. For example, while the USA's GDP per person more than tripled between 1950 and 2004, the GPI per person has stagnated since the late 1970s because "the benefits of economic growth have been entirely offset by rising inequality, deteriorating environmental conditions, and a decline in the quality of our lives" [61].
- Another alternative measure of progress is the Happy Planet Index (HPI), developed by the New Economics Foundation. It combines four key measures in a single index that between them measure what we should be most interested in: Life quality (life expectancy × life satisfaction × equity factor) per unit of ecological footprint. The results can be surprising. The top 3 countries in the most recent assessment are Costa Rica, Mexico and Colombia; the UK is 34th, Canada 85th, Australia 105th and the USA is 108th out of 140 countries.

Most comprehensively, leading thinkers in the field of economics are proposing a new economics, more suited to meeting the needs of the world's population—and the needs of the Earth—in the 21st century. Some describe this as a 'steady state' economy, a concept first popularised by Herman Daly [62,63]. Such an economy is "of stable or mildly fluctuating size" which, to be sustainable, "may not exceed ecological limits". Dietz and O'Neill [64] describe it thus:

"an economy where resource use is stabilized within environmental limits, and the goal of increasing GDP is replaced by the goal of improving human well-being. It is an economy where the goal is better lives, not more stuff"

while Raworth [65] describes a 'Doughnut' economy, where:

"To meet all people's needs within the means of the living planet, rich countries must overcome their dependency on GDP growth and develop economies that are regenerative and distributive by design".

In such an economy, a balance must be struck between providing the "social foundation" (meeting the needs of everyone on Earth for good health and a good quality of life, which requires a certain

minimum level of economic activity so people and societies can ensure clean water, sanitation, adequate food and shelter, education, health, social support, etc.) and staying within planetary boundaries—what might be called an ecological ceiling. Such an economy is 'regenerative' in that it regenerates natural capital and restores ecosystems.

However, central to the concept of a steady state economy is the recognition that if we are constrained by planetary boundaries, the overall size of the pie cannot continue to grow if that means aggregate growth in material or produced capital which further damages natural, social or human capital. So if we are to achieve the social foundation for those who currently have far less than their fair share of the Earth's biocapacity and resources and society's income and wealth, we cannot do so by further growing material or produced capital at a global level, although human, social and natural capital should grow.

It is no longer possible to argue that the answer is more growth in material or produced capital because 'a rising tide floats all boats'. In this case, a rising tide will sink all boats (starting with the smallest and poorest boats), because as Woodward [66] argues, if the levels of inequality we see today persist "*the global economy would have to be 175 times bigger just to push everyone above $5 a day, which would be environmentally catastrophic*".

Instead, the economy must be 'distributive'—actually, redistributive; natural capital and economic benefits must be distributed equitably so that everyone's basic needs are met and everyone can lead healthy, productive lives, within the constraints of the Earth's physical and ecological limits. This means that those who have more than their fair share—high-income countries and people—have to reduce their share in order that those who have too little—who lack the set of resources a person must acquire to maintain a minimum standard of living for survival [35]—can have enough. It is stating the obvious to say that changing these social norms and economic systems will not be an easy thing to accomplish—but what alternative do we have?

4.5. Politics and Planetary Health

As noted earlier in this article, The Ecologist published Blueprint for Survival in 1972 [17], and like other publications of the time, presented a broad analysis of the state of the global environment. However, it went much further, stating in its preface:

> *"This situation must now give rise to a national movement to act at a national level, and if need be to assume political status and contest the next general election."*

This suggestion led directly to the creation in 1973 of the world's first two ecological political parties: The Values Party in New Zealand, followed by the People Party in the UK. I became an area organiser for the People Party and attended the founding convention of the People Party in Coventry in 1974 as a delegate, where we adopted the Manifesto for Survival. (The People Party soon changed its name to the Ecology Party and later, after the success of the German Greens, became the Green Party).

In 1975 I moved to Canada to become a family physician, moving on into public health four years later. However, around the edges of my professional life as a public health physician in Toronto, I continued to be engaged in ecological politics. In the late 1970s, a small group of people ran in the federal election under the informal banner of the Small Party, following which we created the Green Party of Canada, of which I became the Leader. In 1984, we were able to run more than 50 candidates across Canada (the threshold for being officially recognised as a party) and I was one of them. The rest, as they say, is history, although I dropped out of active engagement in Green politics in the late 1980s to focus on my work on healthy cities and communities.

However, politics is not only about formal party politics, there is also the politics of protest, the politics of the street and of civil disobedience:

> *"Naming and shaming, ethical purchasing and investments, boycotts, legal challenges, divestment and civil disobedience in the form of demonstrations and blockades, are some of the legitimate tools and*

strategies to which those who seek to protect the health of the public and the Earth's natural systems have had to resort in the past, and may have to resort to in the future." [67]

5. Beyond Science and Technology: Not just 'Head Stuff' but 'Heart, Gut and Spirit' Stuff

For several years now, based on the evidence of our collective failure not just on climate change but on preventing many other elements of the global ecological changes that comprise the Anthropocene, I have been suggesting that while we need to continue to place emphasis on providing people with data and evidence and educating them ('head stuff'), we need to place more emphasis on reaching them emotionally and spiritually; what I call 'heart, gut and spirit stuff'.

This is not an argument to abandon or throw out science, but to recognise that information alone does not change people's opinions or their actions—we need to complement and supplement scientific information with approaches that appeal to our other ways of knowing, that tap into our mental, emotional, artistic, cultural and spiritual lives. One of the most important ways is through nature contact, which can include all these facets of our lives.

5.1. Nature Contact

We evolved in nature, and for most of our 200,000 years history as a species we lived in close contact with nature. The first cities only appeared 5000 years ago, and the first country to have a majority urban population was the USA, in 1920, followed by other high-income countries in Europe, Japan and Australasia. Globally, it has been estimated that the world's population was only 16 percent urban [68] in 1900; it did not reach 50 percent until the early 21st century. So our 'nature deficit' [69] is very recent, and is counter to what E.O. Wilson [70] has argued is our innate need for nature, which he calls biophilia.

I have seen that innate need myself, in the many healthy city vision workshops that I have conducted over the past three decades. In those workshops, people experience a guided imagery tour of their own community as they imagine it would be in the future as a healthy community, then create collective drawings of what they saw. One of the most consistent elements is that there is greenery and water, they are prominent in every picture I have ever seen, although I have not done workshops in the Arctic or in the desert regions; I wonder if they would be as prominent there? The importance of water and greenery in Islamic paradise gardens suggests they are, at least in those desert regions. Clearly, greenery and water are of central importance for people.

Over the past couple of decades there has been a growing body of work showing a wide variety of mental, physical, emotional and social benefits of nature contact [71,72]. This in turn has given rise to a growing interest in issues such as outdoor play, nature kindergartens and 'forest bathing'. However, not only do children need nature, nature needs children; if we raise a generation that has no connection with and does not love, cherish, respect and care about nature, why would they protect it?

However, many who experience nature would agree there is a spiritual quality to that experience. Nature can be beautiful, a source of peace and tranquillity, of reflection and contemplation; it can also be awe-inspiring and humbling as we see the power of a river, a storm or a volcano, or the immensity of a forest, a canyon, a desert, the ocean or the sky.

I have never lost the sense of awe I experienced one night as a teenager as I lay down in a dark spot and really looked at the Milky Way. It was overwhelming and humbling to realize what a small part of the galaxy our own seemingly vast solar system is, and what a tiny part of all that I am. However, it also gave me a strong sense of my connectedness to the universe, a sense that has never left me.

However, for many people, perhaps most of us these days, that connection is lost. A vivid illustration of our loss of connection comes from Los Angeles, where in 1994 an earthquake knocked out power. It was reported that "many anxious residents called local emergency centers to report seeing a strange 'giant, silvery cloud' in the dark sky. What they were really seeing—for the first time—was the Milky Way, long obliterated by the urban sky glow" [73].

Sadly, this loss of any awareness of the night sky is hardly surprising. The first World Atlas of the artificial night sky brightness tells us, "two-thirds of the U.S. population and more than one-half of the European population have already lost the ability to see the Milky Way with the naked eye" [74]. However, if we cannot see the stars, how do we know our connection to and place in the universe?

The only way to develop a reverence for nature is to experience its beauty, its sometimes awesome power, which is why we need to get kids outdoors—and why we also need to bring nature into our cities and our lives.

5.2. The Arts and the Anthropocene

We do not pay enough attention to the remarkable importance of art in our lives; we had been artists long before we became farmers or city dwellers. The earliest evidence of art—pigment kits, in the Blombos cave in South Africa, perhaps for body decoration, wall painting or both—go back about 100,000 years, half as long as we have been homo sapiens; a recent paper [75] reports finding abstract art—scratchings on a stone flake with an ochre 'crayon'—from the 73,000 year level of the Blombos Cave. That same cave has evidence of jewellery—shell beads dating back 75,000 years, but older beads—about 90–100,000 years old—have been found in caves in Israel [76].

Then, about 40,000 years ago, there is evidence that abstract art became widespread in Africa and Eurasia, and about the same time we find the first statue and the first bird-bone flute [76], although clearly, such a sophisticated instrument must have older roots. Clearly, we have been making music—and presumably singing and dancing—for tens of thousands of years. This long history of art as part of human experience suggests that there is something quite fundamental and profound in that association—to be human, it suggests, is to be an artist and to enjoy art.

We all know that we can be profoundly touched and moved by songs, poetry, theatre, dance, film, paintings, sculpture, photography and so much more, while landscape and wildlife art, photography and documentary video is enormously popular. However, I think that in general we have overlooked and failed to engage with the arts community in addressing the challenge of the Anthropocene. Yet if we want to reach people emotionally, we need to work much more with this artistic aspect of our common humanity.

Given the power and ubiquity of popular music, what collaborations might be possible with pop music bands, hip-hop artists and rappers? (It is noteworthy that a large proportion of the individuals supporting the Pact for a Green New Deal in Canada are musicians and actors https://act.greennewdealcanada.ca/endorsements/). And what can be done with the online world, with computer gamers, video artists and others of their ilk?

To be sure, there are collaborations between scientists and artists, but they are too few. More common are artists who work in and with nature; I think of the work of Nicholas de Pencier, Ed Burtynsky and Jennifer Baichwal on The Anthropocene Project [77], which combines art, film, virtual reality, augmented reality, and scientific research; the great English environmental artist Andy Goldsworthy (although he is not working with scientists, his work powerfully shows us the beauty we can find and create from in nature) or the short but powerful 'Nature Speaking' videos of Conservation International.

In addition, we need to find ways to bring this down to the local level, perhaps in the form of local art and nature projects in the schools, nature festivals and the like; not protests of harmful activities (although we need those too), but community ritual and celebration of nature, mourning for what we are losing but celebration of what we have, or of what we are taking back and re-creating.

5.3. Re-Discovering the Spirit in Nature

Nature contact, we should note, is not just a physical but an emotional and even spiritual experience. Ultimately, saving us from ourselves is not a technological but a spiritual quest to live in harmony with and as part of—not separate from—nature. We need to re-create a spiritual connection, perhaps simply on a personal level, through a modern-day form of animism, or through a

Franciscan-inspired Christianity or other spiritual and religious beliefs that are more in harmony with and see the spirit in nature. Unless and until we revere rather than revile (or ignore) nature we will not make much progress; re-discovering the spirit in nature may be one of the more important ways for us to address the Anthropocene.

Note I am not talking here about religion, but about spirituality; they are very different. In introducing a special section on spirituality, religion and health in the American Psychologist, Miller and Thoresen [78] considered religion to be a social phenomenon; "*social entities or institutions defined by their boundaries*". They noted that "*religions are also characterized by other non-spiritual concerns and goals (e.g., cultural, economic, political, social)*". However, they suggested that spirituality, while harder to define, has two general themes: "*being concerned with life's most animating and vital principle or quality*" (life force or energy), and "*a broad focus on the immaterial features of life*". Concepts of "*inner peace*" and "*a transcendent relationship with that which is sacred in life*" are also part of the picture, they wrote.

In a review on the topic of health and nature contact, Kuo [71] notes that *"Contact with nature has a host of other physiological effects related to relaxation or stress reduction"*, that *"the experience of nature helps shift individuals toward a state of deep relaxation"* and that *"regular experiences of awe are tied to healthier, lower levels of inflammatory cytokine"*.

If we are to manage our way through the massive global ecological changes we have created, I firmly believe that we need to experience the deep relaxation, awe, and vitality that comes from nature and to find—perhaps rediscover—the sacred in nature. I am not suggesting an organised religion, but the cultivation of a deep understanding of our involvement with and dependence upon the totality of the natural world. If we respect and cherish the Earth, we will be able to live more in harmony with it. That would be good for our health, as well as the health of the ecosystems we live within.

6. It is Still "Think Globally, Act Locally"

The concept of thinking globally but acting locally—a phrase variously attributed to Buckminster Fuller, David Brower (founder of Friends of the Earth) and René Dubos—has been an essential part of the environmental movement's approach for decades. Americans, Canadians and Australians use the equivalent of 5 planets' worth of biocapacity annually. So if the entire planet were to live the way we live, we would need 4 more Earths; overall, high-income countries (HICs) on average used 3.6 times the available biocapacity, meaning we would need 2 or 3 more planets (Global Footprint Network, 2018). However, despite the fantasies of Elon Musk and his followers, there are no other planets available to us—there is no Planet B.

So we have to learn to live in a healthy way with an ecological footprint of just one planet. For HICs as a whole, this will require about a 70 percent reduction, while for the USA, Canada and Australia it requires an 80 percent reduction in the footprint. This is a massive and unprecedented challenge. However, while desirable, top-down change is unlikely, given the power, wealth and other benefits that accrue to those at the top of the current socio-economic and political system; so change will mainly have to come from below, from the cities and towns where more than half the world's population now lives, although as Fran Baum's 'nutcracker' analogy suggests, a combination of bottom-up and top-down would be best [79].

Hence the emerging concept of One Planet Living (Bioregional, n.d.) and One Planet Regions [80], which I sometimes frame as 'Healthy Cities 2.0' [81]. A 'One Planet Region' is a place that has a high quality of life and good health for all while living within the limits of this one small planet that is our home. I am working on this challenge with others in my own community—the Greater Victoria Region (GVR), capital of the Canadian province of British Columbia—to raise awareness and stimulate change across all sectors of our community.

6.1. The Greater Victoria Region as a One Planet Region

The GVR is a region of about 350,000 people organized in 13 municipalities (and a weak regional government) on the southern tip of Vancouver Island, a large island on Canada's Pacific coast. The

island is comparable in size to Taiwan or the Netherlands but with a rather small population of about 750,000 people. The GVR's temperate climate and beautiful coasts and forests make it popular both with tourists and with retirees from the colder parts of Canada, making it an expensive place to live. So issues of poverty, hunger, homelessness and unaffordable housing are a significant concern in the community (Victoria Foundation, 2018).

Vancouver Island elected 3 Green Party members to the Provincial legislature in May 2017. As they hold the balance of power and are supporting a minority social democratic government, it gives the Greens their first important toehold in power in Canada. The GVR is also home to the only Green Party member of the Canadian Parliament. The region is thus a hotbed for environmentally and socially conscious activities.

It is in this context that our work on a One Planet Region is embedded. What makes our approach distinct is that we are one of only a few initiatives (with which we are linked and collaborating) that are explicitly trying to integrate the ecological, social and economic aspects of development.

We are fortunate in that we have an assessment of the local ecological footprint for two of our municipalities (Victoria and Saanich, between them about half the population of the GVR), so from the outset we have been able to root our discussions in the context of our local situation and its environmental, social and health implications. (Interestingly, that work had been undertaken quite separately from our work on the Conversations, and while it helped in the subsequent selection of Saanich for the Bioregional project (see below), it was again independent of that—sometimes, fortune smiles on us!)

6.2. The Ecological Footprint of Saanich

The ecological footprint of Victoria and Saanich was estimated using a bottom-up estimate based on consumption, and does not include operating energy for manufacturing goods that are exported from the area, nor does it include upper-tier government services, so it is an under-estimate, but nonetheless revealing [82]. Overall, the ecological footprint was about two planets, but it is likely more like three planets if the non-included elements are included Moore, personal; communication). While this is markedly less than the 5-planet estimate for Canada overall, it is worth noting that our region has a temperate climate, with much less heating and cooling required than for much of Canada; that 90% of our electricity comes from hydro, so there is little fossil fuel used, and that we do not have coal mines, tar sands, oil wells, natural gas or heavy industry, all of which reduces our local footprint (although we do import and use the products of that industrial activity, of course).

The report suggests that the largest single benefit from reducing our ecological footprint will come from eliminating fossil fuel emissions in our buildings by getting off fossil fuels for heating and cooling and, to a lesser extent, electricity production. Our current transportation system is another important contributor to our ecological footprint, accounting for about a quarter of it, with most of that due to private vehicles. Moore suggests that half of all private vehicles need to be electric powered, although of course, that electricity needs to come from clean, renewable energy systems, not from fossil-fuelled plants.

However, while switching to electric vehicles will reduce both carbon emissions and air pollution, it will not solve other problems such as congestion, injuries or a sedentary lifestyle. For that, we need to change the way we move around. In her earlier assessment of the ecological footprint of Vancouver, Moore [76] also suggested a marked increase in active transportation, with as much as 86 percent of all trips made by walking, biking, rolling or using public transit; that would also apply in our region. The health benefits of these transportation policies include reduced air pollution, reduced injuries (public transit is far safer), reduced greenhouse gases (and thus reduced health impacts from climate change), increased physical activity and reduced commuter stress.

However, one of the most surprising findings is that almost half of our ecological footprint, as measured this way, is attributable to our food, and mainly our high-meat, high-dairy diet, which accounts for almost three-quarters of our food ecological footprint, as well as our high-waste agri-food

system; a recent startling report suggests that in Canada 58 percent of all the food produced in Canada is lost or wasted [83]. Thus, one of the key suggestions Moore makes is that we reduce meat consumption by 25 percent, replacing it with chicken (or non-meat alternatives); in addition, we should reduce dairy food consumption by 25 percent and on top of that, reduce overall food purchasing by 25 percent; this latter measure is also an important way in which we can reduce obesity rates, and of course will also reduce food waste.

These suggestions are not only environmentally beneficial, they are also good for health; indeed, the recent report of the EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems proposed a largely plant-based diet much like this [84]. They estimate such a diet could enable us to feed "10 billion people a healthy diet within safe planetary boundaries for food production by 2050" while preventing about 11 million deaths annually (about 19–24 percent of total deaths among adults, globally). The benefits of measuring the ecological footprint at the local level are clear; it enables us to select locally relevant and appropriate priorities to focus on.

6.3. Conversations for a One Planet Region

I initiated the Conversations in 2016, some time ahead of even learning about Bioregional's 'One Planet Living' work, and more than a year before Saanich was selected to be part of Bioregional's initiative (described below). We started the Conversations because right now communities in our region—and around the world—are not even talking about the massive global ecological changes that constitute the Anthropocene, or the implications of those changes for our entire way of life and for future generations; to the extent that we are discussing it, we are focused almost exclusively on climate change.

We recognised that meeting the challenge of being a One Planet region (or city, town or community) will require the full and genuine participation and engagement of all sectors of the society and of the city. Public, private, community and NGO, youth and schools, seniors, academic, faith and other partners must learn to work together for the common good of the people as well as the planet.

Our operating slogan is 'Learn–Discuss–Imagine–Design–Create'; we take the view that if we do not learn about and discuss the challenges we face and the solutions we need, we cannot begin to imagine what a One Planet region would look like, and if we cannot imagine it, we cannot design and create it. So we start with Conversations, which are free, open to anyone and held once a month in the evening in the public library.

We only use local speakers and leaders, since we believe we have the expertise, experience and leadership we need in our own community—although we are aware of and try to be informed about the many examples from elsewhere that we can use and adapt to our need. We hope in time to podcast and perhaps webcast these Conversations so we can have speakers from other places in our community, and they can gather in their own neighbourhoods and have their own conversations following the presentations.

Our presentations are deliberately wide-ranging, addressing more than the obvious issues—energy, transportation, housing, urban design, water supply, waste management, food supply and so on. We have discussed the role of the arts and of faith communities in creating a One Planet Region, have sought to understand the Indigenous perspective, explored what sort of economic and education systems we will need and how to manage cities and regions as urban eco-social systems. In addition, we try to focus less on defining the problem and more on presenting and discussing potential solutions.

As noted earlier, issues of poverty, hunger, homelessness and unaffordable housing are a significant concern in the community, and all of these might be either exacerbated or ameliorated, depending on how we move forward in becoming a One Planet Region. A One Planet way of life could be more expensive if it involves buying expensive new electric vehicles, upgrading to solar powered houses and so on. However, if we do it right, many of the changes we need to make could be less expensive for people living on low-incomes: Smaller houses and apartments would be more affordable; a low-meat diet—such as the new Canada Food Guide, which is similar to the diet recommended

by the EAT Lancet Commission [84]—may be less expensive [85]; improved insulation and energy efficiency should save energy and money; more liveable and walkable communities and good public transport might mean avoiding the expense of owning a car.

In addition, there is reason to believe that a clean, green energy system would create more jobs than would be lost in the switch from fossil fuels—indeed, the clean energy sector in Canada already employs more people than the mining, quarrying, and oil and gas sectors combined, and is growing faster than the economy as a whole [86], while a green and healthy transport system will require large numbers of local jobs requiring a wide range of job skills [87].

Once we begin to understand the challenges we face and the potential solutions available to us, we need to begin to imagine it, before we can design and create it. We have some thoughts about developing a region-wide, community-based multi-year charette to design a One Planet Region, linked to advanced systems modelling in an iterative process. (A charette is a co-design process involving local citizens and design professionals working collaboratively and intensively together—often over a couple of days—to create a design for a building, a remodelled street or a neighbourhood.)

We are hoping to start a 'youth for a One Planet Region' initiative, in conjunction with local schools, colleges, universities and youth-focused organisations, with youth taking the lead to identify and address the issues they and we face—it is, after all, their future we are talking about, and we have done a poor job of stewardship of the Earth for them.

We also want to reach out to municipal councils to provide some basic information and ideas about the long-term challenges they need to be considering, beyond climate change. (We recently had municipal elections which saw several new councillors elected, many quite young and very supportive of these ideas; they now form the majority of councillors in Saanich and Victoria). Beyond that, we hope to educate and train groups of citizens—especially young people—so that they can appear at municipal council meetings to support policies, programs, plans and proposals that move us towards being a One Planet Region—and oppose those that do not. In addition, we have thoughts about a conference/trade fair/film festival and other ways of advancing this vital agenda.

All of this, it is important to note, has been accomplished at almost no cost; while we will be seeking funding from foundations, governments and others in time, we can and have achieved a lot with very little.

6.4. One Planet Saanich

Saanich is one of five communities around the world—the others are Elsinore (Denmark), Durban (South Africa), Tarusa (Russia) and Oxfordshire (UK)—that are part of a project initiated by Bioregional, with funding from the KR Foundation of Denmark. Each community recruits a cohort, including businesses, community groups, schools and the local government who want to join the initiative. Assisted by Bioregional's own considerable experience and guidance documents, by local experts and by building on existing commitments they might already have, these community stakeholders each write their own One Planet Action Plan, indicating how they intend to respond to the challenge of One Planet Living, and how they could collaborate to achieve more.

They will also engage with the municipality and other stakeholders around their vision for sustainability in their own community—with the potential to influence action in the other participating cities.

The project began in April 2018 and will run for one year—at least initially—although clearly it will need to continue and indeed spread to other cities, towns and regions around the world, since it is a challenge we all share.

For more information see https://www.oneplanetsaanich.org and https://www.bioregional.com/projects-and-services/influencing-wider-change/one-planet-cities.

7. Conclusions—Finding Hope, Creating a Vision, Seeing Opportunity

"Hope is finding positivity in the face of adversity". [88]

"Vision is values projected into the future". [89]

Perhaps the greatest challenge—and the most important task—we face today, in the face of the rapid global scale ecological changes and the dysfunctional economic and socio-cultural system I have described, is to find hope, create a vison of the future we prefer and see not just the many challenges we face, but the many opportunities too.

I have worked on and off for many years as a health futurist, and have focused my work on alternative futures, and especially preferable futures [89]. It helps to understand that we face many alternative futures, that we need to decide what sort of future we want and then do what we can—with others—to create it. I remain clear that I seek a healthy, just and sustainable future for my community and for the world as a whole, and I do what I can to create it.

Ironically, the fact that the crisis is worsening is in some ways helpful; people as a whole do not anticipate and make beneficial decisions when things seem to be going well, but they do respond, and often quite dramatically, to crisis or to changing circumstances and values. For example, we have seen quite dramatic shifts in recent years in the acceptance of gay marriage and of divorce in places that were strongly opposed to those ideas. I take heart from the fact that many people share that vision—it is what they draw in the vision workshops I conduct, and those visions are a projection of their values. I think there is a good chance we can get there, and we have a moral imperative not to give up but to persevere.

In addition, and of particular interest for me, there are significant public health co-benefits from the shift to a more sustainable society that are worth fighting for. Three of the key areas for reducing greenhouse gas emissions (and all the attendant health impacts) are the shift to sustainable energy, transportation and food systems, and they all have significant health co-benefits [90]:

- Clean energy systems will result in cleaner air, reduced greenhouse gas emissions and more employment;
- Active transportation's co-benefits include increased physical activity, reduced obesity, reduced risk of motor vehicle crashes and injuries, and cleaner air;
- A sustainable low meat diet would result in reduced rates of cardiovascular disease, diabetes and cancer.

Moreover, there are many new and exciting opportunities for social, technological economic and scientific innovations that will need to be created in the process of shifting to such a future. In talking to young people, this is the aspect I stress. Yes, the situation is serious, and we have to face it and accept it, but it presents exciting opportunities—especially for young people, who will have to lead in the re-invention of almost every aspect of our present social, political, cultural, economic, philosophical and other systems. There is a huge need and scope for innovation, creativity, invention, activism and entrepreneurship to create the new society and economy we need. It is a challenging but exciting time to be alive!

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