Ecological Economics

Solutions for the Future

Edited by Haydn Washington

Academic rigour

This book arose from the ANZSEE (Australian New Zealand Society for Ecological Economics) conference ‘Ecological Economics: Solutions Now and in the Future’ held at RMIT University in Melbourne, Australia in November 2019 (https://anzsee.org.au/2019-anzsee-conference/). In the planning for this conference we agreed that the book arising from this would be self-published so that the pdf could be given away free, and the paperback would be as cheap as possible so that students and the general public could purchase it easily. I took on the role of Editor pro bono to ensure we ended up with a book.

However throughout this process we have remained committed to academic rigour. All chapters were reviewed twice by the Editor (sometimes more). Some chapters were also reviewed by other academics when the Editor thought this was needed. The Introduction was developed by the Editor and ecological economist A/Prof Philip Lawn, who originally had hoped to be co-Editor, but had to cancel due to personal reasons. Several chapters were reviewed by Dr Boyd Blackwell, President of ANZSEE. Hence, although this book was not published by a major publisher, it **upholds academic rigour**.

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Dedication: For Herman Daly - whose lucidity has added so much to ecological economics over four decades (and counting!).

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Cover photo: Lichen-covered rock and ferns photographed by the Editor on his land next to Wollemi NP. This survived just a few metres from where the major bushfires of 2019/2020 stopped. For the Editor it symbolizes the *renewal of life* in the face of disaster. We should remember and value this regenerative aspect of life, as it can advise solutions in ecological economics, and assist society to reach an ecologically-sustainable future.

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Introduction: Ecological economics - what is the nature of the beast?

Haydn Washington and Philip Lawn

As environmental scientist Professor Ian Lowe often says: 'Look at a photo of the Earth from space'. He then asks: 'Where is the economy?'. Society endlessly talks about economics and what is 'good for the economy'. Yet we cannot see 'the economy' from space because it (or more correctly the theories within it) is simply an *idea*. What we see from space is the blue living planet that supports all life and human society. We have called the process of how humans use and distribute aspects of nature 'the economy', yet the fact remains that society is fully reliant on nature (Washington 2013). If we destroy nature, we destroy the life support system for our society. If we destroy or degrade nature, clearly this too will degrade the economy. One would think that accordingly 'the economy' must *serve* society, but one can only question whether many today believe it is the other way around? It's as if we have confused ends with means.

Humanity seems to have put itself in a predicament where the economy (dominated by neoclassical growth theory) is consuming the Earth, and where greater consumption of resources and more people are deemed 'good things', purely because they expand the economy. It is this myopia that ecological economics (at least in its strongest forms) seeks to change, so as to allow us to reach an ecologically sustainable economy in a just and efficient manner. As this book canvasses, this is indeed a big task, but one we need to act on.

This book is titled 'Ecological Economics: Solutions for the Future', condensing the name of the Australia New Zealand Society for Ecological Economics (ANZSEE) conference held in November 2019 at RMIT University in Australia (https://anzsee.org.au/2019-anzsee-conference/). This book has grown somewhat in the process, bringing in other authors who did not speak at that conference. It is clear to us that for ecological economics (EE) to provide genuine solutions to humanity's current predicament, it must convey a clear picture and understanding of reality. It must cover the connection between economy and ecosphere, and the reliance of the former on the latter for sustenance. It also must cover the important role played by society's institutions, which exist at the interface between economy and ecosphere. It must consider ethics, which should not only guide policy-setting with regard to fairness and equity in an anthropocentric sense, but shape our spiritual connections with, and our treatment of, the natural environment in and of itself.

In order to ascertain whether EE achieves this function, we must speak meaningfully about what it is – or should be. That demands that we define what we *mean* by EE. That is where we immediately run into a problem. EE has different meanings for different people. Its definition is not clear, and we believe in recent years that it has become less clear. Washington and Maloney (2020) note that EE is not rigorously defined, and this may have allowed the term to be co-opted by neoclassical economics (NCE).

EE has been described as an economics that better reflects reality than NCE, since it acknowledges the ecological limits of the planet, and considers seriously the interactions between economic and ecological systems (Common and Stagl 2005). Faber (2008) goes further by stating that EE is defined by its focus on nature, justice, and time. Consequently, Faber argues that several issues guide EE – namely, intergenerational equity, irreversibility of environmental change, uncertainty of long-term outcomes, and sustainability. Daly and Farley (2004: 431) define EE as: 'The union of economics and ecology, with the economy conceived as a subsystem of the Earth ecosystem that is sustained by a metabolic flow or "throughput" from and back to the larger system'.

Lawn (2007) has gone even further by describing EE as a form of economics that seeks to improve (or at least maintain) the total quality of life of everyone, both now and into the future, while ensuring the rate of resource use does not exceed the regenerative and waste assimilative capacities of the natural environment. Moreover, Lawn describes EE as an economics that promotes the survival of the biosphere and its evolving processes while simultaneously recognising and upholding its intrinsic value (Ibid). Lawn believes this definition encapsulates what EE was initially intended to be – an economics concerned about the total quality of life, not just consumption. EE should thus be inclusive (intragenerational equity), be conscious of our moral obligations towards future people (intergenerational equity), acknowledge the fact that sustainability requires the rate of resource throughput to remain within ecological limits, and be mindful and respectful of the intrinsic value of the natural world (Ibid).

This apparent plasticity of definition has allowed EE in part to be ‘all things to all people’, just as some authors (Washington 2015) believe is the case with the term ‘sustainability’. Despite some academic claims, we don’t believe this plasticity of meaning is a *good* thing. It is worth revealing at this point that the authors of this Introduction are variously involved with the Center for the Advancement of a Steady State Economy (CASSE) (Washington and Lawn) and the New Economy Network of Australia (NENA) (Washington). We authors believe a reference to EE should have a consistent meaning, and we support the definitions listed above.

As noted, Common and Stagl (2005) have stressed that EE is: ‘an economics that acknowledges the ecological limits of the planet …’. Given that all environmental indicators show society is well past ecological limits (Ripple et al 2017), we feel that a recognition of ecological limits has to be a fundamental and essential part of the definition of EE. Faber (2008) argues that EE has a focus on ‘nature, justice and time’. We agree that EE must have a focus on nature to encapsulate sustainability. We all also agree that it should have a focus on justice, though one could ask ‘justice for whom?’. Is it justice for humans alone (as Faber seems to think), or as Lawn (above) and Washington in his chapter urge, should it also be justice for *non-human* nature? As for ‘time’, we believe that EE must consider the dwindling time available to solve the environmental crisis, as noted by the Scientists’ Second Warning to Humanity (Ripple et al 2017). We think that Daly and Farley’s definition of EE is excellent in that it focuses on the economy as ‘a subsystem of the Earth ecosystem’, where the economy is supported by nature. It follows from this definition that an economy cannot remain healthy without a healthy Earth ecosystem in the long-term. However, this attitude is manifestly eschewed today in that the ‘economy’ is universally given precedence over ecological sustainability (Wijkman and Rockstrom 2012; Ripple et al 2017). This can be witnessed by the incessant reference to, and implementation of, policies aimed at achieving ever-higher levels of growth in both resource use and population.

Given the aforementioned, do the economic models proposed in recent years meet the expectations of these definitions? Let us refer to a table from Washington and Maloney (2020) that compares models that have been described as being part of EE (Table I.1).

Since this table was developed largely by two of the books authors (Washington and Maloney 2020), we refer readers to the discussion in the paper that justifies its conclusion. One could argue about whether the assessment is fully accurate. We accept that Table I.1 is a *generality* and that different scholars writing about these models hold varying views. We also note that many have called these 'ecological economic models', while others, such as Joshua Farley (as editor of the journal *Ecological Economics* special edition on the future of EE), have argued that, more correctly, some should be called 'models *associated* with ecological economics'.

Table I.1: Models Described as Being Part of Ecological Economics (EE) (Source: Washington and Maloney 2020).

EE model	Focus on population ?	Focus on reducing resource use?	Focus on reducing consumerism and advertising?	Focus on equity?	Refuses to be an 'engine of growth?'
Steady state economy (SSE)	YES	YES	YES	YES	YES
Degrowth	MIXED – DEPENDS ON AUTHOR	YES	YES	YES	YES
Social ecological economics	NO	YES	UNCLEAR BUT SPASH (2012) ARGUES YES.	YES	YES, THOUGH CONTROLLING GROWTHISM IS NOT KEY FOCUS
Circular economy	NO	YES	NO	YES	NO
Green economy	NO	YES	NO	YES	NO
Sharing economy	NO	YES	YES	YES	UNSURE
Doughnut economics	NO	YES	MENTIONED THEN IGNORED	YES (KEY FOCUS)	GROWTH 'AGNOSTIC'

We believe the table is useful as it serves to indicate that some models associated with the field of EE do not address some of the key ecological limits applicable to all economic systems: population, resource use, consumerism and advertising, equity, and growth. By not explicitly addressing these limits, these models cannot be justified as falling within a strict definition of EE (certainly not in terms of what EE was defined as around the time of its inception).

One obvious aspect pertaining to biophysical limits is the number of people on Earth, and whether this is ecologically stable or expanding beyond an ecologically sustainable level (Washington 2020). Unfortunately, population has become something of a *taboo* topic and is largely absent from the focus of a number of EE models, such as the circular, green, sharing, and doughnut economies, and social ecological economics. It is clear that some neo-Marxist economists also deny the relevance of population (e.g. Vettese 2020). Only the steady state economy (SSE) and some degrowth advocates place a strong emphasis on population. Hence, there is clearly a deep taboo about dealing with population growth in academia (Kopnina and Washington 2016; Washington et al 2020).

All models in Table I.1 are consistent with the view that we should reduce resource use, but few actually tackle the need to reduce *consumerism*, which is rather odd given that consumerism is the key driver of increased resource consumption. The models that are silent or lukewarm on tackling consumerism include the green and circular economies, while doughnut economics mentions it in passing. All models are consistent with the view that equity must be improved (we are glad to say), though how this is to be done is not always clear.

Another obvious issue for the future of EE is in regard to the widespread commitment to endless growth – in other words, constant efforts to keep the economy continuously growing. The SSE, degrowth, and social ecological economics *oppose* this mantra, while the green and circular economies support growth. Doughnut economics describes itself as 'growth agnostic' (Raworth 2017), and the sharing economy is silent on this topic (Matofska 2016). The question of endless growth is thus also something of a taboo in parts of EE, largely because of the claim by some that an economy can keep growing without exacerbating the environmental crisis. This claim centres around the concept of ‘decoupling’, which is based on the belief that we can decouple the growth of the economy from its impact on the environment. This is the central justification for continuing growth amongst the advocates of the green and circular economies. Many believe the decoupling ‘solution’ is popular with certain interests because it merely requires the technological modification of business-as-usual practices.

There are others, such as Lawn (pers. comm.), who believe the term ‘decoupling’ amounts to green-washing, since to successfully ‘decouple’, it is necessary to sever entirely the link between two things currently connected. It is plainly impossible to sever the link between energy and GDP; between resource use and GDP; and between waste and GDP. Hence ‘decoupling’, as the term is commonly used, is impossible. As for notions of ‘relative’ and ‘absolute’ decoupling, Lawn also believes the use of these terms is misleading. Decoupling, if it was possible, is by definition ‘absolute’. Hence, Lawn argues the term ‘absolute decoupling’ is a tautology, and the term relative decoupling is an oxymoron – two things can’t be relatively decoupled, just as two things cannot be relatively detached. Lawn (pers. comm.) believes the term ‘de-intensification’ should be used to describe what is commonly meant by decoupling – namely, reductions in the resource-*intensity* of GDP; in the energy-*intensity* of GDP; and in the waste-*intensity* of GDP.

Given Lawn’s definition of de-intensification, there is ample evidence suggesting that the resource-intensity of GDP is declining. However, the rate of de-intensification is less than the rate of GDP growth. Hence, the rate of resource use is increasing (Wackernagel and Beyers 2019). There appears to be no general evidence of the rate of resource use declining due to the rate of de-intensification exceeding the rate of GDP growth (Victor and Jackson 2015). The belief that the rate of resource use (and environmental impact) can be reduced through de-intensification is something of an ‘expressed wish’. Twomey and Washington (2016) argue that it is part of a campaign of denial – more specifically, a denial of any need to tackle endless growth.

It is worth noting that while the SSE is critical of growthism, it is based on three key aspects: 1) an ecologically sustainable population; 2) less use of resources; 3) greater equity (Daly 1991; Dietz and O’Neill 2013). We should consider whether GDP in a SSE can keep on growing? It *could* if the country in question is currently using natural resources at a rate much less than can be ecologically sustained, and it subsequently chooses to increase the rate of resource use whilst remaining within ecological limits. However, fewer than half of the world's countries are in this position. Most are using natural resources at ecologically *un*sustainable rates and must therefore reduce rates of resource consumption (Wackernagel and Beyers 2019). Even for countries with the option of increasing natural resource use, most are within easy sight of ecological limits. Hence they need to be wary that actions taken to increase resource use rates can, given the path-dependent nature of economies (David 1985), lock a nation into an economic system that is structurally reliant upon higher resource use rates to avoid short-term economic destabilisation.

GDP in a SSE *could* also grow if it arises out of doing things in a smarter or more creative way (e.g. improving the quality of goods). While recognising that some limited growth of GDP is possible in a SSE, the focus of the SSE is not on 'growth at any cost'. There are two main reasons for this. Firstly, the rising marginal costs of growth eventually exceed diminishing marginal benefits. Hence, there is an 'economic' limit to growth, as many Genuine Progress Indicator studies are revealing (Lawn 2016). Secondly, and more importantly, unabated growth in a physical sense inevitably creates an economy that is physically larger than what can be ecologically sustained. Hence, there is an undeniable 'ecological' limit to growth (Ibid).

Many advocates of the SSE also support degrowth to reach a SSE (Czech and Mastini 2020). They agree that the global economy is already too large for a finite and damaged Earth ecosystem to sustain, as is the case for most national economies. Consequently, we need to degrow (downsize economies) to the level where a SSE can operate sustainably. The chapter here by Czech and Mastini explores the relation between degrowth and the SSE. It points out that rather than their being in conflict (as some economists suggest), the two need to work together.

Complicating matters is the fact that overpopulation and endless growth taboos operate in EE just as they do in mainstream society (Washington 2015, 2020). However, those claiming to be 'ecological economists' – that is, those whom agree that our economic systems are subject to the limits imposed by the biosphere's ecosystems – would (we believe) struggle to ignore or deny that the Earth is currently overpopulated, and that the Earth is *finite.* To do so is contradictory to established environmental science (Washington 2020). However, as evidenced in Table I.1, this does happen in various forms. Rationality is not always the dominant feature of humanity (Rees 2008). This brings us to the issue of 'ideology' and how this affects perceptions of EE. An *ideology* is a set of conscious (and unconscious) ideas that constitute one's goals, expectations, and actions, and it is somewhat narrower than a worldview (Washington 2020). Ideologies can be asserted quite fanatically, ignoring science and facts equally, along with ethics. Neoliberalism is one familiar ideology, and 'The Handbook of Neoliberalism' (Springer et al 2016: 2) notes:

> At a base level we can say that when we make reference to 'neoliberalism', we are generally referring to the new political, economic and social arrangements within society that emphasize market relations, re-tasking the role of the state, and individual responsibility. Most scholars tend to agree that neoliberalism is broadly defined as the extension of competitive markets into all areas of life, including the economy, politics and society.

In essence, neoliberalism makes the market into a God (Rees 2010). Yet markets don't inherently care for either society or the planet. Nor do they inherently worry about the climate crisis, since markets don't think for themselves – they are socially created without any ethical values and positions necessarily inculcated into them. Certainly, most contemporary societies have markets of some sort, but many societies have sought to regulate markets, presumably for the common good (Daly and Cobb 1994). However, neoliberalism is very much a dominant ideology in Western society today. Its influence on public policy setting and institutional design has resulted in markets dominating outcomes of almost every kind, and has almost certainly exacerbated the worsening environmental crisis (Washington 2015).

Similarly, Marxism or neo-Marxism, is an ideology with much to say about EE. Washington has responded to neo-Marxist criticism of the SSE (see Farley and Washington 2018). Such criticism seems to be on the increase. Leahy (2019), for example, gave a paper at the ANZSEE conference criticising the SSE on the basis that it promotes rather than denounces markets. Recently, a paper by Vettese (2020) accused Herman Daly – the most acclaimed advocate of the SSE – of supporting a form of 'Malthusianism' that is racist and sexist. He suggests such racism is aimed at: 'the non-white people whose bodies the Malthusians have sought to control'. In keeping with this view, neo-Marxists deny any need to seek an ecologically-sustainable population, which society clearly has exceeded (Wijkman and Rockstrom 2012; Crist et al 2017; Ripple et al 2017; Washington et al 2020).

Neo-Marxism is well known for being anti-capitalist. Although Daly (e.g. 1991, 2014a) has been one of the most lucid critics of NCE, which is closely associated with capitalism, the fact that Daly rarely criticises capitalism *by that name* has given neo-Marxists further reason to target the veracity of the SSE. Similarly, Daly accepts that markets exist and have efficiency-facilitating properties *provided* they are suitably regulated, as Daly is quick to point out! Notwithstanding this qualification, neo-Marxists, such as Vettese (2020), argue erroneously that Daly is a neoliberal.

In our opinion, Daly (2020) has answered Vettese's criticisms more than adequately by highlighting some of the ideological obsessions that prompt neo-Marxists to target the SSE. This example demonstrates how a can of worms can be opened by ideological fundamentalism. If many who question capitalism and/or the NCE are busy attacking others who question similar concepts (but on different grounds) a 'circular firing squad' can emerge where those on the same side of the fence shoot each other down (Farley and Washington 2018). Sadly, it is the case that adherents to some ideologies will gleefully denounce all who disagree with any aspect of their ideology. This does not help the search for a common understanding of what EE actually *is*. In order to avoid the distractive nature of this ideological debate, we believe it is worth returning to the earlier discussion under definitions of EE. Consider this question: 'Does the argument assist us in establishing and applying a form of economics that ensures the economy operates in an ecological sustainable manner?'. Denying the impact of excessive population numbers and ecological limits clearly fails this test, irrespective of one's ideological stance.

The final issue we raise here is one that often escapes attention amongst those who claim to be ecological economists. It concerns whether EE, like NCE, will remain dominated by anthropocentrism? NCE is dominated by a neoliberal and anthropocentric ethics of utility that denies nature any intrinsic value (Daly and Cobb 1994; Washington 2018). Spash (2011) notes that EE has had historical problems with developing a coherent theory of value. It is perhaps for this reason that ecological economists generally do not regularly speak out on behalf of the intrinsic value of nature, or for ecological ethics in general. The exceptions are Herman Daly (e.g. Daly and Cobb 1994; Daly 2014b) and Philip Lawn (2001, 2007). Washington and Maloney (2020) argue that EE must now progress towards *championing* ecological ethics. Washington, in his chapter in this book, develops this theme further. We authors of this Introduction believe that a revolution in ethics could arguably play a major role in finding sustainable and equitable solutions.

So how do we *create change*, especially in ethics? How do we find solutions to create an ecologically sustainable economy, including those that have sound ethical foundations? That is the focus of the chapters in this book. Overall, this book considers a diverse range of issues – from ethics to equity; from renewable energy to governance; from the UN Sustainable Development Goals to the use of natural gas and water; from EE in both rural and urban environments; from dialogue to education; and from Modern Monetary Theory to solutions 'outside the box' such as 'Neighbourhoods that Work'. We are aware that these chapters are likely to raise as many new questions as they answer existing questions. However, since the future of EE will only be found through *dialogue*, this should only be expected. The conclusion will consider this further, along with what it means for the future of EE, and its capacity to offer viable solutions to the current human predicament.

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Section I: Essay assessing options for the next 30 years

Chapter 1: The Future of Ecological Economics

Joshua Farley

Ecological Economics (EE) is a transdisciplinary academic field focused on understanding the interactions between humans and the rest of nature on a finite planet, including their continual co-evolution. It is also an action-oriented field driven by the moral imperatives of creating a just and sustainable economic system (Costanza et al. 1991; Ropke 2004; Spash 2012)[1]. For the purposes of this chapter, I define a sustainable economy as one in which renewable resources are extracted no faster than they can replenish, non-renewable resources are extracted no faster than society can develop renewable substitutes, wastes are emitted no faster than ecosystems can recycle or sequester them, and none of these activities threaten essential ecosystem functions. Together with a non-growing human population, these are the biophysical requirements for a steady state economy (Daly 2014; Farley 2014). A 'just' economy is more difficult to define and more controversial, but I believe must include a fair distribution of resources among humans as well as between humans and the biotic community of which we are part. EE was founded just over 30 years ago. It's a good time to assess our current status with respect to both academics and action and start thinking about the next 30 years.

Ecological Economics as an academic field

In many regards, EE has achieved great success as an academic field. We have a successful international society with many regional societies that hold annual conferences. We have a successful and highly rated journal, *Ecological Economics*, with a high impact factor. True, many ecological economists complain that the journal publishes too many articles that use neoclassical approaches and belong instead in mainstream journals (Plumecocq 2014; Spash 2013a). Speaking anecdotally, however, as an active ecological economist I have found that when searching for useful articles on a broad

[1] There may be individuals who do not ascribe to these tenets yet nonetheless call themselves ecological economists. This chapter may not apply to them.

range of topics including climate change, ecological restoration, human behavior, food systems, public goods, and financial and monetary systems, *Ecological Economics* contains many of the most interesting and useful articles. There are many excellent ecological economic programs around the world, with the ones in Leeds, Barcelona, Vienna, Montreal, and Vermont perhaps deserving special note.

Ecological economists were among the first pioneers of transdisciplinary approaches integrating the natural and social sciences to study the serious problems at the interface between humans and the rest of nature. The past 30 years have witnessed a proliferation of remarkably similar transdisciplinary fields. We can see this as a sign of our success, or as a sign of failure: transdisciplinary scientists have failed to unite under a single umbrella, but rather feel compelled to subdivide into smaller, less ideologically diverse groups. To the extent there is unity in strength, this may be a sign of weakness. EE has also had some influence on mainstream economics[2], which is known to be among the academic fields most resistant to transdisciplinary approaches (Fourcade et al. 2015). There is growing awareness within mainstream economics of the ecological crises we face (Simpson et al. 2005; Stewart and Elliott 2013; Dietz and Stern 2008). There is also increasing attention paid to the role of nature in generating the goods and services that sustain our economy, frequently, but somewhat controversially, referred to as natural capital and ecosystem services. It is obvious from conversations with colleagues that many ecological economists worry mainstream economics has more influence on ecological economics than vice-versa. Though the ideas of natural capital and ecosystem services were developed by EE, they have largely been co-opted by mainstream theories, approaches and methods. Much of the literature in ecological economics focuses on monetary valuation of ecosystem services and natural capital, often with the goal of internalizing these values in market prices under the assumption that markets can lead to an optimal equilibrium balancing supply and demand and maximizing human utility. This has led to something of a schism within EE, with many ecological economists rejecting monetary valuation and commodification of nature, while

[2] By mainstream economics, I mean the general framework of Competitive Equilibrium ideology in which, if prices can be made to reflect true costs, the price mechanism alone can generate an equilibrium between supply and demand that maximizes economic surplus, conventionally expressed as a monetary value.

others vigorously promote it (Costanza et al. 1997; Spash 2013b; Farley et al. 2015).

Many of the rifts within EE hang on the definition of methodological and value pluralism. The ecological economy is clearly a complex evolving system. It is impossible to understand through the lens of any single discipline. EE not only integrates the natural and social sciences, but it is also explicitly normative and therefore must integrate ethics, philosophy and other humanities disciplines. The system is continually changing, and the methods and tools required to examine and understand it must also change. Even normative goals and values should be continually reassessed. Our understanding of the system is extremely incomplete. It would be hubris to believe we understand the system well enough to assert that any specific approach is precisely the correct one and reject all others.

The major debate about pluralism hinges on the role of mainstream economic goals, theories and methods, and of capitalist markets as they work in practice. The first issue is whether mainstream economics pursues the correct goals. Mainstream economists prioritize the static goal of maximizing the monetary value of economic surplus subject to the existing distribution of income and the dynamic goal of continuous economic growth. Monetary value is determined by the intersection of supply and demand. Demand is determined by preferences weighted by purchasing power, implicitly prioritizing the preferences of the rich. Markets maximize the monetary value of the marginal loaf of bread by allocating it to the wealthy American who throws 40% in the garbage rather than to the destitute Haitian trying to feed her family, and mainstream economists consider this 'efficient' based on the claim that we cannot meaningfully compare interpersonal utilities. 'Sustainability' is only a goal if it is efficient - that is, if the discounted net present value of future benefits outweighs the current costs of achieving it. In a fossil fuel economy, Pareto efficiency is a meaningless criterion since all economic production emits CO_2 with negative impacts on others. I believe most ecological economists prioritize ecologically sustainable scale and just distribution over allocative efficiency, and many reject the mainstream definition of allocative efficiency all together (Spash 2020; Pirgmaier and Steinberger 2019).

In terms of theory and methods, mainstream economics is highly mathematical. Mathematical systems are tautological: all outcomes are embedded in the premises and mathematics is therefore ill suited for analyzing qualitative or evolutionary systems (Georgescu-Roegen 1979). The competitive equilibrium model at the core of mainstream economics assumes the single feedback loop of price can drive the complex ecological economy to equilibrium if only we get the prices right. In reality, no complex system can be driven to homeostasis by a single feedback loop. The human body, a relatively simple homeostatic system, requires thousands of feedback loops to maintain equilibrium, not all of which are known or understood. Mainstream economics is based on the approach of methodological individualism which assumes social phenomena result from individual action (Methodological Individualism 2015), not vice versa, and essentially denies that society has emergent properties. Mainstream economic theory also focuses primarily on competitive market economies. In reality, no economies meet the textbook criteria for perfect competition. A number of recent studies have documented the extreme and growing concentration of market power in the hands of fewer and fewer firms, which use their power to influence politicians, gain government subsidies, prevent any true competition, and accumulate even more power in a positive feedback loop (Wu 2018; Philippon 2019; Tepper and Hearn 2019). Markets only work for resources that are excludable, meaning that individuals can have exclusive private property rights to their use and exchange, and they are only efficient for resources that are rival, meaning that one person's use leaves less for others. It's impossible to use prices to ration access to non-excludable resources, and undesirable to use them for non-rival resources which are not scarce in the economic sense (Farley 2010), yet many of the most serious challenges we currently face are characterized by non-excludability and non-rivalry. In other words, mainstream economic theory does a poor job of describing reality. Capitalist markets effectively socialize costs, ecological and otherwise (Berger 2008), concentrate wealth in the hands of the few (Piketty 2014), allocate essential resources to those who need them least (the wealthy) (Farley et al. 2015) and collapse if they are not growing, all of which run counter to the goals and values of EE.

Finally, to determine whether EE can be declared an academic success, we must also look at its role in the real world. As Keynes observed, our theories about how a system works shape reality. In his words 'practical men, who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist' (Keynes 1936, ch 24, s5). This is one of the things that makes social science so challenging. Social scientists develop theories about human behavior to understand how social systems work. Our theories can affect behavior, and hence change the system about which we are theorizing in a reflexive fashion (Soros 2013). Unfortunately, it appears that our theories have not changed the system or at least not very much. EE was founded to address the problems of ecological degradation, soaring inequality and exponential growth on a finite planet. Our primary goals (speaking for the community of ecological economists I know) have always been ecological sustainability and social justice (Ropke 2004; Costanza 1989). In the past 30 years we have emitted more industrial CO_2 than in all previous history. Human populations have grown by 50% and per capita resource consumption and pollution emissions have skyrocketed. Virtually all nations around the world remain obsessed with economic growth. Mainstream economics continues to dominate the policy debate. We - ecological economists - are failing at our most important task.

The Next 30 Years

So the question is, what should ecological economics do over the next 30 years? What research agenda should we pursue? Should we focus on activism as well as science?

Ecological Economics as an evolutionary science

In terms of research agenda, I believe it is critically important to explicitly ground ecological economics in the evolutionary sciences. Economies are inherently evolutionary systems. For the first 250,000 years of our existence, we lived as small bands of nomadic hunter-gatherers rarely exceeding 200 or so individuals, known as Dunbar's number. Dunbar's number is based on the association between brain size and the number of individuals with whom it is capable of meaningful social relationships (Dunbar 1992). Early societies were based on economies of gifts and reciprocity (Bowles and Gintis 2004; Graeber 2011; Wilson 2012; Henrich 2016; Wilson 2019). For reciprocity to work, one must know if the people with whom one cooperates are likely to return the favor. Early societies were also highly egalitarian. There is even a theory that when some individuals tried to seize too much power or too many resources for themselves, other individuals united to depose or kill them. After several millennia, the result was self-domestication; just as dogs are less violent, less aggressive versions of wolves, self-domesticated humans are less violent, less aggressive, and more social versions of our ancestors (Sánchez-Villagra and van Schaik 2019). By 16,000 years ago, early societies had used technology and social cohesion to expand into every inhabitable continent (Christian 2018).

The advent of agriculture changed everything. Agriculture was a technological innovation made possible by the stable climates of the Holocene (Richerson al. 2001). Abundant evidence suggests the transition to agriculture was accompanied by increased disease, malnutrition, inequality, and premature death (Diamond 1987). However, it allowed for much denser concentrations of people. These denser populations could easily seize the land of smaller hunter gatherer tribes, and presumably did so regularly as agriculture led to degraded soils and growing populations looking to expand (Christian 2018; Moffett 2018). Everywhere agriculture appeared so too did political, economic, and religious hierarchies as well as growing inequality (Gowdy and Krall 2016). The European and Amerindian cultures had been separated for at least 50,000 years before they were rejoined again around 1500 AD. Despite this long separation, the Europeans immediately recognized economic, political and religious structures as extremely similar to their own (Wright 2004). Within denser agricultural populations, ideas circulated rapidly. New ideas readily appeared and persisted. As populations began to trade with others, ideas began to spread ever further. Technological innovation accelerated (Henrich 2016; Moffett 2018).

The next major evolutionary change took place some 250 years ago with the Industrial Revolution. The main driver of the Industrial Revolution was the exploitation of fossil fuels. It's hard to exaggerate the usefulness of fossil fuels. One barrel of oil can do the work of 5000 hours of human labor assuming an 80% loss of work capacity in the conversion process (Hagens 2020). The industrial revolution allowed us to switch from finite flows of solar energy to finite stocks of fossil fuels that we could extract as quickly as we liked. This allowed us to harvest biotic resources much more quickly than previously possible, which in many cases happened much more quickly than they could renew themselves. Fossil fuels also gave us access to many previously inaccessible stocks of non-renewable resources, such as metals and minerals. This new energy source dramatically increased population densities, communication, and speed of transportation, allowing ideas to circulate, develop and improve ever more quickly, leading to increasingly rapid technological advances (Henrich 2016; Diamond 1997).

Somewhere between the advent of agriculture and the Industrial Revolution, many societies developed the use of money, which evolved into a means of coordinating activity with people we neither knew nor trusted (Harari 2015; Ament 2020). Monetary systems continue to evolve. Within recent decades, we have seen a massive financialization of our economy. Mainstream economic theory is based on negative feedback loops: As a resource becomes scarce, its price increases, leading people to consume less and suppliers to provide more, driving the system to equilibrium. Financial markets in contrast are often based on positive feedback loops. Most stocks, for example, are purchased on credit (Hudson 2012). Abundant credit increases stock prices which increases speculative demand for credit. Increasing stock prices also increase the collateral backing up loans. The net result is a positive feedback loop. We know that in nature positive feedback loops cannot persist indefinitely; bubbles always become busts. While many people claim ecological economists are too radical, the recent changes in our financial system may be as radical as anything ecological economists call for. Prior to the 1980s, corporations were not allowed to buy back their own stock (Alsin 2017). Stock markets raised money for investment in real goods and services through initial public offerings (IPOs). In the last decade, corporate buybacks of their own stocks have exceeded IPOs by a factor of 12 (author's calculations from WilmerHale 2020; Ungarino 2019).

Rather than raising money that could be used to invest in the production of real goods and services, the stock market now drains money from corporations they could otherwise invest in real production. Stocks which used to be held on average for eight years are now held for 30 seconds (Hudson 2011). Last year the value of the US stock market increased by 29% to reach over 30 trillion dollars, more than 150% of GDP (https://www.gurufocus.com/stock-market-valuations.php). This means that the stock market increased the wealth of stockowners by 35% of GDP in one year alone. 1% of the US population owns 50% of stocks, so this was an unprecedented transfer of wealth to the rich. The stock market has become a mechanism for siphoning money upwards. Foreign currency exchanges used to be tapped primarily when people needed to buy or sell goods in another currency. These exchanges now exceed six trillion dollars a day (BIS 2019), nearly 28 times the size of the global economy. Positions are held on average less than a minute (Hudson 2011). These are radical economic changes.

Another major change is the information revolution. Much of the world's knowledge is now accessible on a cell phone. Information has the unique characteristic that it improves through use (Kubiszewski et al. 2010; Farley and Kubiszewski 2015). As a result of these changes, humans have succeeded in emitting greenhouse gases far more rapidly than they can be absorbed, depleting biological resources far more rapidly than they can renew, and depleting non-renewable resources far more rapidly than we can develop renewable substitutes. The net result is unprecedented threats to global ecosystems (Ripple et al. 2017). We have profoundly altered the ecosystems that enabled the evolution of human civilization. It appears that our challenge now is to adapt to the changes we have wrought or go extinct.

We all know that neoclassical economics is modeled after 17th century physics. However, 19th and early 20th century economists, Thurston Veblen (1998) and Alfred Marshall, argued that economics should actually be modeled after biology and evolution, a sentiment echoed by Herman Daly in one of his first journal articles (Daly 1968). There are three features required for natural selection to function. The first is reproduction of more offspring than can survive, the second is heritability, and the third is variation. When Darwin first developed his theories, he had no idea that the mechanism for heritability was genes, which had not yet been discovered. But genes are only one of several mechanisms of heritability. Another is social learning (behavioral evolution), the ability to learn skills from others. This occurs in many animals and can confer significant survival advantages. In the human context, however, the most relevant mechanism for heritability is symbolic evolution (Jablonka and Lamb 2005). Behavioral and symbolic learning join forces in cultural evolution. Culture is passed down from generation to generation, but it is never passed down perfectly. New elements of culture evolve and old elements are often changed in transmission. Unlike genes which are only passed down vertically from parents to offspring, culture can be transferred horizontally across cultures. Joseph Henrich (2016) defines culture as: ‘the large body of practices, techniques, heuristics, tools, motivations, values, and beliefs that we all acquire while growing up, mostly by learning from other people'. Economics is part of culture. Culture is biological. Dobzhansky (1973) once said that nothing in biology makes sense except in the light of evolution. This implies that nothing in economics makes sense except in the light of evolution.

Culture is one of the great major evolutionary transitions—a transition characterized by individuals that could previously replicate independently cooperating to form a new more complex life form (Szathmáry and Smith 1995). Archaea and bacteria merged to form eukaryotes, the origin of all complex life. Single celled eukaryotes merged to form multi-cellular organisms. Multi-cellular humans developed culture, which can be viewed as the accumulation of knowledge, norms and customs over generations, far exceeding any individual's capacity to learn or retain even in the simplest hunter-gatherer society. This knowledge is passed down across generations through social and symbolic learning. In essence, culture has profoundly increased both human intelligence and knowledge, dwarfing the capacity of any individual brain (Boyd et al. 2011; Henrich 2016; Wilson 2019). Culture essentially transforms humans into a superorganism. Humans are incapable of surviving without the cultural knowledge accumulated over thousands of years and millions of individuals (Boyd et al. 2011; Henrich 2016; Wilson 2019). An individual can no more survive independently from cultural knowledge than a cell can survive independent from the body.

All biological lineages must evolve to adapt to their ecosystems or go extinct. Most depend on genetic evolution. Humans depend primarily on cultural evolution. Cultural evolution is so powerful that humans have been able to adapt to virtually every ecosystem on the planet. At the same time, our cultural evolution has transformed the planet (Steffen et al. 2011), threatening to fundamentally change the ecosystems to which we are adapted. If we are to believe the literature on planetary boundaries, we have already crossed critical thresholds beyond which we risk catastrophic change (Ibid). Complex systems in general are characterized by critical parameters which, if increased beyond some critical threshold, can flip the system into an alternative state (Liu et al. 2007). We do not know what that state will be or whether we will be able to adapt. It is very likely that we have increased many critical parameters, both ecological and economic, beyond critical thresholds already. Even if we have not yet done so, failure to make radical changes to our political economic systems will lock in radical ecological change. Radical change is therefore unavoidable. Among other radical changes, we will need to transition to alternative energy. The following section will focus on this energy transition and the broader economic transitions it may facilitate.

Energy Transition and Economic Transition

Our economy is currently powered by fossil fuels. Fossil fuels occur as finite stocks which we can use as fast as we like but are exhausted by use. If one person burns a barrel of oil, it is no longer available for somebody else to burn. Competition is inevitable. This means that rationing access to fossil fuels is necessary. Clear property rights exist to virtually all fossil fuel on the planet. Property rights are required for markets to function. Competition for use is required for markets to be efficient. Fossil fuels fit quite well into the market paradigm, with the critical exception of the existential threats they pose to civilization.

Alternative energy is radically different. Solar energy reaches the planet as a finite flux over infinite time, at least in comparison to the life expectancy of a mammalian species. One country or geographical region's use of sunlight does not leave any less for other countries or regions. There is no competition. To more efficiently and cost effectively capture sunlight requires better technologies, which requires better knowledge. Knowledge improves with use. One person's use does not leave less for others. There is no competition for knowledge. Intellectual property rights make it possible to ration access to information, but they are expensive to reinforce and create artificial scarcity. In a market system, separate teams compete to be the first to develop a new technology. They will not share the knowledge they develop for that would risk giving a competing team an advantage (Farley and Perkins 2013). Since knowledge improves through use, the failure to freely share ideas can slow their proliferation (Heller 1998; Benkler 2004). If scientists developed a more efficient and cleaner new technology for alternative energy with a high enough energy return on energy invested to fuel its own production with a significant surplus (see Diesendorf this volume), its value would maximized when its adoption was maximized. Pricing the knowledge obviously reduces adoption. If the price is high enough, countries like India and China might not be able to afford it and would continue to burn coal, resulting in worsening climate change (Farley 2020).

The value of an alternative energy technology is maximized at a price of zero, but at that price, profit maximizing firms will not produce knowledge. Mainstream economists have argued that intellectual property rights solve the problem by creating an incentive for private firms to develop new knowledge. A much more efficient approach is collective investments in R&D required for alternative energy and green technologies in general, with the resulting knowledge freely available to all (Farley et al. 2015). In short, cooperation is far more efficient than competition in driving the needed energy transition. This is not based on an ideology, but rather on the physical characteristics of the resources in question. Fossil fuels are reasonably well suited to a market economy, but alternative energy is not.

Achieving an ecological civilization will require not just an energy transition but also an economic transition.

The COVID-19 pandemic offers one clear example of the need for a broad economic transition. It costs an estimated average of $2.6 billion dollars to bring a new drug to market (DiMasi et al. 2016), and $319–469 million just to reach stage 2a of clinical trials (Gouglas et al. 2018), only now underway for the most advanced potential COVID-19 vaccines with no guarantee of success. Once the vaccine has been developed, the cost of producing an additional unit is negligible, while the benefits of achieving herd immunity are immeasurable—if herd immunity is not achieved, the virus can evolve vaccine resistant strains, taking us back to square one. However, in our capitalist economy, corporations are competing to get the first vaccine and the monopoly profits it can generate (AstraZeneca 2020; Karlin-Smith 2020). Publicly funded teams of scientists freely sharing their research are likely to develop vaccines quicker, while making the resulting formula freely available to all maximizes its value by maximizing the likelihood of achieving herd immunity. With the formula free, firms could compete to produce it as cheaply as possible, though the risk of collusion might require government manufacture as well.

We live in the information age. Information by its very nature benefits from collective provision and free access. Cooperation produces and allocates information more efficiently than competition.

Another clear example is nature, which has been historically viewed as a source of raw materials to be converted into economic products. We have now come to understand, however, that a particular configuration of those raw materials from nature form ecosystems that generate a flux of life sustaining ecological functions essential for all species on the planet (Malghan 2006). Ecosystems generate ecosystem services without being physically transformed in the process. Markets are based on individual choice. Individuals can decide the rate at which they deplete ecosystem structure: how much fish to catch, how much timber to harvest, how much oil to extract and burn. Individuals, however, cannot choose how stable the climate they wish to have, how many species or how much wild biomass they wish to preserve, how clean the air they wish to breathe, or how clean the lakes, oceans and rivers that surround them. Ecosystem health and function must be collective choices. Once we have a given level of climate stability, clean air, or life sustaining ecosystem services, we cannot ration access, allowing some individuals to consume them while others cannot. Collective decisions and cooperation are necessary. The concept of ecosystem services calls attention to the fact that when we deplete raw materials and spew waste into the environment, we unavoidably degrade ecosystem services.

There has been an effort by some economists to commodify ecosystem services. Some ecosystem services are rival, such as the waste absorption capacity for greenhouse gases, so rationing is necessary. Making rationing possible requires excludable property rights, for example, through auctionable emission permits. If emissions are limited to absorption capacity and equitably distributed, commodification can be both sustainable and just. However, many ecosystem services are inherently non-excludable and non-rival and therefore cannot and should not be commodified. They should also not be ignored. Public services serve all members of the human community; economists recognize that these services are ill-suited to commodification and market allocation (Samuelson 1954). Ecosystem services should not be defined as nature's benefits to people, but rather as fund-services that benefit all members of the biotic community, not simply humans. Ecosystem services in general are an even worse fit for commodification than public services (Washington 2020).

In short, if humans are to solve the numerous ecological challenges we currently face, *cooperation is essential*. The most serious challenges we face, ranging from climate change to pandemics, take the form of social dilemmas, in which members of a group can gain by cooperating, but cooperation is costly, so each individual does better personally by not cooperating no matter what the others do (Gintis 2011). The world is obviously better off if everyone cooperated by not emitting greenhouse gases. However, any given individual gains enormous benefits from the incredible energy available in a barrel of oil, and refraining from using that oil is costly. If everybody refrains from burning oil, then my contribution doesn't really matter, and I'm better off if I burn oil. If no one refrains from burning oil, I would be an idiot to do so. The same is true for overharvesting oceanic fisheries, air and water pollution, and investing time and energy in developing clean new technologies (Hardin 1968; Farley and Perkins 2013). So why don't we cooperate?

Can we Cooperate?

It's easy to show theoretically that cooperation is more efficient than competition at solving our most serious challenges, but are we behaviorally capable of cooperating to the extent necessary to prevent catastrophic ecological change? Around the world, we see growing nationalism, worsening partisan divisions within countries, increasing racism and xenophobia. All undermine our capacity to cooperate at the scale required.

Darwin believed that any group with more cooperative and altruistic individuals would likely outcompete other groups with fewer such individuals (Darwin 2004). From the 1960s onward, however, mainstream evolutionists argued that the evolution of altruistic cooperation (i.e. cooperation that does not increase the fitness of the individual or the individual's genes) was extremely unlikely or even impossible. Within a group of cooperative individuals, selfish individuals would benefit from the generosity of others without sacrificing any of their own fitness to help others. This would enhance the fitness of the selfish individual relative to more cooperative individuals. Over time, selfish individuals would outcompete generous individuals within the group, and altruistic cooperation would not evolve (Dawkins 1990). Evolutionists proposed kin selection (Hamilton 1964) and reciprocal altruism (Trivers 1971) as genetically selfish mechanisms favoring psychological altruism (Sober and Wilson 1998), but these mechanisms have difficulty explaining why humans regularly help non-kin with whom they will never interact again. Multi-level selection theory (MLS), in contrast, argues that under certain conditions, selection at the level of the group dominates selection at the level of individuals leading to biological altruism—one individual sacrificing its fitness for the benefit of unrelated individuals. The theory encompasses both kin selection and reciprocal altruism. MLS states that the group with the most altruistic individuals will outcompete other groups, but at the same time, the most selfish individuals will outcompete other individuals within the group, providing an evolutionary explanation for both selfishness and cooperation. Group selection dominates individual selection in humans (Wilson 2007; Wilson and Wilson 2007; Wilson 2012).

Culture is the glue that binds humans together into groups. Variation between cultures often exceeds variation between individuals within a culture, favoring natural selection at the level of the group (Wilson 2012). Culture serves not only to bind humans together into groups but can also evolve norms and institutions that promote cooperation and punish defection, incentivizing even selfish individuals to act for the good of the group (Boyd et al. 2003; Gintis et al. 2003). Ethics is one mechanism that promotes cooperation. Drawing on D. S. Wilson's work, I have repeatedly asked my students to suggest characteristics of 'good' people and of 'evil' people. Invariably, our students have defined a good person as someone who puts the group ahead of the individual, and an evil person as someone who puts the individual ahead of the group. *Homo economicus,* the rational, self-interested, and insatiable caricature of humans found in textbooks, is clearly evil. Ironically, only once did I obtain different responses to this exercise: presenting to students at the economics club at my University, the first characteristic proposed for a good person was selfishness. This was not an anomaly. Numerous studies show that programs in mainstream economics enculturate students to behave selfishly (Marwell and Ames 1981; Frank and Schulze 2000; Kirchgässner 2005; Cipriani et al. 2009; Zingales 2012).

But in multi-level selection theory, cooperation only extends to the boundaries of the group. There is no selection pressure to cooperate with other groups, and few moral restrictions on harming them. In fact, inter-group competition may promote within group altruism (Choi and Bowles 2007). Wartime propaganda typically portrays enemies as subhuman to remove any remaining moral restriction. Groups in fact can only be defined in reference to others, to non-group. The ability of humans to dominate the planet arises from our ability to increase group size to cooperate at larger and larger scales. To achieve this, cultures created social myths of religion, tribe and nationality, which extended trust, reciprocity and cooperation across larger groups. To know whom to trust, adherents often marked themselves physically (clothing, hair-cuts, adornments, etc.) or through their beliefs (Henrich et al. 2001; Haidt 2012; Henrich 2016; Moffett 2018). If failure to believe certain social myths could result in expulsion from a group and likely death as a result, while belief resulted in the benefits of cooperation, belief in those myths was highly rational from an evolutionary perspective, no matter how unscientific or absurd they might otherwise appear. Solving our most pressing global challenges will require cooperation at an unprecedented scale. Unfortunately, it appears easier to bond people together into a group based on shared fear, hatred or dislike of another group, rather than on shared interests or goals, and especially easy to do so when there is competition over resources (Choi and Bowles 2007; Weaver and Bosson 2011). It is not by chance that Trump initiated his 2016 presidential campaign with a tirade against raping, murdering Mexicans.

Though our task is to promote cooperation, it also helps to know what hinders it. Realistic Conflict Theory suggests that winner-take-all or other zero-sum competitions between groups can increase inter-group animus (Sherif et al. 1961; Jackson 1993). Elections in many countries are winner take all. Competition for fossil fuels is zero sum, since one person's use unavoidably leaves less for others. I have previously mentioned how simply studying mainstream economics makes people behave more selfishly.

The most important question, however, is how to stimulate cooperation. Humans have a natural tendency to reciprocate. When someone does something nice for you, the tendency to do something nice for them is so innate it is often referred to as a 'click-whirr' response (Cialdini 1993). Reciprocity can be indirect. If someone does something nice for a friend or relative, people are likely to respond in kind. As previously mentioned, Trivers

(1971) concluded this was the basis for human altruism, and the tit-for-tat strategy or minor variations thereof have proven to be the dominant strategy in prisoner's dilemma games (Axelrod 1984). Another widely studied mechanism is altruistic punishment, in which people will sacrifice their own fitness or welfare to punish others for being selfish, which deters selfish behavior and promotes cooperation (Fehr and Gachter 2002; Boyd et al. 2003; Bowles and Gintis 2004). Perhaps the best example comes from the ultimatum game, in which one person proposes how to divide something of value (e.g. $100) with another person, and the other person can accept or reject that division. If the other person rejects the division, neither receive anything. If people behaved in their own rational self-interest, the proposer would offer $1 and the other person would accept it. In reality, most people in most cultures offer much more than the minimum, and if the offer is too low, the other person rejects it. The most plausible explanation for rejection is altruistic punishment, and indeed proposers often state they fear too low an offer will be rejected (Gintis 2000; Henrich et al. 2005). Games have also been constructed in which it is possible to punish non-punishers, which is even more effective at promoting cooperation (Boyd and Richerson 1992). Empirical research confirms the effectiveness of these mechanisms in the field (Gachter 2007; Henrich and Henrich 2007). Building group identity also promotes cooperation within the group but must be done carefully to avoid promoting competition and aggression with other groups.

Perhaps the most important approach to stimulating cooperation between antagonistic groups in our current context is to face a common challenge that requires cooperation to solve. During the Cold War, it became a cliché to suggest that the only thing that would bring peace between the US and the USSR was an attack by aliens. From climate change and energy transition to COVID-19, there is certainly no shortage of shared challenges. These shared challenges, however, bring up an important question about our societal goals. Many ecological economists and their allies call for creating a more resilient system capable of sustaining large shocks without flipping to an alternative state potentially much less conducive to human welfare (Berkes and Folke 1998). I argued above that radical change is unavoidable, in which case it may be too late for resilience. What we must instead pursue is anti-fragility: responses to shocks that increase our ability to handle new shocks (Taleb 2014). Cooperation is anti-fragile because it strengthens group identity and stimulates reciprocity, facilitating greater cooperation to confront future crises.

If we can manage to cooperate to solve the COVID-19 crisis by sharing all the knowledge required to develop open-access treatments and cures, this would make it easier to share all the knowledge required to develop open-access alternative energy technologies, perhaps leading to a Green Technology Common Asset Trust (Farley 2017; Farley 2020). This in turn will make it easier to cooperate on GHG emissions reductions and other pressing challenges. Each crisis can make us stronger. In the words of D.S. Wilson et al. (2014): ‘the benefits of cooperation are like money in the bank earning compound interest’.

Summary and Conclusions

So what does this all mean for the future of EE? We are an inherently normative field, striving for ecological sustainability and social justice. From the trajectories of socialist and capitalist countries, it is glaringly obvious that economic theories are intended to shape society. Milton Friedman (1982, preface) was explicit about this, stating that:

> Only a crisis - actual or perceived - produces real change. When that crisis occurs, the actions that are taken depend on the ideas that are lying around. That, I believe, is our basic function: to develop alternatives to existing policies, to keep them alive and available until the politically impossible becomes the politically inevitable.

Similarly, Keynes (1936, p. 383) argued that: ‘Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist’.

In essence, most social scientists are intentionally striving to direct the evolution of society, and it is naïve to pretend otherwise. The insights from evolutionary science can help ecological economists to achieve our goals. Achieving ecological sustainability and social justice both require cooperation at unprecedented scales; understanding how society evolved from small bands to enormous nations can help guide us forward. Different problems demand cooperation at different scales. Addressing the myriad problems caused by human expansion requires the understanding that humans are just one component of a deeply interdependent web of life, upon which we depend for survival. Cooperation will need to extend to other species. We can no longer think solely of how nature benefits humans, but to mitigate the damage we have done, must focus at least as much on how humans can benefit nature in the future (Washington 2020; see also Washington chapter this volume). We must forge the Ecozoic, a mutually enhancing relationship between humans and the rest of the Earth community (Swimme and Berry 1994; Vargas Roncancio et al. 2019). Evolutionary theory can also provide deep insights into policy. Our system is too complex to fully understand, and any policies we design are unlikely to work exactly as we would like. Learning from evolution, we should continuously experiment with numerous policies and select those that best achieve our goals to pit against new variants (Wilson and Gowdy 2013). We should also have the humility to accept that none of us truly know how the system currently works, and know even less about its evolutionary path, and the wisdom to recognize strength in numbers. As we strive to direct cultural evolution, we should ally with like-minded others striving to achieve broadly similar goals.

Does the previous statement mean that ecological economists should ally with environmental economists (with a neoclassical bent) as well? Can capitalism and free markets contribute to the goals of EE? Capitalism (depending on how it is defined) appears to require endless economic growth, which is inherently incompatible with the goals of EE (Farley 2016). Furthermore, capitalism prioritizes individual choice. When the benefits we pursue are collective, capitalism is inefficient. When the costs incurred are collective, capitalism is suicidal. The price mechanism does offer a useful feedback loop if used correctly, but we should never believe that any single feedback loop can drive a complex system to equilibrium. Markets alone will not lead us towards a just and sustainable future, but markets embedded within strong social norms of sustainability and justice may be very useful for efficiently addressing matters of taste. Rejecting all use of prices and market mechanisms may be as foolish as blind devotion to them.

In conclusion, economics is too important to be left to ideology. Economic institutions and allocative mechanisms must be determined by our desired goals and the economic characteristics of the resources required to achieve them. Our most serious challenges require cooperation. It is pointless to seek solutions based on competitive markets. EE implicitly pursues intentional cultural change and should embrace evolutionary theory to guide us into the future.

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Section II: Big picture solutions

Chapter 2: Sustainable Cities?

Ian Lowe

Introduction

In 1992, The Council of Australian Governments (COAG) adopted the 'National Strategy for Ecologically Sustainable Development'. This was the culmination of a process begun by Bob Hawke as Prime Minister of Australia. In principle, the Commonwealth and all State and Territory governments are committed by this strategy to pursue a pattern of development that would be 'ecologically sustainable'. There are very few signs that recent governments at any level are even aware of the National Strategy. In practice, as a nation Australia is not meeting any of the important criteria for sustainability identified by COAG. We are using natural resources in ways that will severely impact future generations, our society is becoming less equitable and we face serious environmental problems, as spelled out by successive reports on the State of the Environment (SoEAC 1996; SoEC 2016). While the accelerating loss of biodiversity has not become a major political issue, climate change has. A comprehensive response to that problem could be a major step toward a sustainable future. Even if such an approach garners political support, however, there will remain a fundamental obstacle to sustainability: the widespread delusion that unlimited growth is possible in a finite world. In the particular case of cities, no Australian city has a long-term vision of a future in which a stable population is sustainably supported. All implicitly share the delusion that growth is unlimited and can continue for the foreseeable future, if not for ever.

The several dimensions of sustainable futures

A sustainable future would involve meeting all the criteria for sustainability. The human population would have stabilised at a level that could be supported indefinitely (Ripple et al 2017). Observably, the birth-rate that would enable this goal to be achieved can occur when women are educated, financially secure and in control of their reproductive behaviour (Lowe 2012). Renewable resources such as water, forests, fisheries and productive soils would not be over-used; in other words, usage levels would be below the rates of replenishment. Non-renewable resources such as minerals would only be used at rates that did not seriously deplete the stock, since doing so would mean that use of those resources was not sustainable (Daly 1991). There would be no serious environmental problems such as accelerating climate change, loss of biodiversity or degradation of natural ecosystems. The community's need for food would be within the capacity of the local area to produce, process and distribute. There would be social stability, which is unlikely to occur without a significant narrowing of the wealth distribution and a significant broadening of opportunities to access the services people absolutely need; it would also be desirable to broaden access to other services that are not actually needed, but clearly wanted by many people. There would also need to be an economic system that facilitates the achievement of the fundamental goals. Stating this is not endorsing the widespread presumption in politics that ascribes primacy to economic issues, but emphasising the need for economic decisions to be synchronous with our social and ecological goals.

A recent publication which described the 'most sustainable' cities in Australia could more accurately have been said to list the least *un*sustainable, as it documented the most obvious failings for each of our major cities (Manning 2019). Darwin scored well for biodiversity and commissioning of renewable energy, but has a very large ecological footprint and poor indicators of community health. The Sunshine Coast, where I live, has the best air quality of any Australian urban area and has protected significant natural areas, but is actively planning to increase its population by 180,000 in the next twenty years with no clear idea of how this could be managed while still protecting natural systems. Brisbane scores well for biodiversity conservation and water availability, but has a very large carbon footprint and poor public transport. Townsville is the most biodiverse city in the country, but expansion means about half of the ecosystems are recognised as being at risk. Canberra rates very well for using renewable energy and encouraging green buildings, but is growing rapidly and its transport system relies heavily on private cars. Melbourne has many certified 'green-star' developments, has reduced water use significantly and has a goal of net zero greenhouse gas emissions, but the rapid expansion of peri-urban settlement with little or no public transport is clearly not sustainable. Cairns boasts that less than half the population are car-owners, making it the least worst of our cities for transport, but that is still a long way from being sustainable. Although our largest city, Sydney, has actually claimed to be our most sustainable, it is difficult to see how it meets **any** of the important criteria listed by Manning (2019).

In principle, Australia's national government and the governments of all States and Territories are committed to the principles of sustainability. Nearly thirty years ago, COAG adopted the National Strategy for Ecologically Sustainable Development (CoAG 1992). That document accepted the need for 'a path of economic development that would not reduce opportunities for future generations', recognising 'the global dimension' of our decisions and actions and seeking 'equity within and between generations'. It included some specific ecological goals, protecting our unique biodiversity and maintaining the integrity of our natural systems. It would take an extremely generous assessor to detect any sign that recently elected governments, national or State or Territory, or parties such as the Coalition or ALP, even recognise or remember the National Strategy. It certainly is not used by any recently elected government as a framework within which to take decisions. The path of development followed since 1992 has certainly reduced equity within this generation of citizens. The failure to develop responsible approaches to climate change and the loss of biodiversity is certainly reducing opportunities for future generations (Lowe 2016), and current governments use creative misinformation to avoid recognising the global dimensions of our actions.

Unsustainable futures: A thought experiment

To illustrate the yawning abyss between the stated goal of sustainable development and current practice, I conducted a thought experiment. I imagined I'd been commissioned by the Australian government's new Ministry of Unsustainable Development to recommend policies that would ensure that our path of development was **not** sustainable. Most people have difficulty thinking we could have a government so irresponsible it would deliberately set out on such a strategy, but I urge readers to suspend their disbelief while I walk through the policies I would recommend to such an agency. I would start by ensuring the population was growing, because no species can increase its numbers without limit in a closed system. Australian women are substantially in control of their fertility and as a result the birthrate has dropped from about four children per adult woman when I was young to slightly below the replacement rate of 1.9 today, but the number of adult women in the reproductive age range is still increasing as a result of the past birthrate (Lowe 2012). As a result, the so-called ‘natural increase’ – births minus deaths – is about 150,000 a year. So the population would be growing by a million every seven years if there were no net migration. In practice, recent governments have allowed very large numbers of migrants in the mistaken belief that this is good for the economy, so the total population is growing by a million every 2.5 years (Ibid).

If we wanted to increase the resource demands and environmental impacts of a growing population, we would have policies to increase average consumption per person, perhaps even seeing this as a measure of economic success. If we were to pursue such a strategy we would have the largest new houses of any country in the world, very low rates of recycling, large and inefficient vehicles and so on. Of course, those are the existing features of contemporary Australia. If we wanted to ensure that the demands of this generation would reduce opportunities for future generations, we would be profligate with non-renewable resources such as oil and mineral ores. So we would export huge quantities of minerals like iron ore, coal and natural gas. We would also over-use resources that are potentially renewable such as water, forests and fisheries. While fisheries are now better managed, and the decline of most has been halted (Patterson et al 2018), we are clearly over-using both groundwater and the water in our inland rivers, especially the Murray-Darling system (SoEAC 1996; SoEC 2016). We are also still logging native forests in some States. The new regime introduced by the Beattie government in Queensland meant its forests were being managed sustainably, but the Bligh government sold off the rights to extract timber, meaning there is no longer any public capacity to ensure the resource is conserved (Berry & Barbeler, 2009). In Tasmania, successive Liberal governments have actually encouraged the continuing expansion of logging (Coulter 2019).

In overall terms, if we wanted to ensure an unsustainable future, we would be so irresponsible environmentally that we would be changing the global climate, producing a whole cascade of impacts, and causing a catastrophic loss of biodiversity. The first independent national report on the State of the Environment identified five major problems that would have to be tackled for a sustainable future (SoEAC 1996). Five subsequent reports have all gloomily documented the worsening of these problems, including the loss of biodiversity and the continually increasing release of greenhouse gases (SoEC

2016). These are simply the local manifestation of the global problems caused by the growing human population and increasing per capita demands (Ripple et al 2017).

If we wanted to ensure that our economic approach was not sustainable, we would run down our capacity to produce our basic needs in favour of a model which requires us to import increasing quantities of goods from overseas, paying for them by exporting our geological endowment of minerals. Of course, this approach steadily depletes the richest and most accessible ore bodies, leaving future generations not just with a depleted resource base but with a reduced capacity to export minerals to pay for the goods we no longer produce locally. If we wanted to ensure that our future becomes socially more precarious, we would adopt policies based on a neo-liberal economic ideology, so we would steadily increase income inequality with an inevitability recognised centuries ago (Smith 1776). We could compound the effect of that process by steadily running down the public provision of essential services such as education, health care, transport and information provision in favour of a private provider model, giving the affluent systematically more opportunities than the impoverished. Finally, as an ethical basis that would ensure our future was not sustainable, we could adopt a crass materialism that encouraged rampant consumption, or embrace a religious fundamentalism that regarded ancient texts written thousands of years ago as literally true and a basis for living in the twenty-first century.

The policies I have outlined in this thought experiment, the policies that we would adopt if we were trying to ensure that our future would *not* be sustainable, are alarmingly close to the current practice of our elected governments. I believe a visitor from another galaxy would be puzzled to hear us talking about 'sustainable futures', while adopting policies that might have been designed deliberately to prevent that outcome.

Towards sustainable cities

The first and most fundamental step toward sustainable cities would be accepting that there are physical, biological and social limits on their expansion. There will be legitimate differences of opinion about where exactly those limits are, requiring serious investigative research, but those studies will not be carried out unless and until decision-makers and planners accept the basic principle of *limits*. Once the basic understanding is achieved, responsible decision-makers would be planning a smooth transition from the unsustainable growth phase to a future steady state in which population and consumption have been stabilised at levels that are potentially sustainable (Daly 1991).

The recent phase of rapid growth has produced seemingly intractable problems for Australian cities. At a basic level, this is fundamental arithmetic arising from the average life of built infrastructure. As O'Sullivan (2016) and Lowe (2012) have shown, a population growth rate of two per cent per annum roughly doubles the cost of providing the essential infrastructure of cities, but only increases rate income by two per cent. So there is an accurate perception that quality of life is being eroded as transport services fail to keep pace with the growing needs of an increasing population. Other services such as green space are not expanding at all, so growth means inevitably that there is less open area per person. This is a fundamental problem which no large Australian city has recognised. To the contrary, public officials in Adelaide, which has suffered less than other cities because of a lower growth rate, actually see this low growth rate as a problem which needs to be tackled! (SBS News 2018)

So what are the obvious resource constraints on expansion of our cities? The inhabitants critically need food, drinking water and breathable air. Modern lifestyles also demand serious quantities of usable energy. Most Australian cities have enough productive land around them to provide much of their food, but there is clearly a structural problem that results from short-term economics (Lowe 2017). When I returned to Australia in 1980, the southern suburbs of Brisbane contained orchards and market gardens. In the forty years since then, they have been replaced by housing. In the short term, what people are prepared to pay for houses has meant that the former owners of productive land were made irresistible offers. As one told me, the sum of money he was given for his land meant he was better off financially living at the coast and playing golf four times a week than he was when he worked 15 hours a day in his orchard. The long-term consequence of all those choices is that the fruit and vegetables that used to be produced in the outer suburbs of Brisbane now come from the Lockyer Valley. That in turn means much more truck transport of produce to market, increasing the energy required to supply the city's needs. Similar patterns have occurred in other Australian cities as the demand for land to house the rapidly growing populations has concreted over areas that formerly produced food. There is no shortage of food, except when panic buying temporarily exceeds supply capacity, but there is an obvious longer term problem. The logistics and the economics both depend on cheap petroleum fuels. The conjunction of reduced demand during the COVID-19 pandemic and increased supply from Saudi Arabia may have created the illusion that there will always be cheap petroleum fuels, but the reality is that this will be prevented by both the limited scale of the resource and the need to avoid dangerous climate change. Future generations will almost certainly regret the eagerness of developers to turn productive land into residential areas.

In the medium term, water supply is a potential limitation on further expansion of cities. Most of the potential sites for water supply storage reservoirs were developed decades ago. There are both social and environmental objections to any proposals for either new storage dams or expansion of existing facilities. Every serious proposal for a new reservoir near a major city in recent decades has been successfully opposed, and there are currently concerted objections to the plan to increase the capacity of Warragamba Dam by raising the level of the dam wall (Colong Foundation 2020). Climate change has caused increasing unreliability of rainfall in the eastern States. Brisbane recently faced a potential crisis when its water storage was down to 20 per cent capacity and residents were required to curb wasteful use. Several smaller settlements have needed to transport water during the 2019-20 summer (Karp 2019). Perth's water supply has been permanently affected by climate change, with the average annual run-off into its reservoirs since 1994 one-third of the figure before 1975 and run-off since 2010 one-sixth of the pre-1975 level (WA Water Corporation 2018); it is only the development of desalination plants that has enabled the city's profligate water use to continue. Of course, demand needs to be considered as well as supply. In the case of Perth, the study of its future water needs found that 70 per cent of the water consumed by residential premises is used outside the dwelling, to replenish lawns and gardens, while half of the internal use is to flush toilets (WA Water Panel 2006). So only about 15 per cent of the usage actually requires water treated to the hygiene standards appropriate for drinking. A responsible future approach will almost certainly see the use of 'grey water' from showers and kitchen sinks used to flush toilets and water gardens, as it routinely was when Brisbane had restrictions on use of reticulated water.

Breathable air is potentially a serious future problem. I gave a presentation at an international conference on sustainable development in China, which was told that air pollution in their major cities had become a serious public health issue. The problem was partly caused by burning coal to generate electricity, but pollution from the exhausts of motor vehicles was the dominant factor. Epidemiological studies confirm that urban air pollution is a major cause of respiratory distress, with one calculation suggesting that the pollution from motor vehicles shortens more lives than road accidents (Anenberg et al 2019). While there has long been recognition of the problem of carbon monoxide, recent research has identified the health risks of particulate emissions, especially from diesel engines (Ibid). Brisbane City Council decided twenty years ago to phase out diesel buses in favour of burning gas and their buses proudly boast of this contribution to cleaner air. In future, we are likely to see a return to greater use of light rail powered by clean electricity for urban transport. It will be difficult, if not impossible, for urban planners to cope with the structural problem caused by recent irresponsible development in peri-urban areas. The population density in these areas and the absence of forward planning mean that it will not be possible to provide public transport to meet the needs of people living in these new suburbs (Newman & Kenworthy 1999). They will effectively be condemned to continue driving, even as fuel prices increase and we face growing pressure to curb use of fossil fuels. Even if electric cars become affordable, the transport task will be a serious obstacle to the goal of sustainability.

That raises the obvious question of climate change (Lowe 2005). For as long as Australia's governments continue to drag their feet, the nation's ability to respond to the need to reduce our greenhouse gas emissions will be constrained by two factors: the demand for coal-fired electricity and the overwhelming dependence on the private car for urban transport. Recent irresponsible residential development has greatly inflated demand for power; as a specific example, the move away from the traditional Queenslander house to brick or concrete dwellings in the Brisbane area has seen the probability that residences will have air conditioning increase in forty years from about 5 per cent to 65 per cent (Lowe 2012). We have also failed to take the obvious steps to reduce demand by improving the efficiency of turning energy into the services people want. The report setting out a National Framework for Energy Efficiency (Sustainable Energy Authority of Victoria 2003) estimated that emissions could be reduced by about 30 per cent simply by using cost-effective existing technology with payback times under four years. Almost nothing has been done to restrict the import and sale of appliances so inefficient they could not legally be sold in western Europe or Japan. These will be less serious issues if the power comes from clean sources. Electricity supply could be cleaned up safely and economically, with several reliable studies showing that it would be possible within a decade to meet our needs completely from renewable supply technologies with storage. In the interim, electricity demand and consequent release of greenhouse gases will continue to increase linearly with the expansion of the urban population. The same comment could be made about transport pollution, except that the increase will probably not be linear. Expansion on the peri-urban fringe with little public transport means commuters are inevitably driving longer distances, often in older and less efficient vehicles. Unless there is a rapid transition to electric vehicles powered from the sun or wind, it is difficult to see how even a government more responsible than the current one could curb the continuing growth in emissions from urban transport. That will, in turn, inevitably mean more very hot days in cities, where the lack of green space and the use of energy creates a well-documented 'heat island' effect, inevitably increasing the demand for energy use to reduce internal temperatures.

An inevitable problem of scale?

Some writers have suggested that there is a fundamental issue of whether very large cities can ever be truly sustainable (Jablonski 2011). It is clearly possible for compact cities with fewer than 100,000 people to have good public transport and walkable neighbourhoods. There are several examples in western Europe. For larger cities to be sustainable, even in principle, they would need to function as a series of inter-connected neighbourhoods, each largely self-contained, with strong links to facilities that can only be provided on a centralised basis such as high-technology health care and large-scale entertainment venues (Landry 2000). The basic problems of food, water and other essential services will inevitably constrain the large cities which developed in the relatively short era of cheap petroleum fuels. It is difficult to see how the mega-cities of 2020 can survive the inevitable changes of the twenty-first century in their current form.

Utopian goals

What might a sustainable future city look like? It will have stabilised its population and resulting urban footprint. As surveys show residents want, it will have protected existing natural areas to conserve the remaining biodiversity, and probably be investing in the restoration of areas that have been damaged by irresponsible development. For example, the rush to turn urban creeks into concrete channels will have been reversed and natural waterways restored, with flooding reduced by retention ponds and purpose-built wetlands (FEMA 2018). There will be safe, efficient and affordable public transport, powered by clean electricity from solar panels and wind turbines, with a combination of batteries and pumped hydro storage providing reliable supply. Residential development will have been concentrated around the public transport corridors, enabling easy commuting to workplaces. Recognising that there are modern cities in western Europe where the majority of urban trips are made on foot or by bicycle (City Clock 2014), urban planning will have ensured that the services people use every day are within walking or cycling distance, so children will walk or cycle to school, while adults will walk or cycle to local shops and in many cases to their nearby workplace. Green buildings will predominate, with good design and rational orientation reducing demand for energy. Rooftop gardens will be common. Many houses will have their own gardens for growing vegetables and the roads will be lined with fruit trees. Communities will be involved in planning decisions, rather than allowing them to be driven by speculative developers. Adequate areas will have been set aside for both organised sport and informal recreation. There will be public provision of such essential services as health care and all levels of education, ensuring equality of opportunity. Urban areas will have been made accessible to those with physical disabilities. Local authorities will have consciously invested in cultural opportunities for the whole community.

As an underlying framework, Yigiticantar et al (2018) have argued for ‘post-anthropocentric’ cities which recognise ecological realities and base urban development on ecological ethics. This would be a major advance, applying the more general argument for applying ecological values to the specific case of cities (Paavola & Lowe 2005; Raskin 2006). It would also represent a rejection of some strands of ecological economics which implicitly (or even explicitly) ignore the fundamental problem of population growth, as noted by Kopnina et al (2020). A circular economy, which does not increase in scale, will only be politically sustainable if the population is stable. While a green economy would obviously be preferable to the present brown economy, the day of reckoning with ecological reality will only be postponed, not avoided, if the overall scale of the economy continues to increase. As Victor (2005, 2019) demonstrated, the only credible hope for a sustainable future involves first stabilising the human population, then stabilising its demands within the limits of natural systems. In his words (Victor 2008: 223):

> …there are indeed feasible economic alternatives but getting to them will be beyond us unless we change how we think about our economy, society and environment, undertake some close reflection on what is important to ourselves and others, including other species, and develop a readiness to rethink and transform much of what we have come to take for granted.

Since the per capita demands of cities in developed societies is well beyond those limits (Rockstrom et al 2009), there will need to be much greater reductions in those settlements to achieve the goal of sustainability. As Diamond (2005) has shown, past societies which ignored these fundamental issues have collapsed.

Denial: A depressing conclusion

The yawning gulf between this ideal future and the one being shaped by irresponsible development is a graphic reminder that the decisions being made now are literally setting in concrete the cities of the future. As the Australian Commission for the Future (Slaughter 1992) used to remind us, the future is not somewhere we are going, it is something we are creating. Those of us who live in cities, as the majority of the population now do, have a moral responsibility to be working actively to create the sort of future we would like our descendants to live in.

This problem is both fundamental and apparently obvious, so it seems puzzling that decision-makers have almost all failed to respond. The scientific evidence for anthropogenic climate change, global environmental problems and limits to growth generally has been clear for decades, but denial is still widespread. The technique of Causal Layered Analysis has been used to show that: 'this denial arises from the conflict between the new evidence and the old myths and metaphors widely held onto by decision-makers' (Lowe 2015). The evidence is inconsistent with widely-held myths such as the inevitability of progress, the unalloyed benefits of growth, limitless resources and our inalienable right to dominate nature. Facing a conflict between what the science is showing and those deep-seated myths, decision-makers have for decades rejected the evidence and resorted to simplistic assertions that are really just statements of their irrational beliefs (Coddington 1972). That systemic denial, a refusal even to admit that there is an underlying problem, is the fundamental obstacle to shaping a future that could, at least in principle, be sustainable. In conclusion, I believe ecological economics needs to seriously take on a project of 'Truly Sustainable Cities'. This needs to be a project that transcends denial and accepts the reality of the human predicament.

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Chapter 3: Will the transition to renewable energy damage the global macro-economy?

Mark Diesendorf

1. Introduction

One of the principal themes of the transdisciplinary field of ecological economics (EE) is the steady-state economy, defined by Herman Daly (1977, p.17) as: 'an economy with constant stocks of people and artifacts, maintained at some desired, sufficient levels by low rates of maintenance "throughput"'. Since energy is one of the key inputs to any kind of economy, it follows that a steady-state economy needs an ecologically sustainable system. This is defined to be: 'a system of technologies, laws, institutions, education, industries and prices governing energy demand and supply for the sustainable development process and ultimate for achieving a sustainable society' (Diesendorf 2014, p.24). This system comprises the reduction of unnecessary, wasteful energy demand by energy efficiency and energy conservation, together with renewable energy supply (Jacobson 2009; Diesendorf 2014). Renewable energy and, in particular, its possible impact on the macro-economy, is the topic of this chapter.

Many countries, states and towns are in the process of transitioning from fossil fuels to renewable energy. The transition is driven largely by the need to mitigate global climate change and the lower costs of supplying bulk electricity from wind and solar energy than from new fossil and nuclear energy (see Table 3.1). Other advantages of the transition include reduced air pollution, respiratory and other diseases, water use, water pollution and land degradation; improved long-term energy security; job creation; and, in the case of renewable energy for households, small businesses and local communities, increased independence in energy supply (Smith et al. 2013; WHO 2014; Sinden and Leffler 2016; Jacobson et al. 2017; Campbell 2018; Overton 2020).

The transition to renewable energy is disrupting the business models of incumbent energy suppliers. This has engendered resistance to change that is manifest in critiques and misrepresentations of renewable energy by some politicians, a large section of the media (Knott & Samios 2020; Anon 2020) and some authors of articles in the scholarly literature. The most common critiques of renewable energy – based on reliability of electricity supply, conventional economics and environmental impacts – have been comprehensively refuted (Jacobson & Delucchi 2013; Diesendorf 2016; Brown *et al*. 2018; Diesendorf & Elliston 2018).

A new critique of renewable energy has come from environmental economists and others, some of whom are supporters of the fossil fuel or nuclear industries. This critique is based on the claim that the energy return on energy invested (EROI) for renewable energy technologies and systems may be so low that the transition from fossil fuels to renewable energy may displace investment in other important economic sectors (Hall *et al*. 2014; Ferroni and Hopkirk 2016; Sers and Victor 2018; King and van den Bergh 2018) and may even cause complex industrial societies to collapse (Capellan-Perez *et al*. 2019).

This chapter examines these claims critically for the case of large-scale electricity supply-demand systems in regions with high solar and wind resources that are transitioning to 100% renewable electricity. These regions need storage, either in the form of dispatchable[3] renewable energy technologies that are net generators of electricity (e.g. once-through[4] hydro-electricity with dam; concentrated solar thermal with thermal storage; open cycle gas turbines burning renewable fuels) or forms of storage that are also dispatchable but are not net generators (e.g. pumped hydro; batteries; compressed air).

Because renewable electricity from wind and solar photovoltaics (PV) is now cheaper than electricity from new fossil fuelled and nuclear power stations (see Table 3.1), it is also the basis for transitioning most transport and non-electrical heat to renewable energy. Fuel-based heating can be replaced by electric heat pumps and, for high temperatures, direct resistance heating. Electric vehicles (EVs) are already much less expensive to operate and maintain than internal combustion engine (ICE) vehicles. As batteries are

[3] Dispatchable power stations can supply power promptly on demand. They all have some form of storage associated with them, whether gravitational, mechanical, electrical, thermal, pressure or chemical

[4] Water flows one-way downhill to generate electricity and is not pumped back up again.

mass-produced on a very large scale in 'gigafactories', their prices will drop substantially and EVs will become economically competitive with ICE vehicles for general use. They are already competitive for some fleet uses. Thus a renewable energy future will be predominantly a renewable *electricity* future, supplied on small, medium and large scales. Over most of the world, bulk electricity will be supplied by wind and solar PV 'firmed up' by various mixes of storage technologies and demand response. Those regions that lack local renewable energy resources will import them by transmission line or, in some cases, by sea tanker in which energy is stored in the form of liquid and gaseous zero-carbon fuels produced by using renewable electricity (Jacobson *et al*. 2015; Ram *et al*. 2019; Bogdanov *et al*. 2019).

Table 3.1: Levelized cost of energy (LCOE) in USD/MWh from different bulk electricity generation technologies in the USA and Australia

Technology	Unsubsidised LCOE in USA 2020	Unsubsidised LCOE in Australia 2020	Unsubsidised LCOE in Australia 2030
Solar PV	32–44	29–42	22–32
Solar PV + 2 hr battery storage	–	62–93	36–72
Solar PV + 6 hr PH		71–106	59-106
Wind – on-shore	28–54	34–42	31–40
Wind – on-shore + 2 hr battery	–	59–75	45–63
Wind – on-shore + 6 hr PHES	–	64–82	60–80
Coal – black	66–152	58–78	59–77
Coal – brown	–	67–86	67–86
Nuclear	118–192	–	–

Sources: USA: Lazard (2019); Australia: Graham et al. (2019, Table B.8)
Notes: PHES is pumped hydro-electric storage; monetary values in: 2019-2020 USD; AUD converted to USD by 1 AUD = 0.7 USD.

This chapter draws upon a paper by the author (Diesendorf & Wiedmann 2020) and recent research by others (cited below), to present a case that:

- The claims that wind and solar PV technologies have low EROIs are incorrect, because: (a) they are based on outdated data that fail to address the rapid evolution of these technologies; (b) they fail to address the energy efficiency advantages of transitioning away from fossil fuel combustion to renewable energy; and (c) they over-estimate storage requirements.

- The traditional belief that generation from fossil fuelled electricity technologies generally has high EROIs is incorrect, mainly because it was based on EROIs of the fuels at the point of extraction and overlooks the low efficiencies of fuel combustion that reduce EROIs of fossil fuelled electricity.
- Although high penetrations of variable renewables (e.g. wind and PV) into the grid require additional storage, this chapter shows that, in several extensive regions, the quantity of storage required to maintain reliability of supply is quite small and its impact on system EROI depends on the types of storage adopted and the strategy chosen for their use.
- However, independently of EROIs of individual technologies determined at a given time, a very rapid transition of a whole electricity system to zero carbon could cause a temporary reduction in system EROI.

The plan of the chapter is as follows: Section 2 gives the definitions of EROI and other key concepts. Section 3 exposes the incorrect assumptions that led to the belief that EROIs of wind and PV technologies are low and decreasing. Section 4 reviews recent research that finds EROIs of wind and solar PV technologies are high and increasing, and that EROIs of fossil fuelled electricity technologies are likely to be much lower than previously believed. Section 5 discusses EROIs of whole renewable energy systems with storage. Section 6 discusses briefly the impact on EROI of a rapid transition of the energy system. Section 7 concludes the chapter and offers general comments on the role of EROI.

2. Definitions

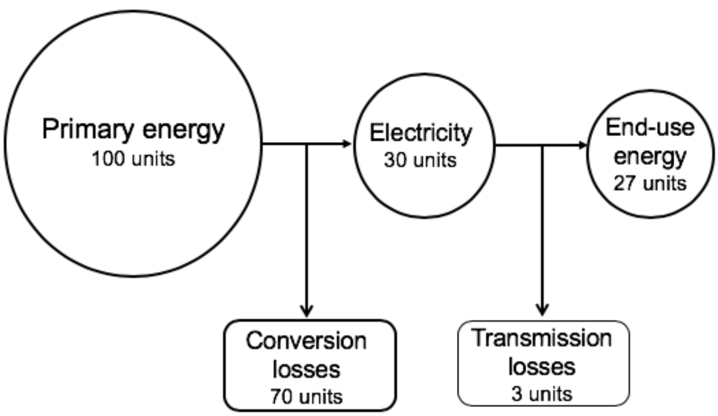
For an individual energy technology or a whole system, EROI is defined to be the energy output divided by the life-cycle primary energy invested. Thus, where E represents energy:

$$\mathrm{EROI} = E_{out} / E_{inv} \qquad (1)$$

As far is possible, ‘life-cycle’ takes account of the energy invested *by people* in mining and processing the raw materials, construction, operation, decommissioning and waste management. Thus E_{inv} is the energy diverted from other possible societal uses. In a topic that is vigorously debated, it is a rare point of general agreement between authors who take otherwise quite different approaches to Net Energy Analysis that the energy in sunshine falling on a solar collector or in wind passing through a wind turbine or the thermal energy content in a fossil fuel is *not* counted in E_{inv}.

For electricity generation, there is debate about whether the energy output is simply the quantity of electricity generated over the lifetime of the technology/system or the primary energy equivalent of that electricity. The outcome of this debate is important, as illustrated in Figure 3.1. Energy losses in the combustion process are typically about two-thirds of the chemical energy in the primary fuel, although they can range from about 60% to 80%, depending upon fuel quality and type of energy conversion technology.

Figure 3.1: Typical flow diagram for electricity generation from fossil fuels



In electricity generation, most of the greenhouse gas emissions and other pollutants result from the combustion of primary fuels. Therefore, saving one unit of final or end-use energy in the form of fossil electricity, either by efficient energy use[5] or energy conservation[6], or substituting one unit of

[5] Supplying the same energy service while using less energy: e.g. using a water efficient shower head.
[6] Saving energy by accepted a modified energy service: e.g. taking shorter showers.

renewable electricity, can save typically three units (range two to four) of fossil fuels and their emissions. Hence, it is argued by one school of thought that, when the context is transitioning to renewable electricity in order to reduce the emissions from fossil fuelled electricity, energy output in Equation (1) should be the primary energy equivalent of the electricity generated (Raugei *et al*. 2012; 2015; Diesendorf & Wiedmann 2020). Hereinafter, the primary energy equivalent EROI is written as '$EROI_{PE\text{-}eq}$', while the traditional version of EROI in which the energy output is just the electricity generated is written as '$EROI_{el}$'. EROI without subscripts refers to both definitions.

For both cases, the net energy gain NEG is defined to be:

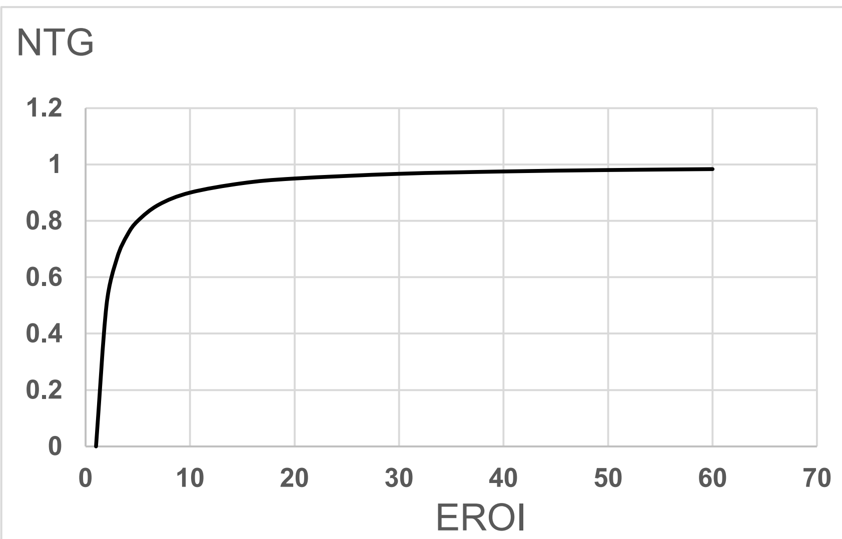
$$NEG = E_{out} - E_{inv} \quad (2)$$

Dividing NEG by E_{out} gives the net to gross energy ratio NTG:

$$NTG = NEG / E_{out} = 1 - 1/EROI \quad (3)$$

This non-linear relationship between NTG and EROI gives the well-known 'energy cliff' illustrated in Fig. 2: as EROI decreases to 1, NTG tends to zero, an outcome to be avoided for an energy system. For EROI = 10, NTG = 0.9, 90% of its maximum possible value, so energy technologies or systems with EROI greater 10, or even 8, should not be of concern to macro-economists.

Figure 3.2: The net energy 'cliff': NTG graphed against EROI



3. Errors in previous estimates of EROI

A major source of incorrect low EROI results for renewable energy is the use of outdated data for technologies that have been evolving rapidly. Sers & Victor (2018) base their assumption that EROIs of variable renewable electricity technologies are 'substantially lower than conventional fossil fuels' on the meta-analysis of Hall *et al*. (2014), who: 'calculated the mean EROI value using data from 45 separate publications *spanning several decades*' (my emphasis). Averaging over several decades is invalid for solar PV and wind, because they have experienced huge technological improvements demonstrated in part by huge reductions in their respective prices. In real terms, wind turbine prices have fallen by between 44% and 64% (depending on the market) from their peak in 2007–2010 to 2018, and solar PV prices have dropped by about 90% over 2009-2018 (IRENA 2019, Figs 1.2 & 2.1). Over several decades the reductions have been much greater. The invalidity in using old data is confirmed by Palmer & Floyd (2017, Fig.2), who plotted data from 1997 to 2014 and found a reduction in Cumulative Energy Demand (which equals E_{inv} + solar energy input) of PV by up to an order of magnitude. Furthermore, Görig and Breyer (2016) showed from empirical data the large energy learning rates, i.e. how energy invested decreases with the doubling of the cumulative capacity, for solar PV.

In choosing 'optimistic' and 'pessimistic' values of EROIs of energy technologies, King & van den Bergh (2018) cited as one of their sources the invalid results of Hall *et al*. (2014). Furthermore, the latter's Table 3.1 of EROI values fails to specify the type of PV cell or the location of the PV and wind technologies, which determine E_{out}. The paper stated that its 'pessimistic' values for wind and solar allow for storage, but this seems to have been done in an arbitrary manner. Hence their EROI values can be dismissed.

A paper by Ferroni and Hopkirk (2016) estimated that EROI of PV in Switzerland, a country of low insolation, is 0.82, i.e. a net consumer of energy. However, a detailed analysis by Raugei et al. (2017) refuted their results by demonstrating methodological inconsistencies involving choice of system boundaries, calculation errors and the use of outdated data.

4. Actual EROIs of renewable and fossil fuelled electricity

Raugei & Leccisi (2016) found that, for wind and three types of solar PV in the UK, which has low average annual insolation, $EROI_{PE\text{-}eq}$ is much greater than 10, and for a fourth type of PV (c-Si) $EROI_{PE\text{-}eq} = 10$. Leccisi *et al*. (2016) examined $EROI_{PE\text{-}eq}$ of PV at three levels of insolation (1000, 17000 and 2300 kWh/m^2/yr), and found that, even for the lowest level, $EROI_{PE\text{-}eq} \geq 10$.

For coal-fired electricity in the UK, Raugei & Leccisi (2016) found $EROI_{el} = 3.6$ or $EROI_{PE\text{-}eq} \approx 10$. Brockway *et al*. (2019) found that most high values of EROI reported for fossil fuels are calculated at the primary energy stage, i.e. where the fuels are extracted from the ground. They calculated global averages for fossil fuelled (coal and gas) *electricity* and obtained $EROI_{el} \approx 4$ and declining[7]. Their conclusion is 'in EROI terms, renewable-based electricity might not be as disadvantaged compared with fossil fuels as is often suggested in the literature (Hall *et al*. 2014) … the renewables transition may actually halt – or even reverse – the decline in global EROI at the final energy stage' (Brockway *et al*. 2019, p. 616).

5. EROIs of systems with storage technologies

Storage in generating systems with high penetrations of variable renewables permits generation reliability to be maintained by filling troughs in variable renewable supply and reducing peaks in demand. Storage provides frequency control and ancillary services. Some forms of storage (e.g. batteries) improve security[8] by providing very rapid response to a disturbance resulting from e.g. the unexpected failure of a power station, the physical collapse or overloading of a major transmission line, or a sudden change in demand. Storage provides greater utilisation of transmission and distribution lines, thus reducing the need for augmentation.

The presence of some forms of storage in a power system may reduce system EROI as a result of the life-cycle energy inputs and round-trip energy losses between generation and storage and back to generation. In the power system,

[7] This number has been adjusted for their different definition of EROI.
[8] In electric power engineering, 'security' is a technical term denoting the ability of the power system to tolerate disturbances and hence maintain electricity supply to consumers.

this is offset to some degree if storage is charged up from excess generation by variable renewables that would otherwise be curtailed. The contribution to EROI of storage is increased by high life-time energy output resulting from frequent charge-discharge cycles of the storage, obtaining more value per unit of energy invested. The case studies below show that the impact on system EROI also depends on the quantities and types of storage in the power system and their operating strategies and therefore generalisations along the lines that 'storage always reduces system EROI substantially' are invalid.

Australia is considered to be typical of regions with high solar and wind resources. These regions include south-west and central USA, north-west China and north-west South America. To these regions could be added the Middle East and North Africa, which have very high solar resources and medium-level wind resources. Together, all these regions could supply a large fraction of global electricity demand via transmission lines. As case studies, we consider two simulation modelling studies of the operation of Australian National Electricity Market (NEM) with 100% renewable energy. In 2018 NEM generating capacity was 60 GW; annual generation in FY 2018-19 was 205 TWh, of which coal supplied 70%, wind 10%, gas 9%, hydro 8% and solar PV 3% of NEM annual electricity generation (AER 2019). One of the following Australian case studies utilises storage in the form of dispatchable renewable technologies that are net generators of electricity, while the other utilises existing once-through hydro together with a type of storage that is not a net generator, pumped hydro.

Elliston *et al*. (2016) took storage in the form of dispatchable renewables having net generation, comprising existing hydro supplemented by CST with thermal storage and open cycle gas turbines using renewable fuels. They found that a reliable 100% renewable electricity generation system system could be achieved with an economic optimal mix comprising 78% of annual energy generation provided by the variable sources (wind + PV) and 22% by the above-mentioned dispatchable renewables. In transitioning from zero penetration of renewable energy (in addition to existing hydro) to 80%, the increase required in generating capacity and annual energy generation from dispatchable renewables was very small (Elliston *et al*. 2016). However, in going from 80% to 100% renewables, the capacity and generation of dispatchable renewables required an increase by a factor of approximately three, with dispatchable power capacity reaching 26 GW and annual generation of 47 TWh[9] (Elliston *et al.* 2016, Tables A.10 & B.13). Gas turbines are mass-produced and generally have low capital costs in dollars per kilowatt and hence low values of energy invested. However, both gas turbines and CST have low capacity factors (i.e. are used infrequently) in these simulations and so have low energy outputs. Therefore, they may not be the best forms of storage to choose from the viewpoint of EROI. Indeed, Barnhart & Benson (2013) found that pumped hydro and compressed air are at least an order of magnitude better than several types of battery in terms of the ratio of total electrical energy stored over the lifetime of a storage technology to its embodied primary energy.

The simulations of the NEM by Blakers *et al*. (2017) assumed a baseline system in which variable renewables, wind and solar, supplied 92% of annual electricity generation. They supplemented existing hydro storage, which supplied the remaining 8% of annual generation, with additional pumped hydro, charged by excess variable renewable generation that would otherwise have been curtailed. They also added a few new high-voltage transmission links. They achieved a reliable generating system with pumped hydro generating capacities of 16-28 GW for various scenarios, similar in magnitude to that of Elliston *et al*. (2016) with 78% variable renewables. The total energy storage capacities required for reliability, 470-490 GWh or 0.22-0.24% of annual generation, appear at first site to be remarkably small, but they are used many times per year. Seasonal storage, in addition to the small contribution from existing hydro, was found to be unnecessary. Demand response was also used during a few critical periods.

These two detailed simulation models each show that, for 100% renewable electricity systems with high solar and wind penetrations, the quantity of additional storage required, both in terms of generating capacity and stored energy, depends on the penetration of variable renewable generation. It is negligible for energy penetrations less than about 40% and, even at 78-92% penetration, the quantity of storage required is relatively small. For pumped hydro, a long lifetime and frequent use of the storage entail that the energy output E_{out} is high. Furthermore, some off-river (closed loop) pumped hydro systems (Blakers *et al*. 2017; Lu *et al*. 2018), e.g. those with the bottom

[9] Note that the energy generations in Tables B.11 to B.13 of Elliston et al. (2016) are actually in TWh, not GWh.

reservoir a mineshaft or the ocean and with short pipeline distances, may have quite low values of energy invested as well as high lifetime energy outputs.

Batteries are generally charged and discharged (at least partially) on an almost daily basis, but their lifetimes are much shorter than that of hydro, as pointed out by Barnhart & Benson (2013), and so they have low lifetime electricity storages per unit of energy invested. Although batteries will reduce system EROI, at present their principal role is not to fill gaps in variable generation spanning several days, but rather for frequency control and ancillary services (FCAS) and with a less important role of storage for periods up to a few hours at most in order to help handle peaks in demand. This is because the cost of battery storage increases rapidly with the number of hours of storage required[10]. Therefore, batteries will be a small but valuable part of storage in power systems with high penetrations of variable renewables. Most energy storage will be provided by such technologies as hydro, pumped hydro and possibly compressed air.

6. Transition dynamics

So far this chapter has discussed EROIs of renewable electricity technologies at a given point in time. Next we must consider the dynamic problem. Climate science has identified a crisis that demands urgent, rapid response. If a system of power stations transitions so rapidly towards zero carbon that the energy invested in building one generation of new cleaner technologies occurs before the previous generation has 'paid off' (in energy terms) its energy invested, then system EROIs will indeed be temporarily low. This applies to all rapid low-carbon energy transitions (e.g. to nuclear) as well as to renewables (Diesendorf and Wiedmann 2020). Accepting that we have a climate emergency entails accepting a temporary diversion of some resources from other sectors of the economy.

[10] This could change in future if flow batteries, e.g. Vanadium redox, are further improved. Increasing their energy storage capacity is already less expensive than for Lithium batteries.

7. Concluding remarks

Contrary to several previous studies, EROIs of wind and solar PV technologies at suitable locations are high and increasing. These variable renewables can provide the vast majority of annual electricity generation in the type of region considered in this chapter: high solar resources, medium to high wind resources, and low conventional hydro-electric potential. For regions with limited wind and solar resources and/or high demand for winter heating, power-to-gas and import-export of electricity by transmission line can be utilised, but this is not the subject of the present chapter. The technologies for electrifying all heating and most transportation are commercially available; the costs of batteries and hence electric vehicles are declining rapidly.

Recent research finds that EROIs of fossil fuelled electricity technologies and systems are relatively small. Therefore, transition to energy systems based predominantly on renewable electricity may actually increase global EROI at the point of use, even when storage is included.

The present research finds from analysis of two case studies that, while some forms of storage (e.g. batteries used as gap-fillers in supply from wind and solar; CST and gas turbines with infrequent use) may significantly reduce the EROI of power systems with high penetrations of variable renewables, other forms of storage (e.g. once-through hydro; pumped hydro; batteries used for FCAS) are unlikely to reduce system EROI significantly and may even in some cases increase it.

EROI is just one aspect of the economic and environmental impacts of the transition from fossil fuels to renewable energy. Most of the other impacts, listed in the introduction, are beneficial to both the economy and the environment. An exception is the impact on employment of stranded assets in the fossil fuel industries. Therefore, government policies will be needed to foster new, cleaner industries and businesses, and the retraining of workers, in affected regions.

Another aspect of the transition that deserves mention is the question: does EROI matter if the energy invested is entirely renewable? Already we are seeing the beginning of a movement to use renewable energy to produce renewable energy technologies. The Tesla Gigafactory in the USA is powered entirely with renewable energy. Some mining, minerals processing and steel industries are purchasing renewable electricity to power their processes. One response to the question is a statement of the well-known fact that just a tiny proportion of Earth's renewable energy resource is sufficient to provide current energy demand by industrial society. The world's energy could be supplied by just the high solar, high wind regions considered in this chapter together with a modest amount of storage. Therefore, although a steady-state economy needs renewable energy to be truly ecologically sustainable, a renewable energy system doesn't need a steady-state economy. However, the transition from fossil fuels to renewable energy would occur much more rapidly in a steady-state economy. The energy invested in the transition to 100% renewable energy can be easily provided by renewable energy. The limits are the finite resources of materials, land use constraints and the understanding that very large increases in energy use, even if supplied entirely by renewables, would cause adverse environment impacts apart from climate change. In the long run, on a finite planet, a steady-state biophysical economy is necessary (Daly 1977; Dietz & O'Neill 2013).

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Chapter 4: Ecological Economics and the 4th Industrial Revolution

Peter Daniels

1. Introduction

The 21st Century is clearly a time of profound and rapid environmental, technological, health and social change. These conditions are global in scope and inextricably related. The technological dynamism and new lifestyles around us may seem of limited direct relevance in a world confronted by climate change, major biodiversity and other planetary limits, and environmental and health challenges. Indeed, in the ecological economic view, technological change has often been considered as a problem source, or even dismissed with scepticism as a positive influence upon sustainable futures. This is probably a legacy of the trans-discipline's 'neo-Malthusian' and Limits to Growth roots, and an emphasis on the historical record of technology as both a driving force and result of material-based, environmentally-harmful economic growth (Costanza 1989; Daly 1977).

However, technology change cannot be ignored given its profound effect on what is arguably the primary ultimate goal of ecological economics (EE) – the long-term wellbeing of humans as part of nature. In this regard, it has brought a panoply of outcomes (both good and bad). These range from climate change, globalisation, overpopulation and pandemics; to phenomenal efficiencies and savings in productivity and transaction costs, physical health and longevity benefits; to the adverse consequences of related excess (obesity and mental health issues, deleterious levels of solid waste and so forth).

Technology is a powerful and inexorable influence on the *raison d'etre* of EE. Ignoring or simply denigrating it in pessimistic Luddite fashion, in the name of sustainability, is unrealistic and negligent of one of the primary potential agents of positive change. Arguably, the most important effects of technological 'revolutions' are social and economic (and more tacitly, but just as significantly, in the environmental domain). Hence, when ecological economic goals are recognised as much more than simply environmental sustainability, the analysis and strategic guidance of technological change and innovation are core to long-term community wellbeing (and all of the inter-related ‘pillars’ of sustainability). Indeed, EE is ideally placed as a surveyor of wellbeing (and the real effects from technology change) given its diverse, evolving, pluralistic, and transdisciplinary perspectives.

The current technological matrix (at least that pervading the increasing cohort of higher and middle income nations) is at least as consequential as those that have dramatically changed life over the past 250 years. While most people are only aware of the history school-book recollections of the (First) Industrial Revolution emerging in the late 18th Century in Great Britain, scholars now often identify at least four technological-industrial revolutions. The evolution through these times has certainly been incremental but they are considered to have distinctive technological, social and economic progressions and features – enough so as to require conceptual and analytical separation. The latest setting – and the focus of this chapter – has been labelled, studied, and widely discussed as the ‘Fourth Industrial Revolution’ (4IR) (Schwab 2017; Bloem et al 2014; Jones 2017).

Though a complex, multidimensional, varied and evolutionary concept (one mostly only introduced around 2015 by Schwab 2015), the essential characteristic of the 4IR is often noted as the broad-based onset of ‘cyber-physical systems’. This means that, in people’s lives, their experience of the physical and digital worlds are becoming ‘blurred’ as digital information access and processing become ever more deeply embedded into human consciousness and physiology. It is not just the use of external microelectronic processing as an aid to human economic and social activities, but involves the fusion or even supplantation of many functions previously performed by the human mind and body. In the 4IR, direct human environmental experience (including labour, social interaction, entertainment, recreational, empirical and experiential knowledge acquisition activities, and understanding of the world) is directly augmented and increasingly replaced by digital media and interfaces, artificial intelligence (AI), robotics, virtualisation, and the Internet and its countless connected sensors and other devices, and data reservoirs.

This phenomenal transformation in the capacities and media of human perception and experience, though often greeted with great delight and anticipated stimulus, fun and reductions in labour and tedium, is actually having a broad gamut of impacts with profound economic, social and psychological consequences. Prospects for guiding this transformation towards enhanced sustainability, and all aspects of human wellbeing, will depend upon input from all wisdoms and the application of trans-disciplinary approaches.

This chapter examines the 4IR from the perspective of EE. It identifies and describes the most relevant aspects of both the 4IR and EE for highlighting the substantial cross-overs between them. The following section describes the essence of the 4IR in some more detail before briefly presenting at least two major ecological economic bases that provide a strong connection to the effects of the 4IR – environmental footprints or sustainability, and changes in mindsets and mental perspectives (closer to social or cultural sustainability). The third section outlines three key characteristics of the Fourth Industrial Revolution (again inter-related) that influence EE' sustainability goals. These 4IR attributes relate to virtualisation, technological optimism (non-deliberative), and bio-digital fusion and its potential coevolutionary consequences.

Section 4 is the core of the chapter with its focus upon exploring the main outcomes and impacts of the 4IR for EE. The concluding section identifies some valuable contributions from EE to help guide or shape this transformative new technological revolution towards supporting more sustainable futures.

2. Ecological Economic Goals and the Fourth Industrial Revolution

The Fourth Industrial Revolution is a relatively new conception and not very well-known or understood. While it is not possible to provide a comprehensive review of the notion here, some of its key pertinent features are described below. The label of an 'industrial' revolution is somewhat misleading, as it connotes an emphasis on manufacturing activities. Instead the 4IR is really intended to represent an extensive suite of marked social and economic transformations, and cultural change, related to 'clusters' of innovations that reach into every aspect of contemporary lives. Arguably, a more recent concept of 'techno-economic paradigms' (Perez 1985) is more appropriate for the scientific and ecological analysis of related societal dynamics. Technoeconomic paradigms (TEPs) are theoretical constructs intended to describe reasonably unique historical epochs at the national or supranational level. The onset of a new TEP would be defined by a new set of characteristic social, economic and institutional arrangements which have profound and interactive relations with an inter-related set of core innovations forming a dominant technological mode or ‘style’ (see Daniels 2005 for more details on TEPs).

To help identify some of the principle attributes of the 4IR, some of major dimensions of each of the conceived four revolutions are presented and compared in Table 4.1. For simplicity, and consistent with much of the existing research in this area, the economic and socio-cultural dimensions of each revolution are not emphasised, despite their likely importance. These aspects will be re-visited (at least for the 4IR) later in the chapter. The final column helps in outlining some essential features of this latest revolution, with respect to previous forms.

A central attribute of the first two industrial revolutions was the application of technology to foster mechanical and energetic assistance in the production of physical goods. The 4IR is borne from the digital, information-based technological milieu of the Third Industrial Revolution. While there may be no clear-cut boundary marking the transition into a *fourth* revolution, a definitive feature is that these technologies, which were largely external in the past, ‘come closer’ and are integrated more directly into human consciousness and even human bodies. This follows the changes from earlier revolutions – moving from the innovation of new energy sources towards a state of ‘digitalization’ where virtual perceptions provide the basis for human actions in the physical world (Sentryo 2017). However, it is also a significant step in the logistical nature of the links between technologies and the human physical presence and psyche. There is marked 'biodigital fusion' involving the innovation and adoption of 'cyber-physical systems' that fuse networked and connected digital devices with biophysical systems (Jones 2017; Schwab 2017). This fusion covers everything from perception (with virtualisation) to physiology (cyborgism).

Hence, there is a generalised merging of humans and ‘machines’ where technology is not just used, but deeply embedded in our lives, and increasingly physically connected to, or commanding our senses, or implanted into our bodies. An additional major, and related, attribute of the 4IR is the onset of extreme levels of connectivity in terms of digital information flows and virtualisation. This is an intensification of one of the major trends on the Third Industrial Revolution linking the virtual and physical worlds (for example, the ubiquitous 'Internet of Things') and compounding power and speed in information access, learning and decision-making.

Table 4.1 Selected primary characteristics of the Industrial Revolutions **(**Sources: Adapted and extended from Schwab (2017), John Grill Centre (2018), Khan and Isreb (2018), Huffington (2017); Klugman (2018); and others)

Dimension	**1st Industrial Revolution** ***1770s to mid 1800s***	**2nd Industrial Revolution** ***Late 1800s to mid 1900s***	**3rd Industrial Revolution** ***Mid-1900s to 2000***	**4th Industrial Revolution** ***21st Century***
Main energy sources (and key materials)	Switch from human and other animate energy to inanimate energy (esp. coal). Coal, water and steam.	Steam power, coal-based electricity, petroleum	Fossil fuels, hydroelectricity, nuclear. Some renewable sources.	Mixed. Coal, petroleum, natural gas but diminishing relative importance. Increasing use of renewables – solar, wind, etc.
Key technology change and improvement clusters	Mechanised, if not mass production.	Internal combustion engine and cars. Mass production, Fordist and Taylorism (scientific management of production). Shift Some analogue electronic. Vacuum tubes, transistors in later period.	The rise of electronics. Computers - microprocessors and memory/ storage, then network systems. Software systems. 'Digital revolution' aiding production (vs directly) producers; shift from mechanical to analogue electronic then digital. Electricity and other energy storage systems. Mobile phone and other computing. Robotics. Biotechnology	Artificial intelligence; algorithm-driven search, consumption and other analytics; apps and systems for numerous tasks; robotics; the Internet of Things; autonomous vehicles; 3D printing; synthetic biology and genetics, genome editing; distributed ledger technology (DLT), blockchain, quantum computing, nanotechnology; biometrics; renewable energy ; peer to peer and shared economies

Main sectors affected	Textiles, metals	All manufacturing. Steel, petroleum, electricity, utilities.	Most sectors – esp. information-related and mass production (whitegoods, autos etc.)	All
Geographic extent	Britain, Western Europe, North America	N. America, Western and Central Europe, Russia, Japan, Australia. Spreading Mid East, S. America	Same as 2nd IR but also East and South Asia. Near global	Global
Miscellaneous production aspects	Mechanical production based on steam (esp. textiles), rediscovery of cement, sheet glass, gaslight.	Standardisation of machine parts. Paper making, rubber.	Digital automation of production by electronics and information technology.	Microelectronics recreates the good or service. Deconstructing and producing new forms of existing and new physical and biological matter at atomic, molecular to supramolecular levels.
Economic system characteristics	Creation of factories. Capitalists and workers social structure. Industrial capitalism replacing late feudal system/Nation States/merchant capitalism or mercantilism Small and local firms.	Emergence of large firms, limited liability corporations, joint stock ownership. Large-scale agricultural production and automation. Heavy engineering.	New ways of processing, storing and sharing information. Globalisation.	Extensive ecosystem of internet devices linked to improve the quality, efficiency and of production and process operations; (Bloem et al 2014). Linkages between machines, personal devices, real-time control and other aspects. Prolific new business services based on virtual- links and intelligent machine replacement of routine tasks. Demise of low skill mass production and employment capable of automation.

Given much variation in the extent to which these processes have taken hold, two significant dimensions of this trend can be observed:

(1) The replacement of direct full physical sensory interaction with digitisation that transcends the spatial and temporal context that humans have been situated for hundreds of thousands of years.
(2) The replacement of many social and economic functions that were previously performed (at least more so, to date) in physical reality.

With this understanding of some of the main traits of the 4IR, it is possible to set the context for its many significant linkages to EE. The relations between the 4IR and EE can often be associated with two major trans-disciplinary conceptual areas, and indeed goals, of EE: (1) environmental sustainability, or footprints and (2) social sustainability. These two foci are, like most key topics in EE, understood to be closely connected. This is not intended to dismiss the relevance of *economic* sustainability but, for the 4IR, it is best to consider this in relation to environmental and social impacts.

The environmental footprint implications of the 4IR are a major basis for examining its links to EE perspectives. Footprints are primarily affected by anthropogenic material and energy flows in source and sink functions (the 'pressures' in the popular DPSIR framework)[11]. Technology change in all forms, and the 4IR is no exception, will have many very significant positive and negative impacts upon human demands from environmental resource inputs and waste assimilation functions. This includes both production (supply) and consumption (demand) activities in traditional economic views.

From a sustainability perspective, the environmental effects of technology are often the most obvious and commonly cited – especially problematic pollution and depletion outcomes. While this aspect is relevant for the 4IR, it certainly has a much broader range of potential social costs *and* benefits that need to be considered. With the EE perspective of the economic system as part of society which, in turn, is completely embedded and dependent upon nature (Daly and Cobb 1989), there is clearly a powerful flow-on effect of human-induced ecological change upon the economy and society. This cuts across all of the

[11] For an explanation of the European Environment Agency's Driver-Pressure-State-Impact-Response (DPSIR) framework see Kristensen (2004).

source, sink, life support, amenity, ecological stability, resilience (and arguably higher order cultural and eco-psychological) benefits or functions that nature provides to humans.

Hence, footprint impacts of technology systems upon environmental sustainability will affect multiple aspects of human economic and broader social wellbeing. However, EE is also concerned with wellbeing beyond just environmental resource scarcity and health. It also advocates the need to identify and act in accordance with 'ultimate ends' that provide 'theories' and guidelines for real and sustained high levels of human wellbeing (Daly 1977). This implicates and links to the 4IR in terms of other dimensions of social sustainability that are not just directed towards biophysical scale or ecological limits. The 4IR is often assumed to be very proficient at enhancing wellbeing through stimulation, entertainment, less labour and so forth. EE is relevant here because it would seek to understand and question prevailing wellbeing assumptions (if within the context of ultimate means from ecological limits). EE definitely has a sceptical approach to the technology-growth axiom of 'more is always better' and would encourage an open-minded, trans-disciplinary analysis of the wellbeing consequences of 'more', even if more is manifest primarily as an increase in services and innovations with substantial dematerialisation and eco-efficiencies.

To date, EE has tended to focus on growth (economic and population) as inevitably leading to increased societal throughput or metabolism and consequent wellbeing losses for current and future generations. However, its holistic perspective extolls the need for considering the profound inter-connectedness between the ecosphere, human economic and social behaviour and the true sources of long-term wellbeing. This seems ideally suited to an assessment of technology systems that may help reduce pressure on ecological limits, yet remain predicated upon the belief that more of everything that appeals to the human psyche in the short-term (such as gratification, entertainment, distraction, sensory stimulation), will really generate human wellbeing. Hence, examining the 4IR potential impacts on valid indicators of objective, and especially subjective, wellbeing and mental health would seem vital for achieving ultimate ends in EE.

It also possible to link the 4IR impacts to the essential scale, distribution and allocation logic of EE (Daly 1992) though many of these overlap considerably with the effects on environmental and social sustainability as just described. For example, the implications of the 4IR for humanity remaining within sustainable *scale* are closely tied to environmental footprint and sustainability effects. There are also numerous potential, interactive, consequences for equitable *distribution*, across generations, classes, countries and species, from the nature of technology change in the 4IR and the associated transformations in production and consumption.

3. Some Relevant 4IR Characteristics

Next, we consider a few of the general characteristics of the 4IR that act as the wellsprings of change affecting the 'pre-analytic vision' and goals of EE. These were introduced with the definition of the 4IR in section 2, but they are examined in some more detail here. It includes some discussion of how these evolutions can constrain or facilitate the various dimensions of sustainability (as the ethos of EE).

Virtualisation

Virtualisation in its broader sense is close to the popular concept of 'virtual reality' and the transformation of normal empirical experience and communication so that direct physical sense connections are replaced with symbolic means (increasingly electronic, digital, software-based)(Microsoft Azure 2020). This trend has been happening for a long time – arguably since the development of language and simple art forms, but it can be seen as undergoing rapid intensification through the industrial revolutions, especially with the advent of electricity and telegraph, photography and film, radio, telephone, television, and the internet and beyond. In the 4IR, the direct spatio-physical aspect of human-human or human-environment interaction can effectively disappear. The object source is often simply not there in terms of proximate sensory connection.

This trait of the 4IR affects both the environmental footprint and the social sustainability mindset and wellbeing domains at the heart of EE. The implications of the virtualisation of human experience can be both positive and negative and cut across aspects such as social connectedness, material and energy flow pressures on natural resources, and the levels of wellbeing actually derived from goods, and especially *service* accumulation or access 'wealth'.

The 4IR is often lauded for its ability to reduce the material and energy demands, and hence the environmental footprint in the economy via reducing the costs involved for effective communication, problem-solving, information access, transactions and, to some extent, trade (WITA 2020). However, the net effects are unclear as communication and information components of production and consumption are only one part of the full costs involved. Material and energy or metabolism flows are still very significant in economic activity. While they are certainly subject to ongoing eco-efficiencies from the 4IR advances, they are biophysical and can continue to push ecological limits – particularly if technological efficiencies lead to effective increases in income and rebound consumption (as has been the case historically).

Furthermore, virtualisation can lead to environmental resource impacts becoming more hidden or invisible to the instigators and thus reduce awareness, accountability and adaptive responsiveness to adverse impacts on the ecological realm. It may be easier to ignore the laws of thermodynamics and flow-on effects from local to global scales in the process of de-spatialisation with virtualisation. Alternatively, the 4IR can have opposite effects by providing more accessible, detailed and accurate information about the environmental impacts of production and consumption choices. Hence, the overall effect of the 4IR is contingent and this is a major area for potential input and guidance from EE and related physical economy approaches and would certainly benefit from EE's trans-disciplinary approach that incorporates inter-dependencies from natural science and ecology, to economic activity, to human behaviour, and the socio-psychological links underlying wellbeing.

Unconditional Technological Optimism

Another general attribute of the 4IR affecting EE visions might be identified as an underlying spirit of extreme, almost unconditional, optimism associated with its virtualisation, biodigital fusion, and other core innovation systems.

This future excitement ‘fetish’ has accompanied previous industrial revolutions or techno-economic paradigms.

Positive outlooks are often a good thing, but it can be argued that rational and strategic decision-making are best set within the context of hysteresis (or at least history) to ascertain the likely community wellbeing outcomes of trends in state conditions. One of the forefathers of EE, Georgescu-Roegen (1971) subscribed to the wisdom of analysing the past and present, and path dependent forces and trajectories, in assessing (and hence, guiding) future societal outcomes. And yet, it is odd that the technological optimism that excites the 4IR is not noticeably affected by research findings that 50 years of profound and amazing technological advances do not really seem to be making people ‘happier’ (in terms of increasing subjective wellbeing and mental health). The physical health and longevity gains are without question though a new suite of health issues, that can often be linked to 4IR technologies (for example, from sedentary lifestyles, repetitive strain injuries, and diet), may well offset these benefits into the future.

This 4IR optimism and ahistoricism is consistent with the neoclassical economic and positivist science perspectives where unique social and economic (and environmental) contexts are not factored into understanding and predicting actions and their outcomes. EE’s technological scepticism and open mode of enquiry can help positively address this oversight by promoting the need to question and deliberate over the possible range of effects of the various dimensions of the 4IR. In this light, a major related EE response to the 4IR would be a strong call for the consideration of its unintended consequences or externalities. Feedback processes and flow-on effects are vital in assessing actual wellbeing impacts versus impulsive curiosity and novelty-based fascination and attraction.

Hence, from the institutional and EE viewpoint, the 4IR proponents and technological optimists in general tend to ‘jump the gun’ and dismiss the need to consider or pre-empt the real wellbeing changes associated with the new technology systems. In contrast, EE would adhere to its precautionary principle and warn of the dangers of passively submitting to rampant short-term consumer sovereignty and actions that lock people into the treadmill of production (and consumption), as lured by enterprise founded upon institutionalised accumulation. This optimism imbued in the 4IR has immediate links to the social sustainability and mindset aspects of EE. As with virtualisation, EE questions the maximising behaviour associated with technological obsession in deference to the wisdom of an approach that takes on board both the inevitable unintended consequences of new technologies (linked to ecological limits, lifestyle changes, and so forth), and the failure of past revolutions to significantly enhance subjective wellbeing.

Biodigital Fusion as Rapid Co-evolution

A third area of major overlap between the consequences of the 4IR and EE thinking is about the surrounding co-evolution and the profound changes associated with biodigital fusion for the human species. Co-evolution is an important concept in EE (see Chapter 1 by Farley) and often considered to be one its conceptual foundations (Munda 1997). It refers to the interaction between species populations with internal diversity so that their evolutionary paths affect each other by altering their selection environment. This has been extended in recent decades to include the dynamics of environmental and social change, including culture.

In the 4IR context, the technological innovations involved are profound modifications to the nature of human behaviour (and effectively, culture) and our relations with the rest of the natural environment. This rapid evolutionary change for humans will have complex and multifarious implications for future society and its supporting ecosphere. The short-term physical wellbeing outcomes seem positive for human basic needs and economic consumption but the more complex long-term psychological, social, and other sustainability effects are more questionable. It is not possible to explore any of these dimensions in detail but the coevolutionary effects of the 4IR will be of great interest for future research.

4. The Impacts of the 4IR on Sustainability

The effects of the 4IR will be extensive and far-reaching. In this section, some of the main impacts relevant to EE, and its ethos of sustainability, will be identified. It must be noted that the focus of the chapter is upon environmental and social sustainability (with an emphasis on subjective wellbeing for the latter). The impacts of the 4IR on the conditions that EE portrays as necessary for future sustainability will also configure the potential contributions or responses from the trans-discipline. This follows logically given that the identified impacts will reveal the advantage and danger sources in this latest technological revolution, and help pre-empt possible strategies to mould its powerful effect towards sustainability.

The 4IR-EE impacts surveyed are organised according to two of the main goal areas or targets of EE. They are two essential elements of EEs 'pre-analytical vision' – (1) environmental footprint and hence sustainability effects, and (2) social sustainability and long-term subjective wellbeing effects. In the list of positive effects below, it should be noted that some of the impacts are not direct and common targets upheld in EE, and the increased wellbeing outcomes from income would be seen as contingent upon affluence levels and the implications on footprints. Many of the effects listed are inter-related – especially the first three outcomes.

Major 4IR *economic* effects that are primarily considered as beneficial outcomes include:

- Increased incomes, quality of life (at least in material or expenditure-based terms)
- Increased productivity - in a wide range of areas; do same with less (labour, material and energy, time); leading to substantial price reductions and associated real increases in real income (purchasing power)
- Major reductions in exchange, transport and other transaction costs and waste - reduced transport, time and communication costs and constraints (and travel demand)
- Zero or very low marginal cost of increased 'supply' of many goods and services, knowledge and know-how for solving questions, problem-solving
- Increased choice and information regarding goods and services
- Optimised service delivery (e.g. transport); supply-side efficiency
- Improved health diagnostics, treatment, ill-health prevention.

There is a darker side to these gains in economic comfort that are the essence of the neoclassical economic dream. Associated changes such as greater income, diversity, less physical mobility at work and in social and recreational activities, mechanised transport, and perhaps increasing demands on time from work, distraction and passive recreation, have seen the spread of lifestyle diseases and other health problems – physical and mental. Arguably, this may reflect a kind of evolutionary mismatch between human physiology (which changes relatively slowly) and the rapid transformation of people's life-worlds, largely due to technology change operating on maximising accumulation, or at least work ethic, motives. There is growing evidence of the psychological and social and health dysfunctions and problems resulting from the dislocation of people from nature in their urban built environments (Reeve et al 2013), and changes in the deeper nature of social interactions. We return to these impacts in the social sustainability and mindset effect discussion that follows.

Environmental footprints and sustainability – productivity effects

Turning to the environmental footprint and sustainability impacts of the 4IR, there are at least two, closely related, aspects to consider – changes in: (1) natural resource demands, and (2) the spectacular increase in information, science, knowledge and education capabilities. These two aspects are also linked to the effect of the 4IR on productivity in general (as described for the economic and basic need outcomes above).

For natural resource demand change, the 4IR has the potential for both positive and adverse effects. In addition to the standard income benefits of technology-based productivity, there are a related set of very substantial environmental resource efficiencies associated with the 4IR – including input productivity and emissions or waste reduction or treatment technology improvements. They are part of general resource productivity gains and also link directly to transport and transaction cost reductions. Transaction costs are any of the costs involved in the actual act of exchange of goods and services, and typically include search and information, bargaining, and legal and contractual costs. In the powerful and pervasive digital electronic networks of the 4IR economy and society, the need to travel to have face-to-face interaction to effect economic transactions is dramatically reduced. Transport and communication costs (in monetary but, more importantly in real labour and environmental resource consumption terms) decrease dramatically.

4IR technologies will continue to enhance per unit output material and energy (and time) saving services via the transport and transaction changes above, but also through the usual technological process and product innovations in production and consumption, as well as quicker and more effective problem-solving (thus increase service-intensity of goods and services). These positive outcomes in the form of reduced demand for natural resource materials and energy *per unit of economic output value or service* are widely acknowledged across many fields of economic-environment study, and are celebrated under labels such as 'eco-efficiency', 'ecological modernisation' and restructuring, and 'decoupling' and 'dematerialisation' (see Daniels and Moore 2001). These benefits of the 4IR make it akin to a 'green' techno-economic paradigm (TEP) (Freeman 1992).

The latest two industrial revolutions have certainly helped bring about enormous growth in environmental resource productivity and, *ceteris paribus*, the potential for natural capital sustainability as one of the key dimensions guiding EE. However, eco-efficiency or productivity is only measured as environmental pressure per unit of output and, unfortunately, history shows that there tends to be a strong offsetting effect upon overall absolute levels of environmental demands due to the 'rebound effect' or 'Jevons paradox' (Sorrel and Dimitropoulos 2008). This is the ongoing increase in consumption of goods and services, and subsequent total material, energy and waste environmental flows, due to people having higher incomes from the source productivity gains. Together with population growth, the rebound effect has been largely responsible for the long-term increase in most forms of overall environmental pressures. The novel innovations and productivity growth of the 4IR will undoubtedly continue to foster a substantial rebound affect that will dampen the positive environmental effects of a shift towards services and dematerialisation (from the virtualisation of communication, recreation and many aspects of exchange and trade).

Environmental footprints and sustainability – greater information access

The 4IR is possibly the ultimate informational revolution – providing an unprecedented increase in the speed and levels of access to information and 'knowledge' for edification. It seems to be constrained in application only by the availability of scientific knowledge and limits upon human's cognitive capabilities. This development has a least two significant implications for environmental footprints. First, there is the enhanced ability to access and use information to improve eco-efficiency throughout the life cycle of goods and services via the technological 'supply-side' advances and impacts on demand (e.g. transport).

However, more uniquely, this information access can facilitate vastly-improved awareness of the full inter-connected welfare effects of production and consumption options and choices, and lead to decisions in the economy and in everyday life and lifestyles that are attuned to sustainability. At the very least the 4IR information system can potentially help bring about understanding, choices and behaviour that actually lead to the wellbeing goals of people and the community. This is a kind of super eco-labelling capacity and, with the right systems and support, the 4IR could be the basis for providing reasonably comprehensive and accurate information on the full extent of supply-chain, life cycle and other externalities and flow-on effects that will determine long-term personal and community wellbeing.

On the other hand, the ability for people to remain within selective, digital environments or virtual realities may lead to ignorance, easy denial and loss of empathy and compassion related to full environmental and other consequences of our economic and social choices and actions. This possible outcome can also be linked to possible disconnection and information overload impacts. Yet another possible development is that the 4IR's informational power may increase collective awareness and widespread moral consciousness and encourage honesty, sincerity and accountability and environmentally-responsible actions and behaviour.

The 4IR can also be seen to have substantial social sustainability effects by its effect on people's mindsets and the nature of (a) social relations, (b) the economy and (c) built and natural environments, to positively support the ability of current and future generations to create healthy and liveable communities (McKenzie 2004). This is a less obvious domain than environmental sustainability and is often overlooked but is a vital area for guiding and informing the goals and strategies of EE. Environmental sustainability alone is a necessary but insufficient basis for achieving long-term wellbeing.

Social sustainability – extreme virtual connectivity but real-world disconnection

Though there are many possible ways the 4IR that can impact on social sustainability, three aspects are examined here. They are all quite vast topics and only a precursory overview is provided as a basis for further investigation. While the 4IR is almost defined by its quest (and success, to date), in instilling pervasive digital or virtual connectivity, it can also be viewed as engendering disconnection in terms of the substantial reduction of connection for people in a direct and immersive form – where there is a real, proximate spatial setting with the full range of senses in interaction. This can apply to both context and immersion with other people, and with nature.

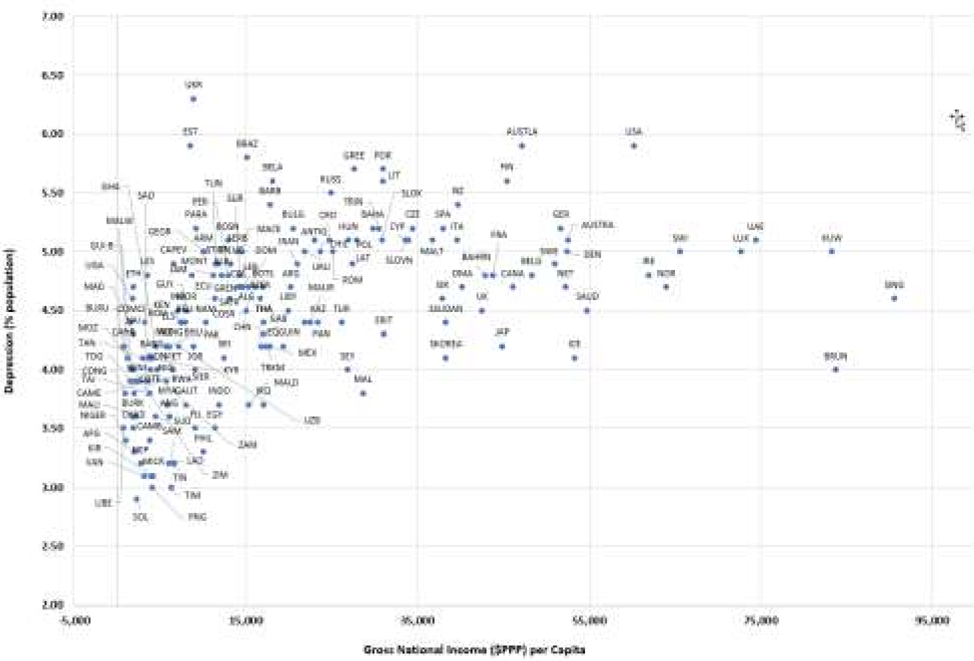
This development may have positive implications if unpleasant or uncomfortable conditions are avoided. However, it certainly represents a rapid and profound modification to the hundreds or thousands of years of humanity's natural and social environmental and evolutionary context. Several areas of contemporary research investigate the physical and mental wellbeing effects of this 'shock' to the human lifeworld (for example eco-psychology and biophilic urbanism) and there is considerable concern about the problems that may be associated with the unbalanced virtualisation of everyday life (PEW Research Centre 2018). It is an area that also fits within the coevolutionary perspectives of EE.

Many of the broader negative effects of the 4IR can be linked to the notion that it leads to social and nature-related interaction that is indirect and somewhat 'fake'. The tools people use to interact in the 4IR often involve social or virtual constructions (for example, social media) that can be image or status-based and focused upon perception building rather than reality. The complexities of these technology effects can't be explored in detail here but one important outcome can be increased connectivity (visual, word, audio), but reduced connection in a deeper sense where there is physical interaction, immersion, body language and full sense awareness, empathy and warmth – some of these factors also apply to natural environment connections. Arguably, direct physical person-person and person-nature interaction and the associated slow immersion promotes deeper bonding and 'deep brain' experiences.

Social sustainability – mental wellbeing, distributional and inequality concerns

One observation that highlights the need and value for EE and related trans-disciplinary approaches for analysing and guiding technology change is the ambivalent evidence of any clear gains in subjective wellbeing and psychological health over the past 60-70 years (see Deaton 2008 and Drabsch 2012). Technological progress over the past 250 years has certainly had many positive impacts for a substantial part of the world's population – providing economic security, improved health, pain management, deferring sickness and death, and information access, diversity of experience and rapid and efficient problem-solving. However, it is odd that all of the productivity, wealth, health, and entertainment and experiential gains do not seem to have not substantially increased people's subjective wellbeing – at least for those already beyond a certain level of income. However, there is evidence that technology-induced income and purchasing power are not improving health or wellbeing (see Figure 4.1). Indeed, depression levels appear to be lower in the lower income nations.

Figure 4.1 - Cross-Country Plot of Depression Disorders by Income Per Capita – 2016. Source: Author using data from WHO (2017).



For social sustainability, it is also important to consider that the pervasive innovations of the 4IR are creating quite dramatic economic and social structural changes that can deeply affect distributional outcomes in society. The fear of widespread unemployment resulting from automation has been around since at least the First Industrial Revolution. The 4IR is no exception with its major advances in artificial intelligence (AI), information access, and robotics that can readily replace routine through to quite complex mechanical, procedural, diagnostic and decision-making tasks – from the assembly line, to schools, universities and training institutes, to health clinics, to the legal world. It is true that the dire prediction of technology change pessimists have not come true for much of the past and this could be a misplaced fear yet again. Historically, the 'creative destruction' of automation has not typically led to endemic and troublesome levels of unemployment. Substantial and disruptive structural unemployment does occur from rapid transformation in labour demand mismatched to available skill, but the labour market, eased with appropriate policy, has tended to adjust.

However, the pace and depth of the 4IR may well lead to prolonged and substantial labour market segmentation and duality with continued polarisation into low skill, low paid temporary jobs, versus permanent high skill, demand and income positions. Indeed, Frey and Osborne (2017) found that almost 50% of employed people in the United States were in jobs that were at risk of job loss from automation in the near future. This trend is already apparent in the 'gig economy' trend as a contemporary area of concern over the growth of inequality deepening 'dual', and primary and secondary labour markets. While labour market flexibility can have many advantages, the 4IR may well accentuate growth in the 'digital economic divide' (Chandsoda and Saising 2018). Together with winner-takes-all scenarios from monopolisation of 4IR technologies, the economic distributional consequences seem likely to contribute to deepening and troubling inequality within communities, and across generations, regions, and nations. Relative inequality has grown – notably at global levels since 1980 (but at very different rates across countries) (Savoia 2017).

Deepening inequality may lead to discontent and social conflict and certainly jeopardise the EE requirements for healthy and liveable communities for current and future generations. The distributional outcomes of the 4IR will be a key issue for strategic analysis and policy for social sustainability as a critical basis of future community wellbeing. The broad welfare consequences of the 4IR will depend upon compassionate and ethical redistribution and access to essential food, housing and other services, and the perceived fairness of political economic systems. Technology change productivity gains should bring increased overall output and surplus and at least allow balanced and fair distribution; raising the economic safety net 'floor' for all and the prospects for social stability and community wellbeing. This topic has a strong potential role input from EE.

There are many other impacts of the 4IR that are relevant to perspectives and goals of EE. It is not possible to discuss these in detail but it worth briefly flagging some of these issues – both positive and negative. Again, many of them are closely related to the previous outcomes, and each other, and are linked to environmental and social sustainability (and economic productivity in some cases).

Additional 4IR impacts to consider in EE include:

1. The mental wellbeing effects of sensory and information overload leading to stress, lack of mindfulness and inner peace and content, disconnection from real human and nature contact, and possible desensitisation and loss of time, care, empathy and compassion for others.
2. Similar effects as above, plus possible productivity losses from the development of extreme levels of distraction, entertainment and social and other attention capture.
3. Hyperconnectivity that leads to poor attention capacity and mental unease.
4. The loss of past human physical and mental functional capabilities of problem-solving, transport logistics, face to face communication and other social interaction.
5. Inability to establish the truth, credibility or veracity of information within a multitude of sources (and all of the political and decision-making implications of possible misinformation on a mass scale). Alternatively the 4IR may engender governance and democratic process improvement – via greater feedback channels, coordination, and engagement.
6. Increased creativity potential.

7. Increase interaction, relationships and sense of social and community belonging in peer networks and social networking social media, blogs, fora, gaming, social network sites.

5. Concluding Thoughts - a Future Role for Ecological Economics amidst the 4IR

There are numerous effects of the 4IR with implications for achieving the vision of sustainability embraced by EE. In turn, the perspectives and trans-disciplinary approach of EE can help ameliorate and positively guide and reshape many of the uncertainties and dangers of the rapid social, psychological and economic transformations (and environmental consequences) induced or facilitated by the 4IR.

Environmental sustainability problems can arise from the growth in production and consumption that the 4IR encourages (and often the toxicity of advanced materials involved), in addition to the capability of virtualisation to easily mask the full externalities or flow-on effects of economic choices, behaviours and lifestyles. In the social realm, the 4IR brings a massive increase in the potential for digital social connectivity, but with possible social costs in terms of the transformation and perhaps loss of warm immersive relations with both people and nature. From a coevolutionary perspective, the profound change in the nature of the primary human-human and human-technology-nature relationships is also likely to involve shocks to the joint evolutionary pathways and significantly affect the wellbeing of humans, and their impact on their habitat. The augmentation but possible replacement and redundancy of numerous functions of the human brain and body will also be sure to have an impact on health aspects of social sustainability.

Many of the 4IR effects on environmental and social wellbeing will be positive – from the usual technical factor productivity gains that save materials and energy as well as labour time, through to the reduced need for physical translocation for exchange transactions, information access, aspects of production and consumption systems, social contact and logistics, and additional peer community formation, maintenance and support. This extends further through to greatly enhanced access to information for decision-making for better environmental responsible choices and eco-efficiency (including waste and consumption costs).

Hence, EE can play a role in helping to reap the benefits and reduce the social costs in support of its sustainability ethos. Two main areas of contribution from EE are briefly discussed. In relation to environmental sustainability, the ecological economic perspective can be applied to promote technology change, innovation and practice that reduces society's throughput or metabolism. A major way of motivating transitions towards 'greener' technologies within the 4IR would be to further develop and stimulate the implementation of a wide range of sustainability assessment techniques to help fully investigate and anticipate the economic, environmental and *social* consequences of technology and innovation clusters. Examples of these assessment techniques (including material flow, environmental input-output supply chain, and life cycle analysis) were introduced in Section 3 and follow the basic footprint thinking extended to all of the 'pillars' of sustainability.

To selectively encourage green technologies (perhaps within the rubric of green techno-economic paradigm), some ideal approaches would include utilising ecological economic-compatible policies that encourage: (a) full social cost pricing, (b) education related to ecological thinking and limits (especially the pre-eminence of interconnectedness) and their links to lifestyles and wellbeing, (c) the real sources of wellbeing in general, and (d) developing and disseminating systems for rapid and highly accessible information on the sustainability impacts of particular production and consumption choices. Strategic policies that support success in green and other past TEPs are considered to have the added advantage of creating virtuous circles of economic success and benefits derived from science and technological research and innovation. For example, material and energy costs savings (from both supply and demand side innovations) and first mover advantages can lead to economic competitiveness and the ability to invest in further research and development directed towards in green technology knowledge and innovation (Daniels 2011; Edomah 2016).

A second set of contributions from the EE sphere relates more directly to its social sustainability goals. These involve changes in 'mindsets' and underlying community and personal 'theories' of wellbeing and deeper ethics that tend to configure values and preferences. Hence, these changes can be seen as more fundamental in nature and would operate over and above simple economic or market incentives to effect relevant behavioural change. An important condition to facilitate such change (and also reflect the mindset change) is the further development and implementation of new society-economy progress goals and measures. This would cover the well-known GDP externality adjustment and natural capital accounting approaches such as the Genuine Progress Indicator (GPI) and Index of Sustainable Economic Welfare (ISEW), but with the integration of important subjective wellbeing measures such as those based on life satisfaction. Only then can the wellbeing consequences of profound changes in technology environments be evaluated and guided towards better futures.

To affect these deeper mindset changes, the analytic and communication power of the 4IR can provide a very powerful vehicle for change. As for environmental sustainability, the trans-disciplinary approach of EE would provide a framework for promulgating a society-wide understanding and appreciation of inter-connectedness as the basis for evaluating and guiding techno-economic change. Again, education and the promotion of appropriate research to support trans-disciplinary evaluation analysis should lead to communal awareness and persuasion that encourages consumption (and production) and leisure and lifestyle choices favouring the health and wellbeing of individuals, the community, and nature.

A primary objective of this chapter has been to highlight the manifold linkages between the 4IR and EE, and thus help suggest some foci for strategies to create sustainable and wellbeing-enhancing outcome from the powerful new technology influences upon the human-environment relation. This latter task has only be lightly touched upon here but the topics introduced represent examples of areas for potentially very fruitful research and strategic policy contributions from EE.

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Chapter 5: How Sustainable are the SDGs?

Kerryn Higgs

The United Nation's (UN) Sustainable Development Goals (SDGs) of 2015 are rightly celebrated as a major achievement: an agreement between nations on a comprehensive plan to tackle worldwide social and environmental crises. However, they rely on elements that are likely to undermine their success, and on trade-offs where some SDGs will have to be sacrificed to achieve others. Of particular concern is the injunction to foster economic growth, defined as growth in per capita gross domestic product (GDP).

The SDGs include specific goals for conservation, protection and restoration of land, sea and climate for the first time. A fourth goal (SDG12), 'sustainable consumption and production patterns', also implies environmental limits. These four goals are an advance on the 2001 Millennium Development Goals which, though they talked of 'sustainable development' in general terms, otherwise ignored the Earth system that supports all life, including human life.

Development based on growth and debt, 1980-2015

In line with decades of development theory and practice economic growth remains the centrepiece of solutions to world problems, both social and environmental (Higgs 2014, 105-162). The World Conference on Environment and Development (WCED) or Brundtland Commission (1983-87), while endorsing ongoing economic growth, also drew attention to the need for redistribution. It warned that the needs of the poor must be given 'overriding priority', that developing countries must 'reap large benefits', that the requirements of future generations must be taken into account, and that the people of the rich world, who were living beyond the 'world's ecological means', must reduce their consumption (WCED 1987). In light of these concerns, and the failure of the twentieth century's astounding economic growth[12] to make a significant difference to the people of the developing world, the Commission made a modest proposal: a *small proportion of future increases* in wealth should be redistributed.

[12] Industrial production was multiplied fifty times, 80% of that after 1950.

Soon afterwards, a new economic orthodoxy, known as neoliberalism, captured thinking across the world (Higgs 2014, Ch. 6). In the reports of the Rio Earth Summit (UNCED 1992), just five years after the WCED concluded, hardly a hint of redistribution of wealth can be found; instead, solutions to both social and environmental ills were confidently anticipated through market liberalisation, economic growth and free trade. Actual funding provisions for the Rio agenda were vague. Various avenues were to be 'explored' or 'encouraged'. The only explicit proposal asked developed countries to meet the UN aid target of 0.7% of GDP, established many decades earlier. There had been a minimal record of success at reaching this target in the past, but all participants agreed to reach it 'as soon as possible' (UNCED 1992).

After Rio, however, aid did not increase; funding did not materialise. Aid was estimated to have averaged 0.51% of GDP in the late 1960s. By 2009, the average volume of aid from North to South had declined to approximately 0.3% of northern GDP (Riddell 2009), while the flow of payments in the opposite direction has also been vast. On the basis of OECD figures, political scientist Susan George (1992: xv-xvi) calculated that a net amount of $418 billion flowed back to the North in debt service payments alone during the period from 1982 to 1990, an avalanche of payments that did little to defray the debt on which they were levied (Higgs 2014). As George (1992) pointed out, the total flow of funds to the rich world was (and remains) greater still when 'royalties, dividends, repatriated profits, underpaid raw materials and the like' are added. Financial assets in tax havens were estimated at well over $21 trillion for 2010, much of it siphoned off from corporate profits in the South (Henry 2012; Shaxson et al. 2012). Thus, aid from North to South is dwarfed by the financial flows in the opposite direction, many of them resulting from the structure of the global economy. Jason Hickel's paper (2019a) on the imperative of redistribution identifies the vast illicit financial flows involved in trade. Overall, far from facilitating appropriate development where it was needed, economic growth swelled the coffers of investors.

The International Monetary Fund's Anne Krueger encapsulated the favoured approach in 2004:

> Our job at the Fund is to support governments in their efforts to deliver the sustained and rapid growth needed to raise living standards

> and reduce poverty.... [T]he solution is more rapid growth—not a switch of emphasis towards more redistribution. Poverty reduction is best achieved through making the cake bigger, not by trying to cut it up in a different way.

'Making the cake bigger' has been the key development strategy of UN institutions for many decades.

SDGs retain growth strategy

A summary of the Sustainable Development Goals is below:

1. End Poverty;
2. End Hunger;
3. Health/Well-being;
4. Education for all;
5. End discrimination against women;
6. Water/Sanitation;
7. Energy;
8. Growth/Jobs;
9. Industry/Infrastructure;
10. Reduce Inequalities, within and between countries;
11. Cities/settlements;
12. Production & Consumption;
13. Climate Action;
14. Oceans;
15. Land;
16. Peace/Justice;
17. Partnerships.

Though far more multi-faceted and specific about environmental objectives than previous development goals, the SDGs (UNDESA 2015) rest implicitly on the 'bigger cake' strategy. They first lay out essential goals to meet basic human needs (SDGs 1, 2, 3, 4, 6). To these are added gender equality (5), meeting energy needs (7), provision of infrastructure (9), urban development (11) and reducing inequalities within and between countries (10). The SDGs then go on to address explicitly the conservation of terrestrial and marine environments and the need to halt global warming (SDGs 13, 14 and 15), as well as an aim to make production and consumption sustainable (SDG12).

Although several goals—such as gender equality, peace (16) and partnership (17) — need not demand much material extraction, there is little acknowledgement of the inherent contradictions between the many goals that require an increase in material flows, and the ecological goals that seek to prevent deterioration of the biosphere. Indeed, the underlying assumption appears to be that GDP growth is indispensable and ecological objectives may be traded off if they threaten it.

The 'planetary boundaries' researchers (Steffen et al. 2015a) have identified at least two areas where humanity has already exceeded its 'safe operating space' (biodiversity loss and biogeochemical disturbances)[13] and two others where we are very close (climate and land system change). Steffen (2019 pers. comm.) concedes that climate data more recent than that used in 2015 may require climate to be moved to the 'already unsafe' category. In addition to these four areas and others not yet considered unsafe, the team has yet to quantify boundaries for atmospheric aerosols, novel entities (chemical pollution in earlier reports) and the functional role of biosphere integrity. Ecological footprint research also confirms an overshoot situation, where the global rates of extraction and pollution already exceed the capacity of natural systems to replace resources and absorb waste (GFN 2019). The idea that economic growth can be cultivated without encroaching further on these planetary boundaries is assumed, in the SDG framework, to be feasible, though that idea has been challenged for decades by ecological economists (Daly 1990; Victor 2019).

[13] This phrase refers to the radical disruption of the nitrogen and phosphorous cycles primarily. In nature, nitrogen is largely inert in the atmosphere, though some is mobilised by bacteria and leguminous plants. As a fertiliser, nitrogen has greatly expanded food production, but is now cascading through rivers, groundwater and continental shelves, initiating algal blooms and dead zones (Rockström et al. 2009). In the case of phosphorous, the other ubiquitous fertiliser, there is an added threat—phosphate rock is a declining resource, commanding a rising price; this has grim implications for future agriculture (Cordell et al 2009), especially where populations lack adequate finance to import it.

SDG2: 'safe, nutritious and sufficient food'

Many of the SDGs that address unmet human needs call for increases in the flow of material resources. In a context of rising populations and rising affluence, SDG2 (to supply 'safe, nutritious and sufficient food' to everyone) is likely to threaten SDGs 14 and 15, which aim to restore and preserve terrestrial and marine ecosystems and SDG13 which pledges urgent action on climate change.

SDG2 speaks of 'sustainable agriculture' but does not examine the predominant practices of industrial agriculture: clearing forests, draining wetlands and peatlands, and relying on significant inputs of fertiliser, herbicides, pesticides and energy, still sourced largely from fossil fuels. The injunction at SDG2.3 to double agricultural productivity for small scale farmers means increasing output per farmer without reference to output per hectare or megalitre. Targets 2.2b and 2.2c focus on impediments to global agricultural trade and commodity markets, factors which are secondary for the small farmers who feed the world at the local level. These targets, once again, reflect corporate and growth-oriented strategies and ignore the situation of the world's smallholders, who largely work outside the global marketplace.

Rockström et al. (2017) have argued that land-use emissions must be reduced to zero by 2050, if we are to meet the Paris climate target of 'well below 2°C'. Industrial farming is a crucial pressure on all four planetary boundaries judged to be in trouble; it affects biodiversity loss, nitrogen and phosphorous pollution, land-use change, and climate. If conventional agriculture is expanded to meet SDG2, this will inevitably sacrifice terrestrial ecological integrity (Crist et al. 2017). Adoption of regenerative agriculture is essential if SDG2 is to be made compatible with SDGs 13-15.

Smallholders can assist in this process. Target 2.3 refers to ensuring secure and equal access to land, a critical element. Using systems of agro-ecology that minimise external inputs and mimic ecological processes, the world's small farmers already produce the majority of the world's food on less than a quarter of its farmland (GRAIN 2014). In a situation where land and water are the limiting factors—rather than labour—doubling productivity per person is less important than increasing productivity per unit of land and water (Higgs 2014: 146-7; UNEP 2019: 13). In fact, focussing on labour productivity may encourage consolidation of land under the control of larger farmers and agribusiness corporations, adding to the numbers of landless and the diversion of land for biofuel, animal food or luxury crops for export (Daniel and Mittal 2009). Secure access to land is indispensable, but will involve reversing the trend towards consolidation, a trend that is evident in the Green Revolution (Higgs 2014: 46-7), the quadrupling in acreage of the industrial crops (soy, canola, sugar cane and oil palm) from 1960 to 2011 (GRAIN 2014), and in 'land grabs' amounting to hundreds of millions of hectares this century (Magdoff 2013).

Peasant farmers resist the growth model, which many of them believe has been imposed on them, deepening inequality and accelerating environmental decline. The smallholders who contributed to the FAO's report for Rio+20 (Wolfenson 2013) described themselves as: 'a driving force towards socially fair and ecologically sustainable agriculture systems'. For these farmers: 'the over-arching paradigm of economic growth, considered the highway to secure development, has left the social and environmental dimensions of sustainable development behind'. Wolfenson (2013: 26) goes on to note that, alongside agro-ecology, smallholders champion:

> … food sovereignty ... a system that returns the land to its social function as the producer of food, puts the people who produce, distribute and consume food at the centre of decisions about food systems and policies, as opposed to the demands of markets and corporations.

Where land is consolidated into larger farms, and smallholders lose access to their communal land and water, they may (or may not) get employment, but wages are poor and productivity gains are not shared with them. Food, fuel and profits go to markets overseas and investors, largely foreign (Daniel and Mittal 2009). The emphasis in SDG2.2c on regulating commodity markets will be of limited relevance where small farmers primarily produce local food for local people, which is the most promising strategy if we hope to provide 'safe, nutritious and sufficient food' for all, without trading off protection of land, sea and climate.

SDG11, SDG9: urban development, infrastructure and industry

SDG11, which addresses urban development, will jeopardise SDG13 (climate) unless towns and settlements are designed and built along low-carbon lines. The word 'sustainable' appears in the SDG11 targets, stated alongside 'safe', 'affordable', 'inclusive, 'and 'accessible'. In line with its ambiguity since the Brundtland Commission, the meaning of 'sustainable' remains unclear. Current town and city development needs radical reform to become sustainable (see Lowe in this book), in particular an explicit goal of low carbon design and a rejection of urban sprawl, which also impinges on SDG15. Neither of these essentials is mentioned in the SDGs.

SDG9 sets a goal of expanding infrastructure and industry. This too will be hard to implement without jeopardising environmental goals. Historically, industrial expansion is linked to escalating energy demand and land system conversion; associated emissions have risen steadily for two centuries, accelerating since 1950 (Steffen et al. 2015b). If this trend is replicated, future emissions can be expected to keep rising (UNEP 2016c). Unless new infrastructure is designed and built along low-carbon lines, the Paris Agreement's goals will elude us. No SDG or target aims explicitly for low-carbon options, an omission that reflects the failure of the SDGs to address the fundamental challenge of providing essential socio-economic reforms without sacrificing environmental goals.

China's Belt and Road Initiative (BRI) is a current example of infrastructure and industrial development which pays little attention to carbon emissions or ecological damage (Losos et al. 2019), though it does not differ in this respect from the development advocated by the European powers for centuries. While the Chinese government promotes a domestic energy transition, China exports coal-fired technology across the BRI (Ren Peng et al. 2017). The pace of this activity has fluctuated, and has slowed since its peak in 2010 (Ibid.), but power plants have life spans of 50 years or more, and roads will carry traffic for decades, so both will affect greenhouse gas emissions for many years. According to the Global Development Policy Center (2020), 70% of BRI energy investments are fossil fuel based. Despite China's pre-eminence in solar technology, only 1.6% of BRI energy investments are solar based (Ibid). In addition to the climate implications, the BRI has impacts on land use, wildlife and habitat, and water; and will expand industrial pollution.

According to ecologist William Laurance (2017) the BRI's 'dizzying variety of resource extraction, energy, agricultural, and infrastructure projects ... are wreaking unprecedented damage to ecosystems and biodiversity' across the world.

SDG12: sustainable production and consumption

In recommending sustainable production and consumption, SDG12 emphasises efficiency, management and the reduction of waste. Such strategies are vital, but no mention is made of the role of consumerism as a driver of the economic growth that is considered to be the bedrock of our economy (see Higgs 2014, Ch. 5). The SDGs do not refer to the role of advertising in harnessing human desire to markets and inciting mass shopping and endemic waste, to keep the consumer economy functioning. Some detailed targets are laudable and essential, such as managing chemicals and their wastes (12.4), and reducing waste in general (12.5) but the over-arching target, sustainable management and efficient use of natural resources (12.2), is not defined. Similarly, the target for fossil fuel subsidies (12.c) is vague:

> Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies... to reflect their environmental impacts.

While this formulation allows room for developing countries to adjust according to their own circumstances, it lacks any categorical rejection of such subsidies in the developed world.

SDG8: 'sustainable economic growth'?

The most problematic of the goals is SDG8 which calls for 'sustained, inclusive and sustainable economic growth' (purportedly generating jobs for all). Apart from the title line, the word sustainable is not included in the targets and indicators; economic growth is the only item that is slated to be sustained here, while the ecological basis of economies, usually regarded as intrinsic to the concept of sustainability (Daly 1990), is absent. 'Sustainable growth' is not defined and has, in any case, been recognised as an oxymoron (Daly

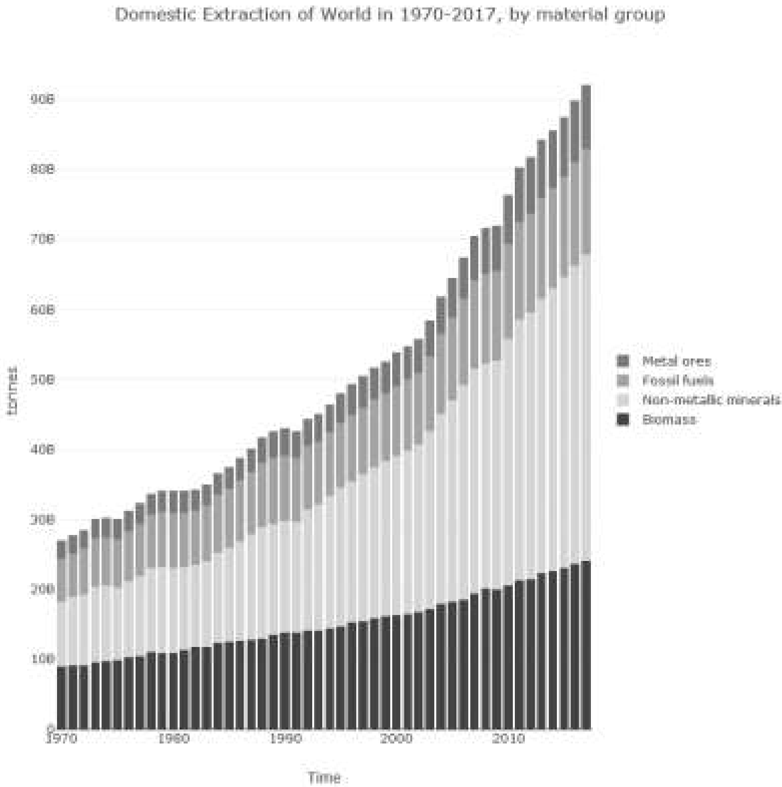
1990). The connection between economic growth and job-creation is also simply assumed, despite the fact that the track record of market-oriented, capital intensive expansion is not encouraging (Hirway and Shah 2011). Where the object is profit-generation under the market model, cost reduction is a routine strategy and leads to mechanisation and job-shedding. Community-based models such as Ashok Khosla's (2015) social enterprise, Development Alternatives, operating in central India, provide a realistic model of business creating jobs and manufacturing items needed by local people. However, this is not the kind of development envisaged in SDG8.

Target 8.1 requires sustained per capita GDP growth, including at least 7% per annum for the least developed countries. Material extraction is essential in less developed contexts in order to provide sanitation, water, and services in general, and this will involve some degree of GDP growth, but, as Khosla's enterprise shows, the emphasis can be on meeting urgent needs rather than simply boosting GDP.

Moreover, SDG8 demands ongoing economic growth throughout the world. This is hardly surprising, given that economic growth has been advanced as the panacea for all problems for well over 50 years and continues to be prominent on the lips of politicians, business people and most of the global institutions involved in sustainability policy (Higgs 2014: Part II).[14] GDP growth requires extraction and waste-disposal and has been associated over the past century with carbon emissions, depletion of resources and ongoing transformation of land systems and marine environments (Steffen et al. 2015a). Although claims are made that growth can be decoupled from these negative consequences (OECD 2011; World Bank 2012; Hatfield-Dodds et al. 2015; UNEP 2016a; UNEP 2019), hard evidence of absolute decoupling is scarce (see also Introduction in this book). Instead, the empirical evidence shows both an ever-increasing rate of extraction (Figure 5.1) and a tight association between GDP and material footprint (Figure 5.2).

[14] GDP measures the flow of monetary exchanges in the market economy and while GDP growth includes genuine positives it also encompasses social ills such as arms sales, and it places negatives such as the business of cleaning up pollution, in the positive column.

Figure 5.1: Material Extraction, 1970-2017. Prepared by Rhianna Topschij. Data from MaterialFlows.net. The material flow analysis portal, http://www.materialflows.net/visualisation-centre/data-visualisations/



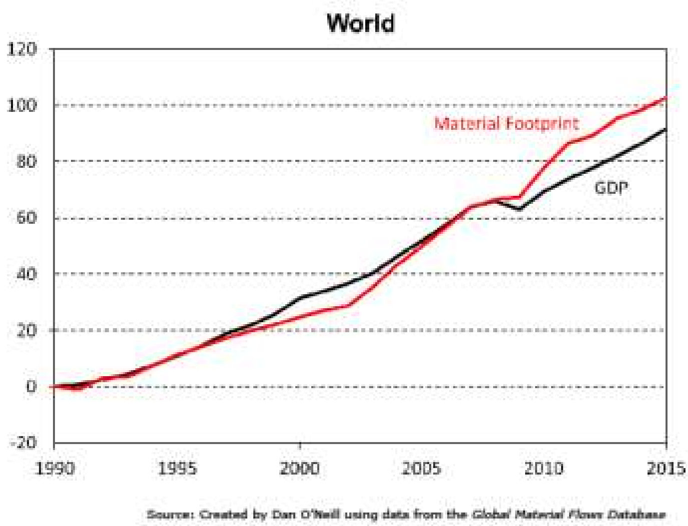
Sources agree fairly closely on the current extent of material extraction, estimated at 87-88 billion tonnes a year in 2015, having tripled over the previous 50 years, and still growing (UNEP 2019). In line with others who quantify material extraction, UNEP (2019) includes in its calculations metals, non-metallic minerals (such as sand), fossil fuels, biomass, water and land conversion.[15] Estimates of an approximate target for sustainable resource extraction cluster around 50 billion tonnes a year (UNEP 2014; Hoekstra and Wiedmann 2014; Bringezu 2015; Hickel 2019a). Even if this figure is

[15] Cooper at al. (2018), in addressing the extent of humans' sediment production in the mineral and construction industries, include all forms of material shifted from its original location (such as overburden, waste rock etc.) and arrive at a figure of around 316 billion tons in 2015, much greater than UNEP (2019).

regarded as reasonable, we are already more than 50% over the target and still moving in the wrong direction.

It is also widely accepted that the continuation of historical trends and relationships, which depend on 'a permanent throughput of materials that are extracted, traded and processed into goods and finally disposed of as waste or emissions' will, by 2060, inflate gross annual resource use drastically (UNEP 2019). In addition, such throughput will increase greenhouse gas emissions by 43%, reduce forests by more than 20% and other habitats (mainly grassland and savannahs) by a similar amount (Ibid). These figures will rise if population growth exceeds the UN's medium projection (O'Neill et al. 2018).

Figure 5.2: Material footprint and GDP, 1990-2015. Source: Dan O'Neill, data from Material Flows database. See: https://www.resourcepanel.org/global-material-flows-database.



UNEP (2016a, 2016b, 2019) is adamant that the decoupling of material extraction from environmental impact; 'will be essential for ensuring future human well-being based on much lower material throughput' (UNEP 2016a). It argues that this can be achieved through resource efficiency, technological advances and circular production with maximum reuse and recycling. By these means, it predicts, the volume of material extraction can be reduced. There is no evidence that such useful (but inadequate) measures will exert sufficient downward pressure on the ever-increasing level of extraction. Instead, over the past decade or so, while UNEP (2011, 2014, 2016a, 2016b, 2019) has backed decoupling, arguing both that it is essential and that it can be done,[16] the trends in the real world run the other way - ever-increasing material flows, more extraction, more consumption and more waste. UNEP (2019: 27) is fully aware that continuation of business-as-usual will make even relative decoupling impossible and argues for worldwide implementation of a 'Towards Sustainability' pathway, which will require: 'an urgent and systemic transformation of how we use and manage natural resources' (UNEP 2019: 19). While the policies outlined here (ibid: 31) are positive, it is unclear how they will be adopted under prevailing political and economic conditions where 'the market' is expected to govern choices. If decisions rely on short term profit and avoidance of government involvement, such policies are highly unlikely to receive widespread adoption.

While the recommended strategies of efficiencies, circular production and technological advance may mitigate the problems, genuine permanent decoupling is improbable (Higgs 2019) or perhaps impossible (Victor and Jackson 2015; Alexander and Rutherford 2019). Permanent decoupling requires ongoing reductions in impacts alongside increases in material flows. Nothing of this kind, especially on a global scale, has yet been observed. The pursuit of decoupling may be a fool's errand in any case. Lenzen et al. (2016) note that: 'it is illogical to expect technological progress to stretch to unprecedented limits in order to let populations enjoy unchecked growth in numbers and affluence'. The assumption that technology can enable growth in extraction and pollution rests on faith in decoupling.

[16] While maintaining optimism about decoupling, UNEP (2016a; 2019) concedes that efficiencies could cause a rebound effect and trigger accelerated economic growth, thus negating efforts to reduce gross material demand. It suggests that tax measures could counteract this trend (2019).

According to UNEP (2016a) we now use more materials per unit of GDP than in 2000,[17] And, in the latest assessment of progress made towards realising SDG12, the UN (2019) reports that material consumption has continued to increase—from 87-88 billion tonnes in 2015 to 92.1 billion in 2019. It notes that 'worldwide material consumption has expanded rapidly, as has material footprint per capita, seriously jeopardizing the achievement' of SDG12. It warns that: 'urgent action is needed to ensure that current material needs do not lead to the over-extraction of resources or to the degradation of environmental resources'. Unless effective action is taken, we will be extracting 190 billion tonnes of materials by 2060, almost four times the amount that numerous researchers consider sustainable (see above). As in 2015, the UN (2019) advances the same solutions: 'improve resource efficiency, reduce waste, and mainstream sustainability practices across all sectors of the economy'.

Problems of population and affluence

Population gets no explicit attention in the SDGs. The endorsement of 'universal reproductive health and rights' (SDG3) indicates that all women should be assigned the right to control over their own bodies. But, while the issue of the rights of women is also reflected in SDG4 and SDG5 (education and ending all forms of discrimination against women), population is not addressed. This omission is likely to have resulted from the UN requirement for all countries to endorse the proposed text; as the history of population control shows, powerful forces deeply opposed to any form of family planning have been dominant in international negotiations since 1980 or before.

In the early post-war decades, population control was a preferred emphasis of the wealthy consumer economies in dealing with hunger and poverty, diverting attention away from our own conspicuous and unsustainable consumption. However, emphasis shifted away from population in the 1970s, when US Evangelicals joined forces with Catholics and conservative Islam (Saudi Arabia) and imposed a natalist ideology. At the 1984 UN conference on population, the US withdrew funding, declaring a new focus on 'family

[17] See Ward et al. (2016) on the underlying physical realities that govern non-substitutable resources such as land, water, raw materials and energy; also Hickel and Kallis (2019) on levels of material extraction compatible with Earth's ecological integrity.

values' and claiming that free market economies are the 'natural' way to slow population growth (Higgs 2014: 36-38).

The rate of population growth has been slowing since the 1960s, a process theorised as 'the demographic transition', where high birth and death rates are said to be gradually replaced by low birth and death rates, as countries industrialise and grow wealthy. However, this change applies to a relatively limited sector of these populations—the wealth created during 70 years of economic growth has not been well distributed and vast numbers of people remain trapped in poverty with little prospect of any transition. This outcome suggests that direct action such as explicit provision of family planning may be needed to reduce population growth, rather than entrusting the task to the automatic operation of the 'free market'. Natalist interests may block such a move, however. Even though the *rate* of population growth has slowed markedly since the1960s, the huge base created then still generates much the same increment as was seen at that time, so we still have more than 80 million extra people to feed and shelter every year (UN Population Division 2019).

The socio-economic SDGs are concerned with development in the global South, where population increase remains at its most rapid. It is vital to remember that, on average, people in the developing world consume relatively little in per capita terms and it is population growth in wealthy countries such as Australia that contributes most to impacts on land, oceans and climate. This is partly due to the high consumption levels of the rich world which 'contribute disproportionately to exhausting and polluting the planet' (Coole 2019: 257; Wiedmann et al. 2020); and partly to the increasing role played by trade, as developed countries reduce their environmental impact by exporting it to the South. In some countries, such as Malaysia, Madagascar, Honduras and Papua New Guinea, 50-60% of species loss is directly attributable to activities conducted on behalf of the North, for example clearing for crops such as coffee, sisal, cocoa and palm oil, or for timber. Average species decline attributable to such activities in the developing world was found to be 30% (Lenzen et al. 2012; Wiedmann et al. 2015).

The trend towards increasing affluence in the emerging middle classes of the South involves the adoption of western dietary habits such as meat-eating and western travel habits such as personal cars. The idea that everyone can replicate these wasteful practices ignores the levels of extraction and pollution that are inevitably attached. Swelling numbers with such expectations will limit the ability of nations to meet the crucial social goals of the SDGs as well as further undermine the environmental SDGs. Population determines the scale of services that will be required and the scale of the economy that will be required to provide them.

The problems of affluence are also neglected by the SDGs, despite the fact that the affluence enjoyed in the rich world and by growing élite minorities in the South, is a key driver of unsustainable material flows. Back in 1991, Paul Ekins noted that 'universal opulence' was simply not an option. He calculated that to supply even 20% of Northern affluence across all people in the South would necessitate a total and immediate freeze on Northern consumption. Using oil and paper as examples, Higgs (2014: 103) analysed the immense increase in material production that would be needed to allow China alone to adopt US or even European consumption patterns. Rising inequality has multiplied the challenge posed by Ekins (1991). Apart from China, developing countries showed greater internal inequality than Europe, Russia, or North America. Oxfam (2018) estimated that 82% of all wealth created globally in 2017 flowed to the top 1%, with no increase whatsoever for the bottom 50%, most of whom live in the South.[18] Notwithstanding many decades of extraordinary growth, prosperity is still concentrated among a privileged minority (Higgs 2014: 105–162). Clearly, radical steps would be needed to change this situation.

UNEP (2016a: 29-30) confirms that 'the level of well-being achieved in wealthy industrial countries cannot be generalized globally based on the same system of production and consumption'—without further jeopardising environmental thresholds that are already under pressure. Here, UNEP concedes that a different system of production and consumption will be necessary if well-being is to be available to all. But the existing world economic system is entrenched and there seems little prospect of replacing it. Indeed, the injunction to pursue economic growth, a mainstay of the accepted solutions put forward for decades, is a key plank in the existing system which requires ongoing profit. A few transnational corporations (TNCs) own and

[18] See also Chancel and Piketty 2017.

control a majority of the entire global productive apparatus[19] and depend on growth of both production and consumption for their continued success at generating this profit.

Control of global wealth is even more concentrated than ownership. Vitali et al. (2011) studied the connections between 43,000 TNCs using topological analysis. This network study revealed that 747 of these corporations controlled 80% of all TNCs worldwide, and that a core 'super-entity' of just 147 tightly interlocking TNCs controlled 40% of all global revenue. The majority of the dominant corporations are financial institutions and this concentrated ownership and control of the world's financial and productive apparatus constitutes a major obstacle to reform. The controlling corporations have no incentive to change since the pursuit of ongoing growth allows them to continue to hold out the promise (however illusory) of future prosperity for all, supposedly including the world's poor.

Conclusion

The SDGs, while including indispensable environmental goals for the first time, skate over crucial contradictions between these and genuine solutions to the unaddressed deficits still experienced by billions of people in the developing world. The 'growth solution' remains at the heart of the 2015 goals, ignoring the extraction and pollution effects inevitably attached to it. Just as in the early post-war years, the rich world continues to avoid the claims of redistributive justice.

To resolve the internal contradictions of the SDGs will require difficult and strategic choices—especially in agriculture, urban development, infrastructure and industry; these are discussed above. It will also demand significant reform, if not transformation, of the economic system. Whether decoupling is feasible or not, we urgently need to abandon all growth that involves

[19] The WCED (1987) noted that 80 to 90% of the trade in each of the world's key commodities—tea, coffee, cocoa, cotton, timber, tobacco, jute, copper, iron ore, and bauxite—was controlled by fewer than six transnationals. TNCs also own and control much of the world's mining, energy, transport and manufacturing. They are multifaceted organisations able to contract out elements of their production chains in different countries to take advantage of low wages, permissive regulation, or low taxes.

increasing material flows, unless it meets actual human needs. We may wish to abandon all economic growth everywhere, but we cannot abandon significant increases in material flows throughout the developing world. We need to accommodate this by cutting growth in the rich world. No solution will emerge without at least minimal redistribution.

Randers et al. (2018: 15-35) modelled four possible pathways to achieve the aim of ‘inclusive and prosperous world development within a stable and resilient earth system’. They believe (Ibid: 30) that there is growing acceptance among governments that maximising GDP as a top priority is not the best path to sustainable human well-being, and that: ‘a conventional market-based growth approach has weak incentives to achieve SDGs and none at all for protecting the commons, social welfare, or any other non-economic values’. Of their four scenarios, 'transformational change’ is the only model that delivers on the objective. This model includes five major strands (Ibid):

- Accelerated renewables;
- Genuinely sustainable food production;
- New development approaches;
- Investment in education for all, gender equality, health and family planning;
- Serious reductions in inequality.

On this last question Randers et al. (2018: 33) propose that ‘the 10% richest take no more than 40% of income,’ an aim to be achieved via progressive taxation of income and wealth, a shorter working year, and similar measures—they argue that this would also help to fund necessary social investments. As noted above, the SDGs do not give thorough and explicit endorsement to such measures: family planning is not mentioned; food and development goals conform to ‘free market’ solutions rather than sustainable ones; and although reductions in inequality get a mention, there is no hint at how this is to be achieved.[20] In addition, it remains to be seen whether even these relatively moderate proposals could gain acceptance in the world’s current political and economic framework.

[20] Maxton and Randers (2016: 108-174) propose thirteen similar measures that they believe to be politically feasible in the rich world.

Clearly, material growth will be essential for the South, but to meet that need, the consumption patterns of the North must contract. It will not suffice to set the market free to do its work. Design and planning must be promoted—and this will require a retreat from the prescriptions of the neoliberal economics that has dominated economic thinking for nearly 50 years.

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Chapter 6: Degrowth Toward a Steady State Economy: Unifying Non-Growth Movements for Political Impact

Brian Czech and Riccardo Mastini

Limits to Growth and the environmental movement

No later than the 1960s, scholars wrote in rigorous terms of the limits to economic growth. Europeans such as E.F. Schumacher, Americans including Herman Daly, and European-born Americans (most notably Nicholas Georgescu-Roegen and Kenneth Boulding) set the stage for later studies in ecological economics and sustainability science. Their scholarship, supplemented by the population focus of Paul Ehrlich and the modeling approach of Donella Meadows and coauthors (for the Club of Rome), resonated with ecologists and opened the eyes of millions of concerned citizens worldwide.

The 'limits to growth movement' was allied in effect with the environmental movement of the 1960s and early 1970s. As indicated by the events of the first Earth Day in 1970, the environmental movement had a global aspect and was a major political phenomenon in many countries. It too had its progenitors. In the USA Rachel Carson, Barry Commoner, and David Brower were in the vanguard, and limits to growth were in their academic DNA. They were essentially 'economists of nature' who were steeped in the concept of carrying capacity.

The cumulative movement—limits to growth and environmental protection—was characterized by a rapidly mounting concern over destructive economic activity. The critique of growth was therefore accompanied by skepticism about the behavior of corporations. In Europe, especially, the sustainability of capitalism itself was called into question, with or without Marxist leanings.

Although the critique of growth was focused on and in capitalist countries, astute observers noted an obsession with economic growth in socialist and communist countries as well. At the time, the most profound example was the Soviet Union. The Cold War, after all, was waged in terms of GDP, as described in meticulous detail by Robert Collins in *More: The Politics of Economic Growth in Postwar America*.

While the cumulative movement had some tangible successes, these were primarily of a regulatory nature for specific environmental protections, including clean air policies and the establishment of national parks in the UK and France. Meanwhile in the USA, the Clean Air Act and the Clean Water Act were passed, and the Environmental Protection Agency was established to give the legislation teeth. The National Environmental Policy Act also helped to prevent the 'sneaking' of environmentally devastating projects into the federal budget without copious public review and discussion.

Little, on the other hand, was done to actually check the rates of economic growth in Europe or the USA. In fact, virtually nothing was done explicitly to that effect, and hardly anyone aside from Herman Daly even called for it in policy terms.

Perhaps the closest thing to macroeconomic reform was the Endangered Species Act of 1973. In the preamble, the 93rd American Congress found and declared that 'species have been rendered extinct as a consequence of economic growth and development…' and went on to provide strict protections for threatened and endangered species. In essence, the Endangered Species Act was an implicit (and unintended, for most legislators) prescription for a steady state economy, albeit a steady state with a long list of species dangling from one last twig on the tree of life (see Czech and Krausman 2001).

The alternatives to growth were always obvious, starting with the opposite of growth; that is, recession, shrinkage, or 'degrowth'. In between the two opposites was stability, equilibrium, or what Daly called the 'steady state economy'.

Daly vs. Georgescu-Roegen: Less a debate than a different frame of time

When Daly started advancing the steady state economy as the sustainable alternative to growth, Georgescu-Roegen protested, as he had described in magnificent detail the unrelenting forces of entropy, which eventually brings down any economy on Earth as the sun runs out of hydrogen. But Daly acknowledged as much. Indeed Daly's steady-state economics was born out of insights derived largely *from* Georgescu-Roegen, who was Daly's Ph.D. advisor at Vanderbilt.

The contrast between Daly's steady-state emphasis and Georgescu-Roegen's entropy focus was hardly a political debate with policy implications. Instead it was theoretical and philosophical, applying primarily to the longest of long terms, not policy-relevant planning terms. Daly's favorite metaphor of a long-term economy was a candle. The candle must first be lit, then will burn, and eventually must die out. The candle's 'production' can approximate a steady state for all but the lighting and the dying.

Unfortunately, however, the global economy was starting to look like a Roman candle with a suddenly vulnerable wick. Non-renewable resources—or 'natural capital' stocks—were being liquidated, and the economy would have to recede to a level sustainable with renewable resources. This was a matter of common sense, yet the laws of thermodynamics were required to refute the notions of neoclassical economists who believed in perpetual substitutability of resources in an ever-growing economy.

There was a sort of middle ground: Within limits, additional mastery over the use of renewables could take up some of the slack as non-renewables were liquidated. Also during this adjustment phase, recycling of non-renewables would still be economic. An emphasis on efficiency has found renewed vigor with visions of a 'circular economy'.

A sustainability slogan for the 21st Century: Clear, accurate, and policy-relevant

Our focus for the current purposes, however, should be less on the technics of growth, degrowth, or the steady state economy, and more on the political common ground of degrowth and steady-state movements. The predominantly European 'degrowthers' and the predominantly American (and Australian) 'steady staters' would *all* have more cachet, influence, and success if they were united in their efforts to topple economic growth from the pedestal of politics and policy.

Our unified slogan ought not be simply 'steady state economy' or 'degrowth', but rather 'Degrowth Toward a Steady State Economy'. The slogan is perfectly clear, charts a path, and readily rolls off the tongue. It passes the test for effective slogans.

The vast majority of tips on communications, rhetoric, and marketing come from the context of business. While we can't reduce social movements and statesmanship to salesmanship, the basics of effective slogans would seem to apply in all scenarios. Consider for example the '5 Tips for Writing an Effective Slogan' described by Dan Smith of *Business Insider*.

Smith's tips 1 and 2 overlap substantially. Tip 1 is, *'Highlight a key benefit. The point of a slogan is to differentiate your product or brand from that of your competitors, while also underscoring the company's general mission'*. Tip 2 is, *'Explain the company's commitment... differentiate the company from other competitors'*.

How could we possibly explain our commitment more clearly with a handful of words? 'Degrowth Toward a Steady State Economy'. This is our vision of sustainability, including environmental protection, economic sustainability, and peace among nations. As for differentiation, in calling for a clear alternative to growth, how could we be more differentiated from Wall Street, the World Bank, and most governments of the world, each of whom are competitors for the macroeconomic vision of the 21st century?

Tip 3. *'Keep it short. Slogans should never be longer than a sentence and ideally should hit the sweet spot between six to eight words'*.

'Degrowth Toward a Steady State Economy' weighs in at precisely six words comprising eleven syllables.

Tip 4. *'Give them a rhythm, rhyme, and ring. A slogan longer than a single word should fulfill at least two of these three criteria'*.

Well, there's only so much you can do with a topic as heavy and demanding as limits to growth. We're not selling paper towels here (the example provided at Smith's article). Given the scope of the topic, it's a relief that 'Degrowth Toward a Steady State Economy' contains no problematic phonetics and causes no tongue-twisting. Also, in the context of discussions, articles, or media coverage, after the slogan has been introduced it can be referred to with the shorthand, ‘degrowth toward a steady state’, which rolls off the tongue more readily yet. For those so inclined, even rhyming is not out of the question. It isn’t difficult to imagine the late Kenneth Boulding quipping, ‘Degrowth toward a steady state—do it ‘fore it’s way too late’.

Tip 5. *‘Stay honest. When writing a slogan, it’s extremely easy to get carried away; however, it’s imperative that the slogan accurately reflects the business. In other words, hyperbole is extremely discouraged’.*

How could we be more honest about what ‘business’ we’re in? We’re offering the sustainable alternative to growth, not some dishonest oxymoron such as ‘green growth’ or ‘sustainable growth’. Nor are we exaggerating with, for example, ‘degrowth toward Heaven on Earth’, or ‘degrowth for infinite ecstasy’. We are advocating, quite clearly, for degrowth toward a steady state economy. Why not call it *precisely* that?

Disharmony between North American and European sustainability advocates?

One wonders why ‘Degrowth Toward a Steady State Economy’ hasn’t proliferated already among degrowthers and steady staters. Certainly the connection got off to a promising start in 2002. That’s when Herman Daly and Serge Latouche were honored side by side in Rimini, Italy, each with a Medal of the Italian Government for their groundbreaking work in steady-state and degrowth economics, respectively.

At CASSE, we use ‘degrowth toward a steady state economy’ a lot, especially in speeches and social media, helping to empower the degrowth movement along with steady-state economics. The slogan works perfectly fine in academic articles as well (see for example O’Neill 2012, Sapinski 2015). In 2018 the nascent DegrowUS adopted the mission statement, ‘Our mission is a democratic and just transition to a smaller, steady state economy in harmony with nature, family, and community’. Yet the phrase ‘steady state economy’ seems glaring in its absence from the European scene today, even in English-speaking venues. We can think of several potential reasons, and heretofore we hypothesize briefly about two.

Might it be, ironically, that Americans from broader sustainability circles are largely responsible? Many elder Americans, especially, still have Cold War sensitivities, whereby the phrase ‘steady state economy’ evokes thoughts of the Soviet Gosplan, the central economic planning apparatus of the Soviet era. Such sensitivities may be largely subconscious, as several generations of Americans were essentially ‘programmed’ into fear or loathing of the Soviet Union and, by association, central planning of economic activity. Self-aware scholars and sustainability leaders, while themselves long past the Cold War, may strongly suspect—perhaps correctly—that much of the American philanthropy community (which tends to be elderly by its nature) would not cotton the phrase.

Avoidance of the phrase ‘steady state economy’ for fear of being politically marginalized (and losing out on grant money in academia and the non-profit sector) is understandable, but it hasn’t been helpful for advancing the steady state economy, much less degrowth, in politics and policy. If only American leaders in environmental protection, economic sustainability, and international diplomacy had spent some time sharpening their steady-state rhetoric over the past five decades, ‘steady state economy’ would be far closer to vernacular. Only when explicit discussion of the steady state economy is in the vernacular can we expect American policy reforms conducive to degrowth toward a steady state economy.

The second hypothesis pertains to a small but vocal group of Marxists from several continents who have stubbed a collective toe on the work of Herman Daly. Daly has acknowledged the relative efficiency of markets for allocating a very specific and limited set of goods; namely ‘rival and excludable goods’ (basically the small stuff such as boots and tin cans), and definitely *not* public goods and services (the big stuff such as environmental protection and national defense). Daly has also proposed solutions that entail tightly regulated market mechanisms, such as cap-and-trade systems conducive to sustainable scale, just distribution, *and* efficient allocation. Furthermore, Daly and generations of students, including textbook co-author Josh Farley, have recognized in detail the types and sources of market failure, even among the widget sectors (see for example Daly and Farley 2010).

Despite Daly's careful, nuanced, and discerning assessment of markets and market-like mechanisms, the handful of vocal reactionaries seem to view him as an apologist for laissez-faire capitalism! This incredibly ironic misinterpretation of Daly's life and work has furthermore led additional folks to overlook, ignore, or even object to *steady-state economics itself*, the highlight of which is, of course, the steady state economy as macroeconomic goal. Steady-state economics might be the biggest baby to ever be tossed with any bathwaters.

To the extent that sustainability advocates are misled into thinking of Daly—and even all of steady-state economics—as a capitalist enemy instead of a perfectly natural ally, it cripples the collective non-growth movement.

Coming full circle

Whenever a question arises about the macroeconomics of sustainability, it behooves us to consider the three basic alternatives: growth, degrowth, and the steady state economy. Neither growth nor degrowth are sustainable in the long run. This is most obvious in the case of degrowth. Meanwhile, the full body of work by Herman Daly, CASSE, and our many friends and colleagues in ecological economics (not always well-represented in *Ecological Economics*) makes it obvious enough regarding growth as well. This leaves the steady state economy as the sustainable alternative.

But what if—as indeed is clearly the case—the present economy has already grown too large for sustainability, much less optimality? (Think especially of American, European, and global economies). Well, that brings us full circle:

No later than the 1960s, scholars wrote in rigorous terms of the limits to economic growth. Europeans such as E.F. Schumacher, Americans including Herman Daly, and European-born Americans (most notably Nicholas Georgescu-Roegen and Kenneth Boulding) set the stage…

(Note that this chapter was originally published in the *Steady State Herald* in 2020, see: https://steadystate.org/degrowth-toward-a-steady-state-economy-unifying-non-growth-movements-for-political-impact/. We extend our thanks to Brian Czech and CASSE International for permission to reproduce this paper as a chapter here).

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Chapter 7: MMT, post-growth economics, and avoiding collapse

Stephen Williams and Samuel Alexander

Introduction

The ever-expanding global economy has crossed safe planetary boundaries and is in dangerous ecological overshoot, creating fragile conditions that raise the prospect of civilisational collapse this century (Turner 2019; Ripple et al 2017, 2020). In recent decades robust and diverse 'post-growth' literatures have emerged which have recognised the existential threat posed by limitless growth on a finite planet (Daly 1997, 2014; Meadows et al 2004; Lawn 2016; Kallis 2017). At its broadest, this heterodox group of economic thinkers call for planned contraction or 'degrowth' of the energy and resource demands of overdeveloped economies, with the aim of creating 'steady state' or 'zero-growth' economies that operate within the sustainable carrying capacity of the planet. With humanity as a whole already in ecological overshoot by about 75 per cent, with no sign of a voluntary plateau on the horizon, the case for rapid but controlled degrowth in many countries seems obvious if incalculable human suffering is to be avoided – not to mention the ongoing suffering and destruction of other species and ecosystems (Steffen et al 2015; Ripple et al 2017). Nevertheless, in societies that celebrate increases in gross domestic product (GDP) as the primary indicator of economic and social progress, it is clear that any transition 'beyond growth' would involve profound economic, cultural, and political transformations.

Even as the evidential case for a post-growth economy continues to strengthen, the profound but necessary changes needed to create such an economy have been, and will continue to be, resisted. As a species, we may have evolved over millennia in cooperative and supportive groups, but that does not guarantee the necessary critical thinking skills for long-term projections and accurate risk analysis. Instead, we seem to be hampered by our less noble character traits: greed, ignorance, denialism, wilful blindness, and no doubt other human frailties that frustrate calls for change. Some would even argue that the capitalist economic system itself has various 'growth imperatives' built into its structure (e.g. Binswanger 2009), which may or may not be true depending on the version of capitalism being discussed (Lawn 2011; Blauworf 2012).

However, another major reason preventing post-growth economic policies from being embraced is the dominant macroeconomic paradigm that informs policy choices. Since at least the 1970s, the dominant paradigm has been neoclassical economics, which replaced Keynesianism. This is the macroeconomics still taught in most universities, with Gregory Mankiw's *Macroeconomics* (2018) textbook being the exemplar. In this chapter we outline a fast-emerging alternative macroeconomics called Modern Monetary Theory (MMT) that we believe is superior and will come to replace the current theory. Prominent advocates offer a preliminary definition in the following terms:

> MMT provides an analysis of fiscal and monetary policy applicable to national governments with sovereign, non-convertible currencies. It concludes that the sovereign currency issuer: i) does not face a 'budget constraint' (as conventionally defined); ii) cannot 'run out of money'; iii) meets its obligations by paying in its own currency; iv) can set the interest rate on any obligations it issues (Nersisyan and Wray, 2019).

Given that MMT attempts to describe how monetary systems work, rather than being a policy platform, it is neither inherently pro-growth nor post-growth, as they are policy positions for individual nations depending on their ideology and the size of their economies. However, we argue that MMT is the most accurate description available of the interplay of macroeconomic forces, and it should therefore be used in the formulation of policies, rather than the conventional, but flawed, neoclassical model. The global crisis initiated by the COVID-19 pandemic has brought the currency-issuing capacity of governments into sharp focus, accelerating interest in MMT (e.g. Kohler 2020; Von Drehle 2020).

We contend that when MMT is understood, post-growth policy options expand dramatically and become more viable, while the dominant neoclassical model is seen to be a kind of ideological straitjacket. Accordingly, MMT should be of interest to everyone concerned with sustainability – including degrowth and steady-state economists – who have, as a group, mostly neglected MMT (but see Lawn 2017). While we may raise as many questions as we answer, we hope this brief overview provokes a broader discussion about MMT and the policies it can engender.

What is macroeconomics?

Macroeconomics is the study of the cause-and-effect relationships between aggregate economic data relating to inflation, the labour market, wages, output, productivity, income, savings, taxation, debt, and so on. Ideally, it should also explain the nature of money, the role of treasuries and central banks, and the limits to government spending. If accurate, it should produce models that are highly predictive. It should not be a set of policies or an ideology, but should facilitate accurate predictions about likely outcomes if certain policies are adopted – for example, the likely inflation rate if the government tried to reduce unemployment. In the real world there is likely to be some overlap between pure macroeconomic theory, on the one hand, and policy positions, on the other, such as we see between neoclassical economics and neoliberal policies (Quiggin 2012, p. 3).

If macroeconomics is an attempt to correctly describe the interplay of various economic aggregates, then we must search for the most accurate theory, regardless of whether we aspire to growth or non-growth. At the same time, we acknowledge that no theory can claim to be entirely value-free if it has political, economic, or social implications (Washington 2018). Contrary to some post-growth advocates, however, we cannot simply choose between competing macroeconomic theories based on a supposition that one will more likely produce post-growth outcomes rather than another (Svartzman et al 2019). Instead, we must choose the theory that most closely represents how economies actually function, mostly by empirical analysis (factual information) and buttressed by its predictive record. Growth, steady state, or degrowth then come through policy choices, political ideology, and biophysical limits, informed by the best macroeconomic theory.

In practice, overturning failing paradigms turns out to be extremely difficult, not least because of the resistance exerted by those who benefit from maintaining the status quo (Cahill 2011). Even so, there are strong indications that neoclassical economics is increasingly on life support, demonstrated, before the pandemic of 2020, by central bankers increasingly calling on governments to use fiscal policy to achieve economic targets; and government intervention as the pandemic spread.[21]

We argue that the rising star of macroeconomics – MMT – is profoundly different to the failing orthodoxy (see Appendix 1 for a comparison table). In particular, it recognises national governments' massive power to shape and control their economies: either to expand them, maintain them in a steady state, or shrink them. In so doing, such a government can also better control such things as wealth distribution and environmental management. No longer would there be a need for 'money-starved' national governments to continually pacify multinational corporations, financial markets, or credit-ratings agencies, as if the governments were beholden to them. They are not beholden, because the currency-issuing government does not need their money for revenue. Fears of all-powerful economic actors who might, for instance, withdraw financial capital from a territory, are shown to be largely the invention of those who benefited from the fear. We will not argue that a more accurate macroeconomics like MMT is a sufficient condition for a post-growth or sustainable economy, since those outcomes would arise from policy choices, not MMT itself. But, as we will seek to show, MMT enables those policy choices in a way that mainstream macroeconomics does not.

Mainstream growth assumptions are predicated on the belief that we would inevitably be faced with decreased wellbeing, mass unemployment and even a severe depression if we invite permanent recessions by not continuing with exponential expansion (Jackson 2009, p. 49). This would appear to invite a difficult choice between two evils – either business as usual leading to socio-ecological collapse, or unplanned and chaotic economic contraction with the well-known range of problems that emerge when growth-dependent economies involuntarily enter a contraction. Among mainstream economists, the dominant response to this tension is to claim that there is an elegant solution: pursue 'green growth' (e.g. OECD 2019; CSIRO 2019) achieved by decoupling economic growth from environmental harm through efficiency

[21] For instance, in 2019, the outgoing president of the European Central Bank, Mario Draghi, said new ideas like MMT needed to be looked at: https://www.bloomberg.com/news/articles/2019-09-23/draghi-says-ecb-should-examine-new-ideas-like-mmt.

gains and technological advancement (as discussed by Jackson 2009, p. 67; Victor and Jackson 2015).

The problem is that evidence on decoupling overwhelmingly shows that green growth is a myth (as discussed in the introduction to this book; see also, Victor and Jackson 2015; Hickel and Kallis 2019). The best solution for economies in overshoot is *controlled* biophysical contraction (degrowth to a steady-state), achievable, we argue, through the insights of MMT that show monetary-sovereign governments can exert fine control over their economies to minimise harm, such as mass unemployment, leading to the ultimate goal of a steady-state system. This can only be done by a macroeconomic theory based in reality – including biophysical reality (Washington 2018) – rather than myth. We now turn to that macroeconomic theory, which focuses on real-resource constraints rather than perceived fiscal constraints.[22]

Introduction to MMT

MMT developed out of an academic post-Keynesian internet discussion group in the mid-1990s.[23] It is a macroeconomic theory profound enough in its implications to usher in a new societal paradigm (Mitchell 2017). It is now seriously challenging the dominant theory, with the latter usually called neoclassical (or neoKeynesian). For convenience, MMT can be summarised into a set of principles that we will outline, although readers seeking more detail should seek out the MMT undergraduate textbook (Mitchell et al 2019). This new body of knowledge draws on many ideas from the past, while marrying them with more recent experience, especially the post-gold-standard era from the early 1970s onwards, when US president Nixon abandoned the Bretton-Woods system. Again, it is essential to understand that MMT is not a set of policy prescriptions, but is a description of how economies function today, regardless of whether they are growth or post-growth economies, and regardless of whether governments are aware of MMT or not.

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[22] In 2005, even US Federal Reserve chairman, Alan Greenspan, admitted under oath that the US government could create unlimited money, and that the main issue was real resources: https://www.youtube.com/watch?v=DNCZHAQnfGU

[23] A collection of scholarly papers on MMT is at http://www.levyinstitute.org/topics/modern-money-theory-mmt. A primer for the general reader is at https://neweconomicperspectives.org/modern-monetary-theory-primer.html. Journalistic articles are at https://wecanhavenicethings.com/about/. An expert blog is at http://bilbo.economicoutlook.net/blog/.

MMT begins by separating nations into those that are monetary sovereign and those that are not. To be a monetary sovereign, a nation needs four things: (1) its own currency; (2) a floating exchange rate; (3) no significant government borrowings in foreign currencies; and (4) a central bank setting interest rates. By being a monetary sovereign – as Australia, the USA, Japan, Canada, and the UK are – a nation's government will have maximum policy space to advance whatever programs it thinks desirable. This is largely because such a government can never be forced to become insolvent: it can always pay any liabilities when they fall due (and social security payments) simply by crediting the relevant bank accounts. It can never legitimately say it does not have the money for this or that policy – such as creating a net-zero-emissions economy – since it creates the funds by spending them into existence. Note that monetary sovereignty is distinct from political sovereignty.[24]

Most nations, including many in Africa, South America, and Europe, are non-monetary-sovereign in the MMT sense, and so they do not have the policy options open to countries like Australia. Not surprisingly, many experts in the MMT community are actively encouraging these countries to become monetary sovereigns – or in the case of European countries that use the euro, to regain their sovereignty. Once a country achieves monetary sovereignty, the following principles apply to its national government.

The government creates new money whenever it spends, usually by electronically crediting bank accounts in the private sector. Note that it is not spending tax receipts.[25] Every dollar the government spends is a new dollar created at the time of spending. Spending must come first, and taxation comes second.

Federal taxes are best understood as merely offsetting government spending, rather than funding it. Using the metaphor of a bathtub to represent the economy, federal spending is equivalent to water entering the bath via the tap. Taxation is money draining from the bath via the plug hole, so that the tub does not overflow. If the government spends too much, or taxes too little, too

[24] We will use the words currency and money interchangeably, since this chapter is pitched at an introductory level.
[25] This was understood by US Federal Reserve chairman Beardsley Ruml in the 1940s (see Ruml 1946).

much inflation will occur (overflow). Taxes are also important to penalise undesirable activities (smoking, pollution) and to limit wealth inequality (through progressive taxation).

The national budget (better described as the fiscal balance) is merely an accounting outcome that shows the difference between government spending and taxation. There is no reason to favour a surplus over a deficit since the government is not equivalent to a household or a business. Indeed, a federal deficit in any period is exactly equal to the non-government surplus because the two sectors must sum to zero (Mitchell 2019a, p. 86). When the government runs a deficit, it does not need to borrow funds from the non-government sector, so there is no absolute need for government 'debt'. When the government voluntarily sells bonds to match its deficit, idle money (reserves) in one account is transferred into another account with better interest. Under current arrangements, this 'soaking up' of reserves helps the central bank achieve its target interest rate (Mitchell 2019a, p. 326). The government can always pay the interest, or buy the bonds back, but such bond sales are largely unnecessary anyway and can be seen as a carry-over from the gold-standard days.

Monetary policy, which is the adjustment of interest rates by the central bank, has limited effect on the economy, since there are winners and losers from every adjustment. Fiscal policy – government spending and taxation – is the primary lever of economic control. The central bank is not independent, as mainstream theory claims, but is always under the stewardship of the government that gives effect to its operations.

With respect to the labour market, policymakers only have two choices: to use a buffer stock of unemployed to control inflation (as the mainstream prefers) or use a buffer stock of employed workers via a 'job guarantee' program to control inflation. MMT prefers that latter on both moral and efficiency grounds (Hail 2018, p. 219). In the job guarantee, workers not employed in either the private or regular public sector, are offered a job in their local community at the minimum wage, complete with holidays, sick leave and so on. This job should be useful work – for instance environmental restoration – that the private sector usually will not do. Besides offering a liveable wage, it is designed to maintain the skills and dignity of the worker until they can be re-employed in the regular economy. The job guarantee sets the minimum standards for work that the private sector has to at least match. Importantly, the government could set fulltime working hours at any level via the job guarantee to help create a non-growth economy (Tcherneva 2018).

Most importantly, MMT – through what we believe is a correct understanding of money and its creation (Mitchell et al 2019, p. 137) – places an emphasis on available real resources in the determination of wealth, health and sustainability, with money merely being a kind of point score of who has a claim to what resources. As such, it makes little sense to encourage foreign financial capital into a country like Australia, as if there is a shortage of money. Similarly, it makes little sense to maximise the export of real resources (wealth) in exchange for money, as if the latter was the more desirable item. While trade is a complex subject, MMT basically sees exports as a cost and imports as a benefit.

In sum, government spending, like all spending, is limited by inflation, which in turn is governed by the amount of real resources that can be sustainably put to productive use – creating output and then consumption (Mitchell et al 2019, p. 520). As ecological economists, however, we particularly emphasise that this 'throughput' should be scientifically assessed and kept within sustainable ecological limits, and ideally well within those limits, to avoid *un*economic growth (Daly 2014).

The implications of this understanding of macroeconomics are profound. So-called federal government debt is not really debt in the normal sense, so increasing GDP (growth) to reduce the debt as a percentage of GDP is nonsensical. Second, a national government budget outcome – either surplus or deficit – is not improved in any meaningful sense by increasing tax receipts relative to government spending, so running an immigration program to achieve a net increase in taxation is pointless. Third, the federal government can eliminate involuntary unemployment and underemployment whenever it chooses by offering meaningful paid work to all through a job guarantee (Mitchell et al 2019, p. 301). It follows that a technical recession need not result in mass unemployment, a mortgage-default crisis, and a positive feedback into an ever-deeper recession. Thus, three major reasons for forever expanding the size of an economy are shown to be flawed.

MMT also puts into doubt the following, just to name a few:

- The need for universal superannuation
- The need to increase the age when people can claim the age pension
- Government support for the private health insurance system
- The need to privatise government assets to 'improve' budget outcomes
- The need to encourage foreign investment
- The need to promote exports, including encouraging foreign students to enrol in universities
- The need for private education and training organisations
- The need for private employment agencies
- The need to rely on the private sector to build and run essential services like electricity generation, communications, ports, roads, and banking
- The need for governments to sell bonds or other securities (so-called government debt).

After considering some criticisms of MMT in the next section, we proceed to explain how an acceptance of MMT could facilitate a degrowth transition to a steady-state economy, and conclude with a list of policy options that are more defendable and achievable through an understanding of MMT.

Criticisms of MMT

Prominent critics of MMT include well-known economists such as Paul Krugman, Olivier Blanchard, Lawrence Summers, Greg Mankiw, Kenneth Rogoff, and Ann Pettifor (Mitchell 2019a; Harvey 2019). Invariably, the critics do not correctly define what MMT is (see generally, Tymoigne and Wary 2013; Mitchell 2019a). The most common criticisms include the following.

If introduced, MMT would lead to high inflation, or even hyperinflation

MMT is not something that can be introduced; it is a macroeconomic theory that seeks to explain what already exists. Policies based on an understanding of MMT could be inflationary or deflationary, depending on the policies. MMT makes it clear that all spending is potentially inflationary, regardless of whether the spending is public or private. Inflation occurs when demand rises relative to the productive capacity of the economy (demand-pull inflation), not because governments run budget deficits (Mitchell et al 2019, p. 254). Cost-push inflation is also possible, if the cost of production increases, but that is not inherently a government spending issue.

MMT only applies to the USA because it issues the world's reserve currency

This false argument is repeated by Naomi Klein (2019, p. 283) in a reference to US Congresswoman Alexandria Ocasio Cortez's plan to pay for a Green New Deal. But MMT theory applies to all countries, including countries in the European Union that have lost monetary sovereignty by adopting the euro. MMT shows how countries without their own currency have a budget constraint, unlike monetary sovereigns like Australia.

MMT is nothing new – we've known it all along

This tends to be said by people wanting to defend their reputations, or the reputation of the mainstream in general, by claiming that MMT is not a genuinely new macroeconomics that could disrupt the dominant paradigm (see Mitchell 2019b). It is true that MMT builds on the work of Hyman Minsky, Michal Kalecki, Abba Lerner, Wynne Godley (and others), but it is more than a rehash of old ideas (Hail 2018, p. 141). As with most criticisms of MMT, the critic will usually not have an adequate grasp of the theory. What's more, questioning the originality of MMT's claims tells us little about its veracity.

MMT says budget deficits don't matter

A federal budget deficit (or surplus) does matter in the sense that either outcome could be too big or too small, depending on other factors in the economy. More correctly, MMT says countries like Australia should never aim for a particular budget outcome, but should let the outcome rise and fall to achieve desirable ends like ecologically sustainable full employment and increased wellbeing. Since budget deficits do not need to be funded by borrowing money or selling assets, there is no accumulating debt burden for future generations (Mitchell et al 2019, p.333). In short, it serves no useful purpose to balance the budget over some arbitrary economic cycle.

MMT is 'printing money' which everyone knows is highly inflationary

In mainstream economics, it is thought that a federal government mostly spends tax receipts. If it wants to spend beyond that, it either has to borrow money through bond sales or sell assets (Mitchell et al 2019, p. 333). As a last resort it might 'print money', which usually means creating new money without borrowing. This is thought by mainstream economists to be highly inflationary and addictive for imprudent governments. But MMT proponents claim all of the above is false, and the government only spends one way – namely, every dollar the national government spends is a new dollar (literally spent into existence), whether that is acknowledged or not. According to this logic there can be no special case of money printing when 'revenue' runs out.

Our country has laws that would prevent MMT-type spending

As discussed by Mitchell (2018), critics sometime claim that certain laws in certain countries – such as government debt ceilings and budget appropriation laws – would prevent some governments from engaging in the type of spending necessary to build renewable-energy infrastructure, offer free tertiary education, free healthcare and so on. However, as the MMT position emphasises, such laws are voluntary restraints that can be removed if the legislature decides that the spending would increase social and ecological wellbeing (Mitchell et al 2019, p. 337). In 2020, in response to the pandemic, we are now seeing these voluntary restraints removed as governments spend large amounts to counteract the loss of private spending. Once policy-makers realise that fiscal and budget outcomes are not the limiting factor, but that sustainable resource use is, misconceived laws with an austerity bias (such as debt ceilings) are more likely to be repealed. Even constitutions can be amended if there is enough support for the change.

MMT is ideologically biased towards growth

Finally, some in the sustainability movement dislike MMT because (a) they see it as an optional policy platform instead of macroeconomic principles attempting to describe reality; and (b) they think, if it was widely accepted, it would result in an acceleration of the ever-increasing money supply that they (quite rightly in our view) associate with perpetual economic expansion (Mitchell 2012). With respect to (a), we have explained that it is not a policy platform, but is descriptive rather than prescriptive. We are all forced to choose, consciously or unconsciously, between competing macroeconomic theories, and the failed neoclassical paradigm, besides not explaining actual outcomes (such as Japan's high government debt and low inflation), has no inherent benefit for post-growth policies. In respect to (b), it is policy choices allowed by the macroeconomic paradigm that determine the size of the economy, such as the policy of allowing private banks to increase the money supply through their lending. MMT insights provide maximum control by maximum policy choice – to either expand an economy or to shrink it. It is essential not to confuse pro-growth policies offered by many MMT advocates with MMT itself.

How MMT could facilitate post-growth economics

If we are to stop or reverse the expansion of economies in the overdeveloped world, we must address the main reasons for their growth. These reasons include 1) concerns about national government debt; 2) concerns about national government budget balances; 3) concerns about recessions and resulting unemployment; and 4) concerns that financial markets will punish a government that does not meet market expectations. From the perspective of MMT, these concerns are largely wrongheaded, so the growth imperative is greatly diminished.

Government debt. A key reason for continually increasing a country's GDP is that it reduces the government debt as a percentage of GDP (assuming the debt does not increase as much as GDP), where government debt reduction is assumed to be a good thing. However, advocates of MMT argue (Mitchell et al 2019, p. 326) that monetary-sovereign nations never need to borrow: selling government securities (so-called debt) to match a budget deficit is stated as being unnecessary, (although it helps the central bank meet its interest-rate target by soaking up reserves). But even if the securities are sold (they are actually auctioned in the first instance) there is no great imperative to buy them back or grow the economy to make the debt seem relatively smaller. The simplest thing is for the national government to stop selling these risk-free investments that amount to corporate welfare.

Budget outcome. Increasing a country's population via migration will not only increase its GDP but is believed by the mainstream to 'improve' federal budget outcomes: because of their relative youth, migrants will pay more in taxes compared with their welfare claims (Australian Treasury and Department of Home Affairs 2018, p. 35). Former Australian prime minister Tony Abbott's then chief of staff, Peta Credlin, explained how immigrant numbers were ramped up in chaotic pre-budget meetings to get the 'right' budget projection, with zero thought to sustainability (van Onselen 2018). Yet MMT shows that aiming for any particular budget outcome is foolish, meaning one of the core assumptions driving Australia's high migration policy is foolish. Ultimately, the government has limited control of the budget outcome anyway, since it cannot accurately forecast tax receipts, welfare payments, or the non-government sector's desire to net save rather than spend. This leads to the MMT position that governments should try to balance the economy, not the budget.

Recessions. Continually increasing GDP avoids technical recessions and associated increases in labour underutilisation (unemployment and underemployment). But according to MMT, a national government can achieve full employment (1-2 per cent unemployment and zero underemployment) via a government job guarantee scheme. It follows that the government could largely ameliorate the otherwise destabilising effects of economic recessions by making sure that wealth and income was distributed more fairly, just as it could when transitioning from a fossil-fuel economy to a renewable-energy economy.

Financial markets. The main fears here are that bond 'vigilantes' will no longer want government securities if the government is seen to be financially reckless (big budget deficits and/or low or no growth). However, this has not been seen in practice (as the case of Japan shows (Mitchell et al 2019, p. 29); and we have previously said that the government does not need to sell securities anyway. Second, and more serious, is the fear that the government's currency will be depreciated by speculative currency traders in a non-growth scenario. The MMT response is capital controls, where the government simply blocks the currency transfers (Mitchell et al 2019, p. 398). Ultimately, a government's currency will always be attractive in a democratic nation where the rule of law prevails, corruption is minimised, natural capital is protected, and where health, education and skill levels are high.

As long as a society uses money as a medium of exchange, it is necessary for policymakers to understand such things as the nature of money, how it is generated, what are the limits to its generation and spending, what is the nature of central bank and commercial bank operations, and what are the implications for money generation at various levels. Since the abandonment of the Bretton-Woods system and the gold standard in the early 1970s, mainstream neoclassical economics has failed to provide an adequate description of these things. Now, with a new financial crisis in 2020 caused by a pandemic, the mainstream is struggling to make sense of government new-found power and largess, while the MMT community simply point to the MMT literature. When policymakers better understand the cause-and-effect relationships in macroeconomics, including currency operations, it is more likely they will accept the possibility of a controlled descent towards a steady-state system, vouchsafed by government fine control. We have briefly outlined how MMT provides that understanding of government control.

We believe that without MMT, policymakers who advocate for things such as a Green New Deal, or even stronger sustainability measures, will be restricted by notions of a government budget constraint; the fear of the necessity to raise taxes to fund government spending; the fear of government debt and insolvency; and a fear of financial markets that might choose to inflict punishment by not buying government debt and/or depreciating a nation's currency. MMT, as a coherent macroeconomics, states that these concerns are largely, or totally, unfounded. If MMT were to be accepted, we maintain that policy options such as the following are more likely.

Policies for a sustainable, post-growth economy

Governments in the neoliberal era have gradually abandoned what we think are their main responsibilities (Murphy 2020). These responsibilities include ensuring a healthy natural environment; full employment with price stability; and increasing general levels of wellbeing. In short, governments have failed to understand, let alone address, sustainability.[26] Extreme wealth inequality, which they have allowed to run rampant, is not consistent with sustainability (Daly 2013). Ideally, the size of any economy should be reduced to near the

[26] For instance, the UN Sustainable Development Goals, which Australia endorses, call for ongoing economic growth.

optimum (that is, smaller than the maximum ecologically sustainable size) where cost-benefit curves are at their maximum distance from each other (Lawn 2017).

Without making any claims about the list of policies below being complete or uncontroversial – and due to space constraints, we have stated rather than defended them – here are some bold ideas for facilitating a degrowth transition to a steady-state economy (see also, Daly 2013; Alexander 2016) which are supported by an MMT position on macroeconomics:

1. Declare a state of emergency that goes beyond the climate emergency to encompass the unsustainable nature of society as a whole and the risk of collapse. This would mean that all government decisions would need to address the new priority of sustainability (including the social- and ecological-justice dimensions). MMT focuses on the availability of sustainable real resources as the limit to government spending. It also removes the imperative to (a) grow the economy to ameliorate government debt; and (b) increase the number of taxpayers to 'improve' budget outcomes. It should not be surprising, therefore, that MMT is strongly associated with the movement for a Green New Deal, given it acknowledges that resources need to be used sustainably (Nersisyan and Wray 2019, 2020).

2. Establish a permanent statutory office whose sole task would be to advise government, and the public, on the path to sustainability (Washington 1991). It would coordinate the work of other bodies, such as climate change, agriculture and energy authorities. A key task would be facilitating the design and construction of a 100 percent renewable-energy system. MMT, unlike neoclassical economics, accepts that resources need to be used sustainably. Therefore, if policymakers accepted MMT, they would be more likely to establish such offices, especially when its recommendations (for instance, to reduce economic growth) would be less problematic than under a neoclassical framework.

3. Enact a bill of rights (or charter of rights) that explicitly acknowledges rights to a healthy natural environment. In so doing, enact a plan to reserve at least 50 per cent of terrestrial and aquatic territory for non-human species (Wilson 2016; Dinerstein et al 2017), ensuring all key

ecosystems were protected. Pay farmers (or give tax subsidies) if they adopt the best regenerative practices that protect the environment. We have explained above how MMT undercuts the imperative to continually expand an economy. We have also said that MMT emphasises that real resources need to be sustainably managed.

4. Explore a range of wellbeing measurement tools (e.g. Genuine Progress Indicator, see Lawn 2016) that would become the primary focus of government reporting, especially at budget time, and during election campaigns. MMT acknowledges that 'conventional market-based measures of national income as indicators of well-being are flawed in several ways' (Mitchell et al 2019, p. 520), and most ecological economists see the value in alternatives like the Genuine Progress Indicator.

5. Stabilise the human population as quickly and ethically (in line with accepted human rights) as possible (Engelman 2016) to ensure the rights of both human and non-human creatures, now and into the future, and plan for a controlled decrease in the human population. Excess accommodation would eventually be bought by government to control real estate prices. We gave the example of how positive net migration policies are flawed insofar as they are based on myths about 'improving' budget outcomes (via more tax receipts) and facilitating economic expansion. With an increasing focus on sustainably managed real resources, population numbers beyond an optimum level will dilute provisioning of these resources, leading to reduced income per capita and/or unacceptable incursions into natural capital.

6. Introduce gradual tax increases over a period of, say, 10 years, so that personal annual income greater than $1 million is taxed at 100 per cent (i.e. a maximum income, see Washington 2017), together with an otherwise highly progressive tax regime.[27] At the same time, introduce a progressive inheritance tax to remove extreme wealth.

7. Vastly expand the regular public service as government nationalises banking, ports, airports, essential services such as electricity generation

[27] About 13,000 Australians earn $1 million or more a year (Hutchens 2018).

and distribution, and natural monopolies. In particular, employ the vast knowledge and experience of the indigenous population to manage protected natural areas (Dinerstein et al 2017). Ensure that critical government agencies such as the CSIRO, Australian Bureau of Statistics, Bureau of Meteorology, tax office, federal police and courts, hospitals, and publicly-funded media are properly resourced.

8. Introduce a federal job guarantee (Mitchell et al 2019, p. 301) to eliminate involuntary unemployment and underemployment and control inflation. This scheme will set minimum pay and working conditions that the other employment sectors would need to at least match. It will also set normal hours for the working week, which we suggest could be initially four days. This scheme should be seen mostly as a safety net for those workers who are temporarily not wanted by regular employers (public and private), although a minority of people would likely be semi-permanent in the scheme.

9. Gradually decrease the retirement age to 60, while ensuring the age pension meets people's needs, especially those in rental accommodation. This will likely mean expanding public and social housing – this will not be difficult as the population stabilises and slowly decreases. Disabled persons should receive similar protections. Stop promoting superannuation and gradually remove all tax concessions associated with it. The age pension should be seen as the normal and adequate retirement income.

10. Do not means-test free services such as education, health care, and so on, but provide them as a citizen's right. This will eliminate much unnecessary bureaucratic checking on the one hand, and the temptation to deceive on the other – not to mention resentment by those who would otherwise miss out on benefits paid to others. If a person has considerable assets or income, tax them at a higher rate (see point 6 above).

11. Increase the range of fee-free services to include childcare, vocational training, and higher education. Cancel all student debt. Add dentistry to Medicare. Like the following policies, the government can pay for this (if there are idle real resources) and tax accordingly to avoid inflation.

12. Increase higher education funding by increasing tenured teaching and research positions while eliminating the need for researchers to rely on industry support. In short, stop politicising higher education. The same can be said of once-great research institutions such as the CSIRO.

13. Establish government-owned and co-operative manufacturing ventures (where the private sector is absent) to reduce reliance on trade – both imports and exports – with the aim of creating a more self-sufficient nation. In so doing, legislate for rethink, repair, re-use and recycling in manufactured goods (using the waste hierarchy).

14. Increase restrictions on foreign investment in line with the new state of emergency (degrowth to optimum size) and the knowledge that foreign financial capital is not required.

15. Work internationally to cancel unconscionable debt owed by developing nations. Increase foreign aid (especially that which targets women's health and family planning), international cooperation, and the transfer of cleaner technology, so that poorer countries can quickly increase their sustainability and stabilise population.

Again, we make no claims about this list being exhaustive or uncontroversial. In fact, it barely scratches the surface of the restructuring that would be required to initiate and manage a degrowth transition to a steady-state economy. The policy ideas above are merely illustrative of the types of options that open up when the political economy of sustainability is viewed through the lens of MMT.

Conclusion

We believe the discipline of ecological economics provides the best overall framework for understanding the relationship between economic activity and biophysical limits, and should replace the neoliberal framework (Daly 2014; Kallis 2017). Its tools will help us determine the optimum size of any economy, recognising that the optimum size could change somewhat with, for example, technological improvements and population levels. But within that framework, and subject to its principles of living within biophysical limits and maximising wellbeing, there is still a need for an accurate macroeconomics.

MMT has been called 'macroeconomics done properly' (Harvey 2019). Whether a society wants to increase the size of its economy, stabilise it, or reduce it to an optimum size, it will benefit from the most accurate macroeconomic theory to dispel false assumptions and give policymakers predictive confidence. Mainstream macroeconomics has failed to do that.

As we have argued, advocates of MMT outline how and why monetary sovereign states have many more policy options available to them than the mainstream allows. Such nations have massive power compared with the private sector, if only they would use it (as the 2020 pandemic is demonstrating). Rather than set policy to placate the bond markets, currency speculators, and corporate greed in general, the national government can concentrate on maximising human and non-human welfare (Washington and Maloney 2020) through a fairer distribution of sustainably-managed resources in the knowledge that business interests will always seek to invest in stable, democratic nations.

Once it is understood that government can have fine control over the economy using the levers of monetary and fiscal policy – but especially the latter – it becomes clear that a just (or green) transition is more easily achievable than currently thought. For rich, overdeveloped nations, that means a degrowth transition of planned economic contraction, leading to, somewhat paradoxically, increased wellbeing. Our view is that MMT is the best available macroeconomics to facilitate the transformation – and to avoid collapse.

Appendix 7.1

Comparison of neoclassical theory and MMT as applied to monetary-sovereign nations (complied by the authors).

Neoclassical	**MMT**
Little or no focus on money sovereignty	Essential focus on money sovereignty
Does not prioritise theory of money	Prioritises theory of money
G'ment is like a household, has budget constraint: 'sound finance'	G'ment nothing like a household, no budget constraint (except inflation, sustainability): 'functional finance'
Continual budget deficits accumulate and	Continual budget deficits do not

will lead to higher taxes, inflation, possible insolvency	accumulate; spend up to full employment and no further
G'ment must fund spending with tax receipts, borrowing, asset sales	G'ment does not 'fund' its spending, never needs to borrow its own money
G'ment can 'print' new money in exceptional circumstances	G'ment spends new money into existence whenever it spends (never prints money)
G'ment borrowing (bond sales) 'crowds out' private-sector borrowing, investment	No 'crowding out' as banks will lend to any credit-worthy customer by lending money into existence (do not lend deposits)
G'ment must sell bonds to match deficit, at mercy of bond vigilantes	Bond sales are optional, used to soak up excess reserves so central bank can achieve overnight interest rate target
G'ment collects taxes, then spends them	G'ment spends, then collects taxes (as an offset). Taxes are destroyed, not spent
Monetary policy is best tool to control economy	Fiscal policy is best tool to control economy
There is a natural rate of unemployment where inflation is stabilised (NAIRU)	No natural rate of unemployment
Market determines unemployment rate	G'ment determines unemployment rate
Use buffer stock of unemployed to control inflation	Use fiscal policy, buffer stock of employed workers in job guarantee pool (on minimum wage) to control inflation
Central bank is independent of G'ment	Central bank is part of G'ment
Market, central bank sets interest rates	G'ment can set interest rates at any level, including zero
Usually a need for foreign financial capital	G'ment and its agents (private banks) can provide all financial capital
G'ment should respect credit-rating agencies	G'ment should ignore credit-rating agencies : cannot be forced to default
G'ment should fear sudden and deep currency depreciation	G'ment can implement capital controls if speculators dump currency
Little fear of resource depletion due to human ingenuity, substitution	Management of real resource constraint determines wealth, inflation, sustainability
G'ment is at mercy of international forces, large corporations, financial sector	Citizens, via elected G'ment, are masters of country's destiny

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Chapter 8: 'Neighbourhoods that Work' and the Walden Wage: How access to land plus a participation income could change the world

Samuel Alexander and Alex Baumann

Access to land as a barrier to sustainability: A statement of the problem

Industrial civilisation is facing an alarming barrage of overlapping crises, together presenting an existential threat to life as we know it (Ripple et al 2017; Turner 2019). Climate breakdown is intensifying; human economic activity is decimating natural habitat and wildlife populations; and more generally, our life-support system called Earth is trembling under the weight of overconsumption and the waste streams that flow from it (Steffen et al 2015). Just as concerning are the social consequences. The global economic system has produced deep, socially corrosive inequalities and poverty around the world is extreme (Hickel 2017). Furthermore, even those who are 'winning the rat race' so often find that the promises of consumer lifestyles are unfulfilling (Lane 2000).

In response to these overlapping ecological, economic, and cultural crises, a diverse school of ecological economists has emerged over recent decades calling for the developed, or rather over-developed, regions of the world to initiate a 'degrowth' process of planned and equitable contraction of their energy and resource demands (see generally, D'Alisa et al 2015; Kallis et al 2018). The fundamental vision is to move toward a stable, broadly egalitarian, steady-state (or zero-growth) economy that operates within sustainable environmental limits (Daly 1997; Washington and Twomey 2016; Frankel 2018). This radical 'post-development' paradigm of political economy (Escobar 2015) is generally recognised as being incompatible with the accumulative and profit-maximising logic of capitalist development (Blauwhof 2012).

Although the degrowth and steady-state schools have no singular vision of the 'good society' or singular theory of transition, many argue (see D'Alisa et al 2015; Holmgren 2018) that the transition to a just and sustainable world will have to be driven into existence primarily from the grassroots up, with individuals, households and communities coming together to 'prefigure' a new post-growth society within the shell of the old. According to this broad theory of change (Buch-Hansen 2018), such prefigurative action, which is based on participatory democracy, is projected to filter upwards over time to change social, economic and political structures in recognition of the systemic nature of the problems (Trainer 2010; Alexander 2013). From this perspective, social movements need to create the cultural conditions for structural change, and that structural change can then be a further driver for social change, representing a dynamic mode of society's transformation that relies on multiple movements, innovations, and policies for change (Washington 2017).

The privileging of grassroots or community-led action is mainly due to the widely shared belief that the ability or willingness of politicians or businesses to lead a degrowth transition in a neoliberal age is scarce to non-existent (Alexander and Gleeson 2019; Kallis et al 2018; Holmgren 2018). The logic here is that there are just too many 'growth imperatives' built into the economy for us to expect political leaders, corporations, or existing institutions to initiate or facilitate a degrowth transition to a steady-state economy (Blauwhof 2012). Nevertheless, despite the coherency of these doubts about 'top down' political change and 'green businesses' leading the way, similar doubts can be levelled against any hope for a degrowth transition rising up from any kind of a socio-cultural groundswell (Frankel 2018).

Indeed, in this chapter we seek to emphasise that this apparent paralysis in degrowth transition theory is owing, in part, to the growth imperatives of the dominant politico-economic order of global capitalism *specifically relating to land*, where ordinary people who are expected to lead the transition 'from below' are typically locked into a very long market commitment in order to buy or rent housing and keep a roof over their head. We will attempt to demonstrate the way in which this very demanding cost of land for housing has significant societal implications, affecting what we do for work, how much we work, and a range of other engagements with consumer society. We will highlight the way that modern capitalist economies have developed in perverse ways, particularly when it comes to land and housing cost. In our view, land – just as with air or water – is not a product of the market but a part of our collective natural heritage and inheritance that must be shared equitably with each other and all other species (OHCHR 2013). Accordingly, we wish to explore whether true political freedom is undermined in light of this lifelong land buy-in and resultant dependence on market opportunity, and whether there are alternative land governance arrangements that could better serve people and planet.

Our reading of this structural obstacle to degrowth suggests that deep economic changes relating to land access and governance are needed to help facilitate a degrowth transition to a steady-state economy and empower true democratic agency for those who would subscribe to such a transition. While the biophysical aspects of the degrowth and steady-state perspectives are critically important, coherent, and by and large compelling – indeed, we accept the validity of the case (Meadows et al 2004; Turner 2019; Kallis 2017; Daly 1997, 2014) – we argue that the broad 'post-growth' movements have given insufficient attention to land (and housing) cost. It is our view that this is a significant barrier in the way of a grassroots driven degrowth transition, in particular, and genuine democratic participation, more generally, highlighting the deep and complex relationship between cultural and structural drivers for change.

The promise and limitations of the Walden experiment: How the privatisation of land can function to coerce people into to consumerism

We would like to highlight the premise of our argument with reference to the great 19th century philosopher of 'simple living' Henry David Thoreau. Now a canonical figure in the environmental movement (Walls 2017), Thoreau famously spent two years living on the shores of Walden Pond, where he built himself a small abode, grew his own food, and generally lived an abundant life of voluntary simplicity (see Thoreau 1982). He had very little by way of material wealth and possessions, but even so, he had enough to 'live deep and suck out all the marrow of life' (Thoreau 1982, p. 344). This living experiment at the pond provoked an entire tradition of theory and practice that has sought to explore the prospects of living more on less (Grigsby 2004; Cafaro 2006), as 'part and parcel of Nature' (Thoreau 1982, p. 592).

While living in the woods, Thoreau wrote his autobiographical manifesto *Walden*, in which he presented a fiery critique of the emerging consumer culture in the United States and a beautiful defence of simple living. Both his example and his words are provocative and inspiring – and, in an age of overconsumption, more important today than ever before (Steffen et al 2015). To be successful, any sustainability transition will require high-impact societies moving away from consumerist cultures of consumption, and increasingly seeking happiness and purpose in non-materialistic sources (social relations, community engagement, self-governance, and generally privileging more time over more things, etc). Promisingly, the social science on the correlation between income and happiness (reviewed in Kasser 2017; Alexander 2012) supports Thoreau's case for sufficiency and moderation as a guiding ethics of consumption. It seems that beyond a relatively modest material threshold, getting richer stops contributing much to wellbeing, and things other than material wealth become increasingly important factors in quality of life (Lane 2000). In a key passage, Thoreau (1982, p. 325) writes:

> I am convinced, both by faith and experience, that to maintain one's self on this earth is not a hardship but a pastime, if we will live simply and wisely.

But Thoreau's living experiment at Walden Pond depended on access to land (his friend Ralph Waldo Emerson owned the land and allowed free access), and in this chapter we are suggesting that for most people today, acquiring access to land is a significant barrier to people living simply and sustainably. In other words, it is hard to follow Thoreau's example of sufficiency-based living, even for those of us who want to. As detailed further below, most of us have to work full time in an unsustainable growth economy just to afford somewhere to live. And not many of us have friends like Ralph Waldo Emerson to grant us access land to live on in the woods on the shores of a beautiful pond.

The critical point is that Thoreau's low-impact lifestyle of 'voluntary simplicity' – necessary though such practices may be to a just and sustainable world (Trainer 2010) – are generally available only to people who have access to land – a *place* to live simply, grow food, and perhaps even build one's own house. But for most people today, especially in urban contexts, access to land generally means extensive market engagement in an unsustainable economy to pay for somewhere to live. Our concern, then, is that practising voluntary simplicity on expensive land is a compromised example of prefigurative degrowth practices. This is not an argument against voluntary simplicity, of course. The point is that systems of land governance within which we live can make voluntary simplicity very difficult to practice. People are often pressured to conform to high-impact living (Sanne 2002), primarily because they find themselves needing to work in the existing growth economy to afford a place to live.

To unpack this point, we will now seek to illustrate that the struggle for access to land for housing regularly locks people into sustained but not sustainable market participation. Moreover, by sketching an outline of the tremendous housing cost pressure faced by many Australians, we will attempt to demonstrate how the expense of the mortgage or rent means that people otherwise sympathetic to a degrowth transition to a steady-state economy will often find themselves participating unsustainably in growth-dependent or growth-promoting practices.

The cost of land and housing: willing consumers or locked in?

Australia's long running housing crisis has seen house price inflation outstripping income growth since the early 2000's (Wilkins & Lass 2015). This increase in housing prices relative to incomes also means that housing affordability has declined dramatically, and home ownership has become progressively beyond the reach of many households. According to the Grattan Institute, median Australian house prices have 'increased from around 4 times median incomes in the early 1990s to more than 7 times today (and more than 8 times in Sydney)' (Daley et al 2018, p.16).

This most recent affordability crisis has often been discussed within the context of 'late neoliberalism', and the financialisation of housing (Aalbers 2016; Morris 2018).[28] However, this global trend, to increasingly view land and housing as a means to accumulate capital, represents nothing essentially new. Indeed, land's commodification (and the social exclusion that inevitably results) can be traced all the way through Australia's housing history (Troy 2000), shaped by early land privatisation. This began in Europe, with the privatisation (enclosure) of commons, and spread through the world through colonisation (Thompson 1991; Miller 2001). Legal commentators, such such as Blackstone (1875) and Locke (1980), as well as economic philosophers like Marx and (1985[1848]) and Proudhon (1876), recognised enclosing the

[28] 'The increasing dominance of financial actors, markets, practices, measurements and narratives, at various scales, resulting in a structural transformation of economies, firms (including financial institutions), states and households' (Aalbers 2016: 2).

commons via land privatisation as the instigating structural shift that gave birth to capitalism. On this Miller (2001, p. 111) states:

Figure 8.1: House Prices have grown much faster than incomes since the mid-1990s. Source: Daley et al (2018).

> The emergence of the capitalist world economy (Wallerstein 1974) also saw the beginning of the first major wave of enclosure. This marked the start of a worldwide process of privatization and commodification of land, ocean and atmosphere. It fundamentally restructured the way people perceived themselves, each other and the land.

While commoner land rights were indeed restricted and far from ideal in feudal times, the extent to which land remained unexploited by the nobility allowed the continuation of ancient subsistence traditions.[29] However, because of exploitative conditions on which feudalism was built, these land rights were ultimately eroded and lost as it became profitable for the nobility to enclose the commons (Thompson 1991).

Thus ended the era of the agrarian commoner, and any common law notion of rights to land, and began the era of private land and the capitalist market subject, with citizenship rights and responsibilities pivoting on market employment (Wallerstein 1974; Miller 2001). From this inception point onward, land commodification resulted in a dispossession from land and a shift to a dependence on the market as a source of income to buy or rent land for housing. This was socially problematic from the start, resulting in widespread peasant riots and hardship.[30]

In terms of this analysis around land commodification and affordability, contemporary housing scholars, such as Pawson et al (2020, para 2), recognise that the problem of housing unaffordability is:

> … fundamentally structural – not cyclical – in nature. Yes, periodic turbulence affects prices and rents. And yes, market conditions vary greatly from place to place. Australia-wide, though, there is an underlying dynamic that – over the medium to long term – is driving housing affordability and rental stress in one general direction only: for the worse.

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[29] Commoners held joint legal rights over common land which preceded parliament's statute law and was protected under common law (Yandle 1992). Peasant farmers typically had their own plots of land and could choose what to grow there and keep at least most of what they raised (Yandle 1992). They were also able to use commons to pasture animals, fish, take sods of turf for fuel, take gravel and sand and take wood. There was also the belief and practice that 'if an Englishman could build a house on common land, raise the roof over their head and have a fire in the hearth between sunrise and sunset, then they could have the right of undisturbed possession' (Harrison 1989, p.135). While this perception and practice was not corroborated in common law, it was not until the *Erection of Cottages Act 1588* (an Act against the erecting and maintaining of cottages) which coincided with the emergence of enclosure laws, that the state made a legal stance against landless peasants 'squatting' on commons (Harrison 1989).

[30] Angry tenants impatient to reclaim pastures for tillage were illegally destroying enclosures. Revolts swept all over the nation, and other revolts occurred periodically throughout the century (Thomson 1991, p. 237).

Surely, if there were a 'structure' we may seek to review in this regard, it would be the structure of the commodification of land, which is not so much a market good and more a social need. Like the housing affordability crises that proceeded it, our most recent affordability crisis has placed tremendous pressures on a broad gamut of Australian households, from intensifying rental affordability problems for those with lower incomes, to over indebting and locking out would-be first home buyers (Pawson et al 2020). Essential Research (2018) findings show that these pressures are being felt deeply across Australia, with more than half of all Australians feeling 'stretched' in order to meet their current housing commitments, be they mortgage or rent. Even more concerning, their research also showed that forty-two per cent of households fear they could become homeless if their circumstances (e.g. cost of living, health, employment, etc.) were to change for the worse.

For the fast-growing group that we would position as most vulnerable, pre-COVID Australia was already beset with an estimated 1.6 million low-income people struggling to meet their housing costs (Bently and Baker 2020). Far from atypical, this housing crisis is consistent with Australia's long trend in high and unaffordable housing prices (Wilkins & Lass 2015). Indicative of how long this affordability crisis has run, the 2020 Productivity Commission report (2020) has found that the number of low-income households struggling to pay their rent had doubled in the past two decades. Bently and Baker (2020, para 30) now estimate that if: 'unemployment in Australia jumps from the pre-COVID level of around 700,000 to 1.7 million, it translates to 2.4 times more people unemployed. In real terms, this means more than 550,000 extra insecurely-housed families'.

So, what does this widely experienced and long-standing housing and land cost pressure mean, in terms of the sort of freedom required to disinvest oneself from the market and embark on a more sustainable 'degrowth' path?

The cost of land and housing creates market dependency

If a household wanted to step out of the cycle of their dependence on consumerism and economic growth, and instead wanted to choose the sort of sufficiency-based lifestyles advocated by the degrowth and steady-state movements, they would first still need to contend with the cost of land and housing. However, as indicated above, access to this most basic need is a serious and often lifelong economic determinant. In short, securing land for housing requires a lot of ‘dropping in’, before one can conceivably ‘drop out’ of market engagement.

The central problem here is that this housing cost generally coerces people into specialised and extensive market employment, and, given the housing cost pressures most face, one cannot be too fussy about the sort of market opportunity they take up. Indeed, for all Australian’s to have the job opportunity they need to service their housing costs within a neoliberal framework, Australia requires ongoing economic growth to accommodate for a growing population and the redundancies that can flow from technological innovation (Purdey 2010; Pandey 2019). This apparent lock-in has a broad range of implications, from the economic growth and consumer industries we must depend on for employment opportunity, to things like our need for transportation and the clothes we must buy and wear in our market roles. Our specialised labour also means we have become increasingly time poor, and we are outsourcing more and more of our household responsibilities (Oster et al 2018), and are thus relying on specialised production and distribution of an ever-increasing range of goods and services.

This brings us to our next point, which is that very few if any livelihoods in market societies can be considered sustainable. Even the wages of post-development academics like us (how the authors pay for their housing) flow from university investments in fossil fuels industries, and overall we are earning an income from an extremely carbon-intensive education sector, with its reliance on student aspiration to secure their market share, international student intake, and generally high levels of academic travel (Miles 2017).

Those in the degrowth or downshifting movements who have been fortunate enough to afford land and housing may well be in a position to grow their own organic food, put solar panels on their roof, bike to work, and reduce working hours in the formal economy – and these practices may indeed provide some important prefigurative degrowth examples of localised economy, downshifted consumption, and post-carbon energy practices. However, we argue that they provide a fundamentally compromised example of a degrowth pathway, because their path to housing security relies on long and deep market participation for anyone who seeks to follow their lead. For these unwitting followers, who face an even higher cost of housing, they would have to earn wages or profits in an unsustainable economy to afford their rent or mortgage payments.

There is absolutely no way affluent consumption practices of the developed regions of the world can be globalised to all 7.8 billion people on the planet today, let alone the 9.7 billion expected by 2050 (UNDESA 2011; Trainer and Alexander 2019). Technology alone cannot solve this ecological contradiction (Hickel and Kallis 2019). If we are to respond effectively to the overlapping crises of our times, we need (among other things) to empower individuals, households, and communities to transcend consumer culture and embrace a 'simpler way' of life.

In short, the case we seek to make is that, even for those who share the vision of degrowth or a steady-state economy, this underlying land-for-housing 'buy in' requirement creates a significant structural impediment to people engaging in prefigurative degrowth practices that could be more broadly adopted. This barrier makes it very hard for degrowth sympathisers to live in a way that accords with their visions of societal downshifting for sustainability and justice. We argue that this represents a problematic curtailment of political and democratic freedoms, because land privatisation, and how it functions as a significant economic constraint, only permits 'lifestyle options' to emerge within the context of an unsustainable, growth dependent, market economy.

Political implications

With land and housing cost being such an inescapable and overwhelming economic determinant for so many people, we now explore the idea that this pivotal cost also plays a significant role as a determinant related to political orientation. As was reported in Essential Research (2018), job opportunity was one of the only issues that rated higher than housing affordability. Given the direct link between economic opportunity and people's ability to secure their housing, it is little wonder that this is the case, and that 'Jobs and Growth' has become the unyielding political mantra of the major Australian parties. In one sense it is quite understandable why people perceive political parties promising market growth as attractive, given that a growing economy, *from a neoliberal perspective*, is fundamentally needed to allow them to service their rent or mortgage payments. This perceived need for growth is a reality that has become very clear during the COVID -19 economic crisis, as the crashing economy is resulting in a crisis related to people's ability to service their rent and mortgage payments (Ong Vifor 2020). We also contend that it is because of the economic and political need to deliver jobs and growth that parties like the Greens succumb to promoting industries like tourism, despite the demonstrable unsustainability and carbon privilege involved in such carbon intensive industries (Miles 2017; Malik and Sun 2018).

We also argue that this has undemocratic effects in that it puts significant structural pressure on people struggling to afford access to land and housing to vote for political parties that seek growth and income, thus constraining the political imagination and making it difficult to vote for political parties (if such parties existed) that sought to initiate a degrowth to a steady-state economy. As things presently stand, there is no mainstream political party that campaigns for degrowth or steady-state economy. Even if one is able to vote for some *future* manifestation of a degrowth or steady-state party, people's daily democratic, economic, and lifestyle practices will be fundamentally constrained by their mortgage/rent obligations.

Ecologically, all this entrenches the destructive paradigm of economic growth, in many ways coercing people into market participation and high-impact lifestyles, and inhibiting people from prefiguring local and post-carbon modes of production and consumption. We are not even free to live simply off the land. How then, can we expect a broader prefigurative degrowth movement to emerge within current structural constraints? Our foundational point is that neoliberalism thwarts the democratic right to pursue genuine sustainability in our lives and politics.

The fundamental implication of this argument is that degrowth, and the broader movement of ecological economics of which it is a part, should give increased attention to land, housing and property rights as critically important aspects of any degrowth transition to a steady-state economy (Buch-Hansen 2018). In short, we argue that without non-commodified access to land, the democratic freedoms of citizens will emerge within a market paradigm of growth economics, thus erecting structural constraints that make it difficult to live and vote in opposition to that paradigm. Our policy proposal outlined below seeks to enable low-impact living for more people, by providing access to land (in the form of secure housing) and a 'participation income' (a modest living wage). The goal is to help create a structural context that would allow more people to live lives of voluntary simplicity.

Let us explain how it could work.

A policy proposal

Having demonstrated the way in which access to land is a serious obstacle in the way of a sustainability transition, we'd like to make a positive, constructive intervention by offering a policy proposal that we feel has transformative potential.

Despite the land privatisation that has continued unabated under neoliberalism, many countries around the world maintain a heritage of public housing. In some of these public housing communities, residents self-select to participate in community development programs (sometimes under the umbrella of tenant participation) such as community food gardens, resources repair/share programs, housing management, maintenance and, in the UK, even housing construction (Baumann and Alexander 2019). In this way, public housing provides an (albeit limited) example of publicly owned land for a form of community development that is local, cooperative, and not inherently defined by a dependence on market consumer growth.

At its simplest, our proposal involves further supporting unemployed public residents who self-select into these collaborative programs by providing them with a basic, living wage – which we will call a Walden Wage in acknowledgement of Henry Thoreau's example of voluntary simplicity. With housing and other basic needs secured, the goal would be to enable these self-selecting public residents to participate in the creation of 'simple living' communities and neighbourhoods that are sustainable, resilient, and consistent with human flourishing and the flourishing of the broader community of life. Put otherwise, we will argue for a strategy we call 'Neighbourhoods that Work', which essentially involves providing people marginalised by capitalism with (1) access to public land and housing; and (2) a 'participation income' (i.e. a modest living wage) for helping build new, relocalised, ecologically viable, and socially just communities and economies on our shared planet.

If successful, our hope is that these initial examples could be scaled up to support those marginalised or cast aside by the existing economic system – an expanding group because of the increasing realities of globalised labour, technological job redundancy (CEDA 2015; Madgavkar et al. 2019; Thomas & Lambert 2019), and environmental limits to consumer jobs and growth (Turner 2019). This alternative housing and productive opportunity could also attract people across the political divide as a foundation for an alternative economy – a viable, sustainable, steady-state economy. Central to this vision is the recognition land is not a market product but a shared inheritance that ought to be managed democratically to advance the best interests of people, other species, and ecosystems. As we outline this approach and unpack a broader vision for transition, we argue that this strategy could support the prefigurative action called for by many in the degrowth and steady-state movements and, just as importantly, expand the political imagination to make more space for a degrowth transition to a steady-state economy.

Unpacking the vision of 'Neighbourhoods that Work'

In recognition of an inescapable need for inclusivity and degrowth (and therefore land access reform) and the confrontational and unlikely acceptance of such a radical reform in contemporary Western capitalist nations, we will now explore a preliminary land and community development strategy that has the potential to be politically palatable. Indeed, it is a strategy (if framed correctly) that has the potential to provide benefits that could be marketed to economic and social conservatives and the broader politically and economically conservative public – not just ecological economists and degrowth advocates.

First, people must *see* how liberating access to land and housing can be when coupled with collaborative practices of collective sufficiency (e.g. growing food, home-based production, sharing resources, fixing things, etc.). When some limited but practical and real-world examples are seen, it is our hope that the political imagination could be expanded in ways that could deepen the institutional restructuring needed to provide such opportunities to more people. We feel there is potential to use public housing to show that access to land can remove a barrier to sustainability and provide a foundation upon which to escape market imperatives and begin building new forms of local, collaborative, and sharing economies consistent with the degrowth perspective.

At its simplest, the Walden Wage is similar to a 'voluntary-work-for-the-dole' scheme – but with a broader vision that we will share. This scheme is entirely voluntary, as opposed to mandatory programs like Work-for-the-dole in Australia or Workfare in the UK. The mandatory programs have shown themselves to be very problematic and would certainly undermine the ethics and participant-driven viability of our proposal. Also, where mandatory work-for-the-dole and Workfare represent a situation where the unemployed are used as cheap labour at the bottom end of the labour market, our proposal offers a path of work integrity, community connection, and housing and economic security.

The policy's most important feature is linking a secure but modest income with access to public land and housing. This housing and income option would be offered (at first) to unemployed people who are already in, or on the top of the waiting list for, public housing. These self-selecting public residents would choose to be involved in around 15 hours per week of local community programs, like growing food, maintaining the neighbourhood, facilitating sharing schemes, or even building new homes.

In other words, the Walden Wage would provide a participation income (Atkinson 1996) for jobless public residents wanting to engage in the necessary work of creating new forms of sufficiency-based living, enabled by access to land. The 'wage' part of this scheme has some similarity to the notion of a 'universal basic income' (UBI), which is being talked about and analysed a lot these days (Washington 2018; Frankel 2018). However, there are some critical differences. The primary difference is that it would be offered, not universally, but only in the context of public housing and localised, community economies – as a minimal and sustainable living wage. This would make it affordable to governments, and since it is linked to access to public land and housing, people receiving the Walden Wage would not find themselves needing to 'top up' their incomes by engaging in an unsustainable growth economy in any significant way.

Interestingly, the fact that this income (through the voluntary-work-for the-dole-scheme) it is already available (in Australia) for unemployed people who are over 55, demonstrates that it has already been deemed affordable by government. And, unlike the UBI, it would neither be universal (i.e. paid to all citizens) nor promote or depend on a limitless growth economy to fund it. Indeed, a Walden Wage would function to support the building of sustainable economies (Hopkins 2011; Gibson-Graham et al 2013), based on a more inclusive and liberating land governance arrangement. If participants over 55 could show a viable pilot, we believe this option could be extended to those under 55 who are unemployed in public housing. Indeed, there could be a pilot experiment available for any keen practitioners of simple living who 'self-select' into the scheme.

Land, we should add, would still be owned by the Commonwealth, and we propose that residents would pay 25% of their income in rent. Without having the expense of private land and housing, the goal is to ensure that a modest participation income would be sufficient to live well and sustainably. If we assume that income is a (very rough) proxy for environmental impact (Wiedmann et al 2015), we can also say that the Walden Wage would imply roughly an 85% reduction in impacts compared to the national average, on the basis that a Walden Wage at a level of the dole (currently $489.70 per fortnight) would be roughly 15% of the average Australian income.

Given the security of public housing and the many benefits of local collaborative development, this wage could be sufficient and even desirable. If shown to be viable, it's a way of living that represents a massive reduction in market dependence and certainly puts it in the ballpark of global sustainability. In short, we could end up with neighbourhoods that work – the name of our scheme.

The benefits and prospects

The best thing about this seemingly radical idea is that it isn't actually that radical. With the right support, it could actually begin now – given that the policy settings are already in place to allow public residents, who are over 55, to self-select into voluntary-work-for-the-dole programs. Such a pilot could show that access to land plus a participation income could help build genuinely sustainable forms of economy. If this pilot showed some success, it's not hard to see how one pilot could turn into two, and even be offered to some willing participants who were under 55.

The next phase could be slightly more ambitious. If governments could provide some more land (see Palm et al 2018), these public residents could not just develop relocalised, community economies around existing public housing projects, but actually participate in the building of their own homes, in collaboration with others, and under the guidance of experts. This would also reduce pressure on existing public housing, giving others the opportunity to participate in this scheme.

Also, providing these public residents with such an opportunity, coupled with a voluntary-work–for-the-dole scheme (reframed as the Walden Wage), represents a shift many on the political right may want too, in the direction of less passive and more active forms of 'welfare'. In fact, this policy would totally reframe welfare for those who self-select. If such an opportunity could be encouraged, the identity we give to public housing tenants who participate could begin to be uplifted and even celebrated. Their status in society, and how they might conceive of themselves, could move from being regarded as 'social dependants' to 'pioneers of a sustainable economy'.

What if things scaled up?

As more people are cast into unemployment by the automation of jobs, the globalisation of labour, or the phasing-out of high impact industries like fossil fuel power stations, it is highly likely that more and more people will require a new and sustainable housing and community development option like the one being proposed here. We should also remember that the so-called 'Golden Age' of public housing emerged as a result of governments having to deal with post-war economic reconstruction and the Great Depression. If challenging economic times lie ahead for the world again, then governments will *have* to respond as growing portions of the population are made redundant and cast into unemployment, as evidenced by governmental responses to the COVID -19 pandemic. Indeed, governments may *want* to respond, because otherwise there is the likely prospect of escalating poverty, serious security issues and political instability, since multitudes that cannot afford food or housing are a recipe for serious social unrest and decline. It is important that examples are provided in advance of deepening crises so that governments can see how best to respond when circumstances force them to act.

With the community economies we envision becoming increasingly self-reliant, it is possible that this ‘Neighbourhoods that Work’ approach, that started with the unemployed in public housing, could expand to include the growing numbers who have found themselves alienated from the market. This is where things get really interesting, and where our policy may show most promise. Once this local and cooperative sector of the economy started to flourish, it is possible that the sustainability dream may come into fruition – bike lanes weaving their way through food forests, with a few shared electric vehicles available for occasional use when necessary. We can imagine renewable energy micro-grids and large water tanks supporting these new communities on public land. And we can imagine people enriched by the process of participating in the building of their own sustainable homes (e.g. mudbrick) under expert supervision, and in collaboration with others. Soon enough, these pioneers, who have been liberated from a market mortgage or rent, may well be living as free eco-citizens in a thriving, local economy of sufficiency. With this structural economic shift from a market economy (private land and paid work) to a ‘commons economy’ (Wall 2014; McGuirk 2015; Baumann and Alexander 2019) (public land and collaborative local work), a degrowth transition to a steady-state economy may well be underway.

This work building new sustainable communities would ‘earn’ or justify the small participation income, providing many benefits – not only to participants, but also to the broader neighbourhood. As noted above, through the participants 15 hours per week in local sustainable productivity (collaboratively run community gardens, resource share schemes, and repair programs etc.), many neighbours could opt to be involved and enjoy collaborative benefits. Neighbours could also enjoy a greater sense of community connectedness. Importantly, all neighbours would also benefit from a much more sustainable future.

Empirical studies show that some simple living communities (Lockyer 2017) and strategies (Trainer et al 2019) can reduce ecological impacts by up to 90% or more, which is arguably the scale of downshifting needed to bring developed nations within sustainable limits of the planet (Trainer and Alexander 2019). Our policy provides an important aid to helping such sustainable communities and neighbourhoods proliferate, namely, by empowering people with access to land and housing (thereby freeing them from the lifelong debt of the mortgage/ rent and everything that goes along with it).

Over time, as the realities of globalised labour, technological job redundancy and environmental limits to consumer growth really start to kick in, thousands of these ecovillages could emerge within, and integrating with, existing urban societies. If this happened, we might at last see the planned contraction of energy and resource demands that is so clearly necessary for any degrowth transition to a sustainable, steady-state economy. Let governments be as ambitious as the Senegalese government, which is has announced a plan to establish and support 14,000 ecovillages (Olivier 2015).

As more people recognise the forthcoming dangers presented by the 'limits to growth' predicament (Turner 2019), we expect that the degrowth and steady-state movements will expand more broadly into the cultural consciousness. This is arguably already underway (Drews and van den Bergh 2016). When this larger sector of society sympathising broadly with degrowth also realises that governments and businesses will not lead a degrowth transition (given the various growth imperatives), the expanding social movement will be part of the drive to change from the grassroots up. This is a primary alternative strategy for deliberate societal change. More people will endeavour to live materially downshifted, post-carbon lives, only to discover that access to land makes that difficult. Frustrated by this barrier to living their values and exercising their democratic agency, the movement will shift its focus to how land is governed in society, in order to broaden access to land and housing, which would allow greater democratic freedoms to choose a sufficiency-based way of life without such extensive and prolonged market engagement. If such a movement for change was successful, people would no longer be under such constraining financial pressure to meet basic land and housing needs via extended market participation. Sufficiency-based living would be a viable option for more people through new land governance arrangements. This post-consumerist culture may expand the political imagination beyond growth politics and, over time, lead to more extensive institutional and structural changes that could take place in the direction of degrowth to a steady-state (Czech and Mastini 2020; Alexander 2020). We contend that the logic of this theory of change is sound, even if we accept that many social, economic, and political barriers lie in the way of its realisation.

Build a new model

Despite its foundational relationship to consumerism, land privatisation is a subject typically unseen or disregarded by most would-be environmental and social reformers, including, as we have noted, degrowth advocates and ecological economists more broadly. Even in the extremely rare cases where it is acknowledged, it is typically the view that any kind of land reform is extremely threatening to the private property status-quo, that it sits on the extreme Left politically, and so is not politically palatable or pragmatic. There is no denying that both ideologically and economically, Australia – and Western nations more generally – are societies deeply invested in land privatisation. Any mention of land reform is typically met with deep suspicion and deep ideological objection, even from those who might benefit most directly from new frameworks of land governance. Because of this, the most common response to the need for land reform is that it represents unachievable structural change, and that it's simply too big a project, given the limited time we must address what is clearly a climate emergency (Spratt and Dunlop 2017).

However, the widely held reform proposition – that we endeavour to 'green' capitalism through a shift to renewables – is simply untenable without a meaningful plan to halt perpetual growth (Hickel and Kallis 2019). After all, a growth-oriented world running on renewables will still be necessarily wasteful and consumeristic – and will certainly push us beyond environmental limits (Turner 2019). With countries like China and India now rapidly developing, the global trajectory of growth and consumerism over the next decade simply cannot be made sustainable through renewables alone – not in a way that will adequately address our now overwhelming environmental challenges (for literatures reviews examining the promise and limitations of renewables, see Floyd et al 2020; Alexander and Floyd 2018). Indeed, while green technological development and the shift from fossil fuels are essential to any sustainability transition, this shift will fail to achieve sustainability if it is not accompanied by a systemic shift toward ending our collective reliance on (and pursuit of) economic growth and high-impact consumer lifestyles (Daly 1997; Hickel and Kallis 2017).

However, in this chapter we have argued that without a new land opportunity that would free people from a lifetime of participation in an unsustainable market economy, we are socially, politically and economically constrained from achieving low-impact lifestyles consistent with planetary limits. We believe that experiments with ways to broaden access to land are indispensable to any degrowth transition, and since degrowth in some form is necessary to the ongoing inhabitability of Earth, we maintain that land access ought to be given far more attention by all those seriously concerned about sustainability, social and ecological justice, and the flourishing of the community of life on Earth.

We believe it is time to experiment with alternative frameworks that can increase access to land for housing. This would empower more people to explore lifestyles of reduced consumption, increased self-sufficiency, and local economic collaboration, thereby enabling a prefigurative degrowth transition to a steady-state economy and reducing pressure on planetary ecosystems. Our vision is that if people are provided with affordable rent through public land and housing opportunities to undertake their own sufficiency-based living experiments like Henry Thoreau, then many people would do so. Access to land liberates people from market growth and facilitates ways of living consistent with genuine sustainability. At the very least, it makes sense to support all willing pioneers and encourage their skill development and empower them to build new worlds within the shell of the old (Trainer 2010; Holmgren 2018).

As Buckminster Fuller (BFI n.d.) once said: 'You never change things by fighting against the existing reality. To change something, build a new model that makes the old model obsolete.'

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Chapter 9: The need for ecological ethics in ecological economics

Haydn Washington

Introduction

This chapter builds on the article in the journal *Ecological Economics* by Washington and Maloney (2020). I seek here to be thought-provoking in regard to the worldview and ethics of economics, and of ecological economics (EE) in particular. It is time for a serious dialogue to begin about this. For EE to be effective, sustainable and ethical (in the broadest sense) EE must embrace ecocentrism, ecological ethics and ecojustice. Neoclassical economics (NCE) is rarely analysed in regard to its worldview and ethics (Daly and Cobb 1994). However, EE is now in the same boat. Spash (2011) notes that EE has had historical problems with developing a coherent theory of value. Spash (2012: 37) argues that ecological economists: 'should not be afraid to articulate our ideological positions'. Spash (2012: 36) notes that EE has had an encompassing pluralism (advocated since the beginning of the field) which has led to a:

> … resulting incoherence and brushing over of fundamental conflicts between different worldviews and the need to question the validity of those views in light of reality.

In fact he notes (p. 40) regarding EE's historical commitment to pluralism that: 'acceptance of this as the natural order of things seems to condemn ecological economics to ultimate irrelevance'. Spash (2012: 43) raises questions as to EE's 'value commitments to the non-human'. He concludes that the case is strong for including commitment to an ethical significance of the non-human. Anthropocentric 'modernism' is central to how humans treat nature today. It is a historical movement that: 'begins with the Renaissance and extends to the present' (Oelschlaeger 1991: 68). Modernism operated through science, technology and liberal democracy. Modernism underlies the emergence of a profound anthropocentrism still dominant in the world, where nature is conceived of as 'nothing more than matter-in-motion' (ibid: 69). In response to the dominance of anthropocentrism, Curry (2011) and Rolston

(2012) argue that an ecological or Earth ethics is now vital for the survival of life on Earth.

While Daly (e.g. Daly and Cobb 1994) and Lawn (2007) *did* consider issues of ecological ethics such as the intrinsic value of nature, since then much of EE seems to have shied away from such discussion. This may be because mainstream economic approaches were from the outset brought into EE by various scholars. However, the original aim of EE for many other scholars was explicitly to move away from this orthodoxy (Spash 2011). As Spash (2012: 46) concluded:

> Ecological economics as a radical movement is required today, more than ever, in order to criticise and change the social organisations and institutions that spread false beliefs about economic, social and environmental reality.

Hence I argue that EE should transform itself to what orthodox NCE would consider 'radical', by explicitly advocating for an Earth-centered worldview, and for bringing human activities within ecological limits. Overtly adopting an ecological ethics is I believe part of this transformation. This chapter considers the definition of key terms, it then considers the centrality of worldview. It then discusses whether there is an ethics of economics and compares the ethics of various EE models. The chapter then discusses four steps to move forward - achieving ecocentrism, adopting Earth jurisprudence and the 'Rights of Nature', upholding ecojustice, and dealing ethically with the commodification of nature.

Definitions

Neoclassical economics (NCE) has been said to be an approach to economics focusing on the determination of goods, outputs, and income distributions in markets through supply and demand (Campus 1987). Together with Keynesian economics, NCE forms the neoclassical synthesis which dominates mainstream economics today (Clark 1998). Eight assumptions of NCE are summarized by Washington (2015), being: 1) Strong anthropocentrism; 2) The idea that the free market and the 'invisible hand' will control all that is needed (Daly 1991: 3) The idea that the economy can grow forever in terms of continually rising GDP (Daly 1991: 4) The refusal to accept any biophysical limits to growth; 5) A circular theory of production causing consumption that causes production in a never-ending cycle (Daly 1991); Ignoring the Second Law of Thermodynamics (Georgescu-Roegen 1971); 7) Environmental damage is merely an 'externality' (Daly and Cobb 1994: 8) All forms of capital can be substituted (= weak sustainability, Washington 2015)

Regarding **neoliberalism**, Springer et al (2016: 2) note:

> Most scholars tend to agree that neoliberalism is broadly defined as the extension of competitive markets into all areas of life, including the economy, politics and society.

In regard to **ecocentrism**, Washington et al (2017: 35) state:

> Ecocentrism is the broadest term for worldviews that recognize intrinsic value in all lifeforms and ecosystems themselves, including their abiotic components.

Ecocentrism sees humanity as *part of nature*, where human values don't end with humanity but encompass the rest of life (and indeed the land itself). It thus rejects the dualistic worldview common in Western society where humans are seen as separate from nature (Curry 2011). In contrast, in its strongest form, anthropocentrism has been described as 'human supremacy' (Crist 2012), where only the human has any moral standing (Kopnina et al 2018). Ecocentrism is thus the worldview under which we apply ecological ethics, and which foregrounds the belief that nature has moral standing in its own right. **Ethics** is about right and wrong or a theory or system of moral values. **Ecological economics** is not rigorously defined, as noted in the book introduction, but many agree that it *must* acknowledge the ecological limits of the planet (e.g. Common and Stagl 2005).

The centrality of worldview

Rather than refer to a worldview, some scholars refer to a 'paradigm', or ideology. However, whatever term one uses to describe this, a change of mindset in society is needed. Donnella Meadows (1997: 84) explained why worldview (or paradigm) are key for social change:

> People who manage to intervene in systems at the level of a paradigm hit a leverage point that totally transforms systems. ... In a single individual it can happen in a millisecond. All it takes is a click in the mind, a new way of seeing.

Why then is a change in worldview essential for society and EE? Because without it we will remain blind to the underlying real causes of our failures to reach sustainability (Catton 1982). A worldview such as anthropocentrism that limits all ethics, value and justice to humanity is unlikely to work practically when humanity is fully dependent on nature to survive (Washington 2018).The alternative is to adopt an 'ecocentric' approach. To accept the *intrinsic value* of nature for itself, and see the natural world as something 'sacred', of which we are a part (Taylor 2010; Curry 2011; Rolston 2012; Washington 2018; Washington et al 2017). Some scholars also point to the need to adopt an *evolutionary* worldview, which Thomas Berry (1999) has called the 'New Story', a new 'sacred story' where the evolution of the Universe and life is something we celebrate. Berry (Ibid: 200) concludes that:

> If the outer world is diminished in its grandeur then the emotional, imaginative, intellectual, and spiritual life of the human is diminished or extinguished.

Brown (2012: 5) suggests the evolutionary worldview: 'dethrones humanity and undercuts the presumption that human ownership is morally justified'. Such an evolutionary worldview is based on the respect and celebration of life, and hence is strongly aligned with ecocentrism and ecological ethics.

An ethics of economics?

So, is there an 'ethics of economics' within NCE? Brown (2012: 6) notes that: 'Our *ethics* are the residue of the crumbled foundations of metaphysics past' and hence need to be updated. Indeed he suggests current ethics are leading to a *zombie jamboree* or *danse macabre* (laying waste to the planet). Daly (2008: 3) argues:

> … the neoclassical view is that man, the creator, will surpass all limits and remake Creation to suit his subjective preferences, which are considered the root of all value. In the end, economics is religion.

Daly and Cobb (1994: 21) note they:

> … find it hard to suppress a cry of anguish, a scream of horror. We humans are being led to a dead end, we are living by an ideology of death and accordingly we are destroying our own humanity and killing the planet.

Neither ecological ethics, nor returning within ecological limits, are compatible with endless growth, or portraying this living world as 'just a resource' for purely human use (Crist 2012). NCE accepts no limits, and does not ascribe to nature any intrinsic value, hence what is 'desirable' to it is just growth. NCE thus reduces ethics to the level of 'personal tastes' (known as 'preference satisfaction', Wight 2015). Individuals set their own priorities, and NCE becomes simply what William Jevons called the 'mechanics of utility and self-interest' (Daly 1991: 20). Hence NCE does have an 'ethics', but it is strictly a *utilitarian ethics* based on a modernist worldview. Concern for nature is not expressible within the context of preference utilitarianism (Spash 2011). The big problems of overpopulation and overconsumption: 'have no technical fixes but only difficult moral solutions' (Daly 1991: 39). The current corporate ethic (adopted by many governments) seems to be to: 'use resources as fast as possible until they're gone' (Heinberg 2011: 253). Clearly, the ethics of NCE is one of endless growth, where this goal is seen as implicitly synonymous with human well-being (for it is insisted that the economy must grow - no matter the real cost). The growth ethic of NCE is also clearly seen as being far more important than the well-being of nature - which, while it supports society - is ignored. The ethical problems of neoclassical economics are thus fundamental if we seek a sustainable future, though they have to date rarely been foregrounded by EE.

What is the ethics of ecological economics?

Is there an ethics of EE? Apart from the steady state economy (SSE), most models of 'ecological economics' remain *firmly anthropocentric* (even if only implicitly so through their assumptions and language). The only model discussed in the table in the Introduction that overtly accepts the intrinsic value of nature (through its key advocate Herman Daly) is the steady state economy (Daly and Cobb 1994; Daly 2014). Intrinsic value is not discussed by other models associated with EE, and justice and equity are defined only for humans. Some degrowth advocates do speak of ethics, but it is almost always human ethics. The Green (UNEP 2011) and Circular (EMF 2014) economies do not overtly discuss ethics. They seem to operate from an anthropocentric ideology where nature has no intrinsic value. The Sharing economy similarly limits ethics to being only about humans (Matofska 2016). Doughnut economics (Raworth 2017) does mention the intrinsic value of nature, but equity and justice are just for society *not* for nonhuman nature. It is thus essentially human-centred, as it outlines how human activities must fit within Planetary Boundaries in a 'socially just' manner, but Raworth does not argue for ecojustice or articulate how the rest of the living world fits within this model.

Regarding social ecological economics (SEE), Spash (2011) does speak of ethics in regard to EE, but this is limited to current and future human generations. In regard to the ethical stance of the SSE, Daly (1991: 248) notes:

> It is widely believed by persons of diverse religions that there is something fundamentally wrong in treating the Earth as if it were a business in liquidation.

Daly and Cobb (1994) wrote the book 'For the Common Good' where the common good included nature. They observe (p. 379) that a: 'sustained willingness to change will depend on a love of the Earth that humans once felt strongly but that has been thinned and demeaned as the land was commodified'. So EE *did* have discussion of ecological ethics early on as part of the SSE, but this seems to have largely disappeared in other EE models. I believe it is time for EE to resurrect such a focus.

A step forward – achieving ecocentrism

If anthropocentrism is behind much of the environmental crisis (e.g. Berry 1988; Curry 2011), why would ecocentrism be better? Imagine an EE that moved overtly from anthropocentrism to ecocentrism, one that sought to bridge the divide between humanity and nature, one that acknowledged nature's intrinsic value. This could challenge the anthropocentric underpinnings of much of academia, and develop an 'ethic of ecological obligation', a 'land ethic' that widens the moral community to include the land, as Aldo Leopold (1949) suggested. This would support respect, responsibility and reciprocity towards nature, something virtually absent in Western culture (Washington 2018). To change our culture, Taylor (1986) thought we needed an inner change in our moral beliefs, from anthropocentrism to biocentrism and respect for nature. Similar sentiments have been expressed by Naess (1973), Ehrenfeld (1978), Shephard (1982), Berry (1988), Taylor (2010), Curry (2011), Rolston (2012), Vetlesen (2015), Washington et al (2017) and Kopnina et al (2018).

Rolston (2012) argues we are 'Earthlings', our integrity is inseparable from Earth integrity. Hence, people and their Earth have *entwined destinies* (Ibid). Environmentalists (and arguably ecological economists) should create a more comprehensive philosophy, complete with an ethics, cosmology (even stories of redemption) that could deeply affect people and change the way they live (Ibid). The Earth is not something we outgrow or rebuild and 'manage to our liking', it is the ground of our being (Ibid). An Earth ethics invites awakening to the greater story of which humans are a part. Humans need to move past resource use into 'residence'. Being a resident is something more than maximum exploitation. It takes us past 'management' to *ethics* (Ibid). Rolston (2012) argues we need to be liberated from our egoism, from humanism, into a transcending overview that sees the Earth as a blessed land, exuberant with life, filled with beauty and storied history. Ecocentrism and Earth ethics advance beyond human ethics in that they can treat as ends others besides humans. EE could thus play an important role in championing (and achieving) ecocentrism and ecological ethics.

A step forward - Earth jurisprudence and the Rights of Nature

A growing field of theoretical inquiry and practical implementation that could inform EE is 'Earth jurisprudence' (EJ), a term coined and articulated by 'geologian' Thomas Berry. Berry (1999) proposed that the challenge for humanity is to understand the underlying reasons for the ecological crisis, and to transform our relationship with the natural world from one of destruction to one of mutually-beneficial support. He suggests that acting ethically and living within Earth's natural capacities requires that we look to a new jurisprudence, a new way of governing ourselves for the challenges and possibilities of the 21st century so as to protect the integrity of Earth systems (Berry 1999).

Berry (1999) elaborated that the 'Great Work before us, the task of moving modern industrial civilization from its present devastating influence on the Earth to a more benign mode of presence', requires a change in governance structures and laws (Ibid: 7). Elements of EJ include deepening our understanding of the living world, understanding and living within ecological limits, recognizing the ‘rights of nature’ to exist. EJ also involves learning from and reaffirming the knowledge and wisdom of First Nations Peoples (Graham and Maloney 2019).

A step forward - ecojustice

Another valuable approach for EE to consider is ecological justice. Ecojustice is distinct from and more inclusive than environmental justice, and is concerned with other species independent of their value for humans (Schlosberg 2004; Baxter 2005). The simplest definition of ecojustice is justice for nonhuman nature. Washington et al. (2018) argue there is a great moral crime that society (and economics) have carried out for the last few centuries – ignoring that the nonhuman also deserves justice. Washington et al (2018) note that the common argument in academia is that justice and injustice are only applicable to relations among creatures considered ‘moral equals’. Dobson (1998) notes that sentiments of leaving nature and animals out of traditional theories of justice seem to come more out of a desire to exclude nature, and are not based on sound theoretical reasoning. These reasons usually centre around a fear of giving nature an equal moral footing. This is why for decades an academia dominated by anthropocentrism has refused to consider that nonhuman nature also has a right to justice (Washington et al 2018).

A step forward - dealing ethically with the commodification of nature

Scholars have put in a great deal of time discussing the value of nature (e.g. Kumar, 2010; Costanza et al 2014; Pascual et al 2017). However, valuation can contribute to the creation of a ‘commodity fiction’ that nature is pure materiality (Brondizio et al 2010). The danger of this is that the commoditized environment becomes a contrived artefact of itself, as ecosystems and biodiversity can be owned and traded in the market system for money (ibid). Brondizio et al (2010) and James (2015) explain that commodification of nature can remove non-material valuation of nature altogether out of the equation.

A key term to consider is ‘natural capital’. By using this term, society is effectively reducing the diversity of life down to just a ‘resource’ (Crist 2012) and a natural form of ‘capital’ for NCE to consider (Rolston 2012). Chesiera and De Groot (2003: 221) argue that such an appraisal of nature as capital: ‘simply reiterates the reductionistic and utilitarian vision of neo-classical economics’. Daly (2014) explains the confusion around the way the term is now being used. NCE was treating nature as though it was ‘income’ that can be consumed, rather than ‘capital’ that should *not* be consumed. Hence Schumacher (1973) and Daly (2014) speak of natural capital in terms of ‘stocks and flows’ of matter and energy in nature, arguing they must *not* be diminished. They were not arguing that it should be given a monetary value and commodified, quite the opposite. Daly (2014) argues strongly that nature *does* have intrinsic value. However, the monetarised meaning has now taken over almost all discussion about ‘natural capital’.

Monbiot (2014) argues that natural capital (in the commodified sense) is the triumph of neoliberalism, where we don’t speak of ‘nature’ anymore, for:

> It is now called natural capital. Ecological processes are called ecosystem services because, of course, they exist only to serve us. Hills, forests, rivers: these are terribly out-dated terms. They are now called green infrastructure. Biodiversity and habitats? Not at all à la mode my dear. We now call them asset classes in an ecosystems market.

He argues the monetary values derived for natural capital are gobbledygook, as we are dealing with values which are non-commensurable. It is notable that the ‘Natural Capital Project’ (https://www.naturalcapitalproject.org/) has zero discussion of the ethics of the commodification of natural capital. Even more worryingly, the focus by some scholars on ‘critical natural capital’ suggests that some natural capital is *not* in fact critical to humanity, and hence is not something to be concerned about (implying it would not matter if it went extinct).

Another key term is ‘ecosystem services’ (ES), which as defined is anthropocentric in that it is all about the services provided ‘to humanity’ by nature (Batavia and Nelson 2017). The term could have been defined differently (see also Farley chapter this volume), being the services ecosystems provide *all their species* (not just humans) (Washington 2020). Clearly, all species on Earth require the services that their ecosystems provide. However, that was not the definition used, and at present society and economics are stuck with this anthropocentric definition. Batavia and Nelson (2017) believe that the idea of nonhuman intrinsic value is certainly at risk, and will likely become functionally extinct if the ES approach continues to subsume conservation practice and policy.

Pascual et al (2017) suggest that ES be replaced by the term 'Nature's Contributions to People' (NCP). However, perhaps it is time to ethically consider an alternative term – 'People's Contributions to Nature'? Given that humanity is part of nature, the term is really short-hand for people's contributions to nonhuman nature. This is something a new EE could champion. Given the damage humans have done to the rest of nature, I believe this should become one of the major foci of economic activity. Key amongst such contributions would be granting nature intrinsic value and respect, and upholding a human 'duty of care' towards nature (Washington, 2018). Perhaps it is time to consider that if the anthropocentric and utilitarian ethics of NCE are flawed, this helps to explain why commodifying nature is also flawed (Washington 2020)? EE should research the inherent anthropocentric bias in natural capital and ES, and consider what the alternative 'People's Contributions to Nature' might involve.

Where do we *ethically* go from here?

Washington and Maloney (2020) suggest a 'new research agenda' to integrate ecological ethics into EE. Covering this in full is beyond what can be done here. However, some key points can be considered. First, adopting ecocentrism and ecological ethics could give EE the overall coherent vision that Spash (2012) notes it has lacked since its inception. Given that much of academia has been dominated by anthropocentrism, adopting ecological ethics would allow EE to test theories and models in terms of whether they are properly viable in terms of retaining an ecologically-sustainable world for both human *and* nonhuman nature.

If EE were to foreground ecological limits, plus foreground ecological ethics and ecojustice, it would have to consider the key drivers of *un*sustainability.

Environmental science has long referred to the entity Impact = Population x Affluence x Technology (Ehrlich, Ehrlich and Holdren 1977), which foregrounds overpopulation and overconsumption as drivers of unsustainability. Although many recognise the sensitivity of discussing overpopulation (e.g. Kopnina and Washington 2016), an EE that operates from a 'duty of care' to nonhuman nature could not ethically ignore this issue. EE should also explore connections with Earth jurisprudence, particularly the broader call for systemic change to modern society's governance systems (see Maloney this volume). EE should also adopt ecojustice (Washington et al 2018).

EE should apply ecojustice to the issue of nature conservation through the support of the 'Nature Needs Half' vision (Dinerstein et al 2017) (also called 'Half Earth', Wilson 2016). This aims for half of terrestrial lands to be protected in conservation reserves. This is a strategy that should massively reduce the extinction event currently underway (IPBES 2019). Part of such research would be applying ecological ethics and ecojustice to the academically popular idea of 'sustainable use' (which currently ignores these). The commodification of nature is in full swing, indeed it is promoted by some ecological economists (and even some ecologists). EE could examine to what extent this is driven by anthropocentric and neoliberal ideology and ethics. EE could research whether the entrenchment of anthropocentric and neoliberal ethics in neoclassical (and ecological) economics has been a key cause of ecocide (as argued by Washington 2020).

EE could expand existing research (e.g. Rees 2016) about the deep denial currently operating within both society and NCE (and also perhaps parts of EE) in regard to the impossibility of endless growth on a finite planet (Washington and Kopnina 2018). Part of this might be through examining why society thinks that GDP must *always grow*. EE could also research why society and governments – if they speak of 'justice' – speak only of social justice, and ignore the need for ecojustice for nonhuman nature. If ecojustice was commonly accepted by academia as being entwined with social justice (as society is fully dependent on nature, Washington 2013) then economics (of whatever type) would be more likely to treat nature in a respectful and sustainable way (Washington et al 2018). Another topic of interest for EE to research is the growing idea of *ecodemocracy* (www.ecodemocracy.net), where nature is given representation in governance systems.

Conclusion

NCE has rarely considered its worldview or what its ethics *is*. What is more surprising is that EE also rarely considers *its own* worldview and ethics. Indeed, EE seems to lack a coherent ethical vision. Accordingly, it is time for EE to review its ethical underpinnings. It should now foreground worldview and ethics. Society's current anthropocentric and neoliberal worldview has pushed it way beyond the sustainable ecological limits that EE originally argued society must operate within. Hence, EE needs to come out of the closet and *talk* about worldview and ethics.

A worldview that shows respect and accepts a duty of care towards nature is far more likely to retain the functioning ecosystems that support human society. Similarly, ecological ethics sits far better with an EE that (by many definitions) accepts the reality of ecological limits. Accepting a definition where the economy must operate within ecological limits means EE cannot rationally support the mantra of endless physical growth on a finite planet. Hence the ethics of EE needs to embrace the task of keeping the living world intact. EE should now become a *champion* of ecological ethics.

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Chapter 10: Environment, economy and equity: Towards a Green New Deal?

Frank Stilwell

Environment, economy and equity are interrelated concerns. Environmental considerations are fundamental, of course, but, as a society, we also need economic arrangements that cater for our material needs and wellbeing by providing useful work and equitably distributing the fruits of that economic activity.

Multiple, interconnected problems currently cause us to fall short of attaining these triple requirements. Most profound are climate change and the other environmental stresses caused by current patterns of economic production, consumption and transportation. The economic system is also not working well, even in its own terms, because periods of stagnation and recession recurrently threaten material living standards (Quiggin 2020). Moreover, the fruits of economic activity are not well spread: the benefits go disproportionately to the already most affluent (Piketty 2013; Stilwell 2019a). These are problems of environment, economy and equity that require radical redress.

The global coronavirus pandemic that began in 2020 may be regarded as a wake-up call. As a health crisis, morphing into an economic crisis and impacting most severely on disadvantaged social groups, it has highlighted the importance of collective remedial action. Even governments of normally conservative or neoliberal inclination have recognised the need for major economic and social policy changes, although these have come with promises of a speedy ‘return to normal’. As a society, should we now embrace more ongoing change to deal with the intensifying environmental, economic and equity challenges? What would need to be different? What could be a ‘new normal’ that is desirable and feasible?

This chapter reflects on the steps that would be necessary to move towards a more sustainable and equitable economy. It pays particular attention to the character and prospects for a Green New Deal. This is a strategy that combines the creation of ‘green jobs’ with redistributive economic policies and reduced reliance on extractivist and trade-oriented economic activities. While there can be no ‘silver bullet’ capable of simultaneously resolving all the economic, social and environmental difficulties, I argue that a Green New Deal can be a means of getting started on a transition to more equitable and sustainable socio-economic arrangements.

Framing and re-framing the issues

First, some comments on analytical method. As a political economist, I distinguish between three elements – the real world, the realm of ideas and the process of prescription. For political economists (arguably, for *all* social scientists), the primary analytical concern is to understand the social world as it is, including how its economic arrangements operate and affect society and the environment. The second concern is with theory, looking at how different conceptual 'lenses' reveal or conceal particular features of how the socio-economic arrangements work. The third concern is more explicitly normative, looking at what strategies or policies could contribute to better social, economic and environmental outcomes.

Recognising these three aspects of political economic inquiry helps to clarify, among other things, the oft-misunderstood difference between the economy, economics and economic policy. The economy is real: it may not be visible from a spaceship, but it is not simply an idea. Real people are everywhere engaged in economic activities, using land, products of nature and manufactured capital to produce goods and services - whether on farms, in factories, offices, shops, or on buses, trains, ships and planes. When economists – or any people – generalise about these economic activities, they create theories. It is these theories that are 'just an idea' or, more typically, sets of interlocking ideas. These economic ideas matter because of their ideological effects and influence. They may provide legitimacy for the current economic arrangements. Conversely, they may provide a basis for criticism of the *status quo* and for creating alternative economic arrangements in which people can achieve their material aspirations and/or live effectively within environmental constraints. This third element – the development of strategies and policies – involves using economic ideas for the purpose of social improvement, i.e. changing the world through strategic interventions.

On similar reasoning, inequalities of income and wealth are real. There are fabulously rich people and desperately poor people. However, ideas about why this situation exists vary enormously. Some economic theories, such the marginal productivity theory in neoclassical economics, represent people's income differences as reflecting differences in their productive contributions. Other theories treat inequality as resulting from unequal power, rather than productivity, thereby drawing attention to processes such as domination, exploitation and discrimination that compound inequalities based on people's gender, race or class. Arising from these different theoretical perspectives are characteristically different policy prescriptions, ranging from conservative 'laissez-faire' views to reformist and revolutionary prescriptions for comprehensive societal change.

These points show the significance of framing, reminding us that how we interpret our current societal arrangements influences how we act. In modern capitalist societies, the dominant framing is shaped by a particular orthodoxy that sees: (1) economic growth as the engine of social progress, (2) markets as the principal means of achieving economic efficiency, and (3) a limited role for government policies to 'fine tune' the economy when 'market failures' (such as environmental damage) occur. It is not difficult to show the deep flaws in these assumptions, both as a basis for understanding *what is* and for prescribing *what ought to be*. Heterodox political economists have been doing so for decades, showing the tunnel vision that results from looking through this particular econ-centric lens and the damaging consequences that result (Stilwell 2019b).

There is no shortage of suggestions for alternative ways of framing and tackling current environmental, economic and societal challenges, as other chapters in this book also illustrate. However, what is often lacking is a coherent view of how the desired social, economic and political change can actually occur. As I have argued in previous writing (Stilwell 2015, 2017), four elements must be present for this purpose: critique, vision, strategy and organisation. *Critique* requires cool consideration of the nature of the existing problems and the reasons why current policies are failing to resolve them. *Vision* needs deep thought about the preferred alternative. *Strategy* requires a pathway for getting from here to there. *Organisation* requires a social/political vehicle to take us to the desired destination. Together, these four elements are necessary for any coherent analysis and program. Otherwise, we're variously just grumbling, dreaming or acting incoherently.

Building on this type of political economic framing, the rest of this chapter considers the case for a Green New Deal (GND), looking at whether and how it could offer an effective way of dealing simultaneously with the three interrelated concerns of environment, economy and equity.

Green New Deal: Principal characteristics

First, it is important to be clear about the nature of GND proposals. While there is no definitive format (nor need for one), the following concerns are what I regard as key themes:

- Creating buoyant economic conditions for employment
- Restructuring the economy for ecological sustainability, creating 'green' jobs
- Pursuing equity through policies, such as progressive taxation and targeted public spending, including spending on workers' re-skilling
- Encouraging participation of First Nations peoples
- Changing trade patterns to put more emphasis on local production for local consumption
- Building on grass-roots activism to ensure that the political process is not 'top-down'.

Together, these six principles constitute a basis for a GND to deal concurrently with the problems of a deteriorating environment, a faltering economy and growing social inequality.

Support for a program of this sort has been gaining traction internationally over the last two decades. The New Economics Foundation and its chief economist Ann Pettifor began to advocate and popularise the concept in the UK (New Economics Foundation 2008), and it gained further international momentum from the publication of a report by the Worldwatch Institute (2009). More recently, in the USA, it was championed by Congresswoman Alexandria Ocasio-Cortez and enthusiastically embraced by Senators Bernie Sanders and Elizabeth Warren during their ultimately unsuccessful bids to become the Presidential candidate for the Democratic Party. Vigorous advocacy continues from Canadian public speaker/author Naomi Klein (2019).

Here in Australia, the GND idea made a tentative appearance at the time of the GFC when the Australian Conservation Foundation and the ACTU, together with some other NGOs, issued a joint statement emphasising jobs and the environment (ACF/ACTU 2009). It resurfaced in the context of deepening concerns about climate change and prolonged economic stagnation during the latter half of the last decade. In late 2019, it was formally adopted by the parliamentary leadership of the Australian Greens (di Natale 2019).

It has to be recognised at the outset that the GND has many critics. Predictably, opposition comes from climate-change deniers, including those with influential positions in the Liberal and National parties and from those sections of the media that routinely back reactionary political positions. Equally predictable opposition comes from sections of business, even though the short-term effect of a GND would be to create investment opportunities in the restructuring of industries, energy supply, systems, transportation and patterns of urban development. This reflects the capitalist class interests that are at stake. The owners and managers of capital, most notably the big corporations that dominate the national and global economy, regard a GND as a challenge to their prerogative to use capital however they wish, including the exploitation of nature.

On the other flank, environmentalists with deep green perspectives tend to be unimpressed by a GND that they regard as constrained by restrictive assumptions and too-modest ambitions. The anthropocentric character of a GND, for example, may be criticised because considerations of equity do not explicitly include non-human species (although, implicitly, one may presume that non-human species would be generally less threatened if the economy were restructured for greater ecological sustainability). The GND's failure to explicitly address the rate of population growth may also be a basis for criticism. GND advocates tend to take the view that, whatever is the rate of global population growth (which is difficult to reverse other than by authoritarian interventions), public policies embodying a GND would tend to reduce the environmental stresses resulting from that growth. Similarly, regarding growth of economic production, the general view would be that, whatever is the overall economic growth rate, a GND would reduce its adverse environmental impacts. This is because the GND's principal focus is on driving change in the forms of production, consumption and transportation to reduce environmental damage, not on slowing the overall rate of economic growth to zero. This somewhat agnostic stance on economic growth understandably disappoints advocates of a steady state economy.

Clearly, the GND is not a ‘purist’ environmental stance. Rather, it is a means of getting started on an overdue journey. It invites fellow travellers to come aboard even though the journey cannot guarantee arrival at all their desired destinations. It offers a pragmatic program of reform which has the potential to attract widespread popular support, including from working people wary of any political economic changes they fear will undermine the economic basis of their livelihoods.

Green New Deal: creating more jobs?

Employment has always been central to the notion of a ‘new deal’. This reflects the term’s origin in the social struggles in the USA during the Great Depression of the 1930s when the official unemployment rate soared over 20% (as it also did in Australia). Some new political economic direction was imperative and President Franklin D. Roosevelt’s New Deal policies were its basis. The primary political economic goal was to get the millions of unemployed people back to work, and public works projects were the principal focus. Some of the job-creation projects concurrently addressed environmental concerns. For example, work was created in planting approximately 3 billion trees, creating thousands of miles of windbreaks, in regions such as the ‘dust-bowl’ of the Great Plains where poor agricultural practices had contributed to the combination of environmental and economic calamity (Alexander 2018).

Meanwhile, in the UK, a more general theoretical justification for ‘interventionist’ policies to deal with the scourge of unemployment was being developed. John Maynard Keynes showed that creating the conditions for reduced unemployment would require economic stimulus. Governments in Britain and Europe were slow to act on these urgings, however, and it was not Keynesian economic policies *per se* but the Second World War that finally brought the Great Depression to an end. The rise of fascism, tapping into the prevailing social discontent of that era, was the key element. Millions of people were mobilised for expansionary military purposes in Europe - and subsequently in other countries around the world that joined the war. Keynes personally preferred the prospect of unemployed people being mobilised for productive and peaceful purposes – building houses, schools, hospitals and other social infrastructure. Indeed, after the Second World War, much work of that kind occurred in rebuilding war-devastated countries and expanding welfare states. Keynesian economics became part of the new economic policy orthodoxy – in tandem with, but never replacing, the still-dominant microeconomic theory of market efficiency.

These brief historical reflections provide a reminder that Keynesian policies can significantly soften, albeit not eradicate, capitalism's inherent crisis-tendencies. This is of obvious relevance now, more than a decade after the GFC, with the economy in a fragile state and sliding into recession, jolted further by the Coronavirus pandemic in 2020 (Rosewarne 2020). Even right-wing politicians normally espousing neoliberal 'free market' rhetoric have had to recognise the need for economic stimulus to prevent unemployment reaching levels that could threaten the reproduction of social order. The interesting question now is whether this emphasis on job-creation through economic stimulus should be more deeply embedded, rather than just a short-term response to economic crisis.

The promise of more jobs is a great source of a GND's potential appeal within the labour movement - and to all who are worried about the consequences of continuing economic stagnation, unacceptably high unemployment and welfare state cutbacks. But environmentalists and proponents of a 'steady state' economy may well ask: is the priority *really* just to continue cranking up the engine of economic growth? Isn't economic growth, as proponents of a steady state economy have consistently argued, the major long-run driver of environmental stress, particularly climate change? Eco-feminist Ariel Salleh made the point succinctly in relation to early versions of the GND when writing that 'the new green Keynesianism still rests on productivist assumptions' (Saleh 2010).

These important concerns require us to explore carefully in what sense, if any, a GND can be a useful means of creating both more employment opportunities and greater ecological sustainability. The potential 'bridge' is its capacity to steer the growth into forms of production, consumption and transportation that are based on less environmentally damaging energy sources and technologies. Can that can be achieved, making the effects quite different from the mainstream crisis-driven re-embrace of Keynesian stimulus policies? This is where the 'green' credentials of a GNP are crucial.

Green New Deal: how green?

Whether a GND is actually helpful from an environmental perspective depends on the details of the program and its implementation. Most obviously, it depends on what type of jobs it aims to create. Advocates of a GND say that the jobs growth must come through restructuring the economy onto a more ecologically sustainable basis (Heenan & Sturman 2020). Indeed, there is lots of potential for that – creating green jobs in producing energy from renewable sources, more energy-efficient transport, waste-management and recycling, better water infrastructure, more sustainable agricultural practices, building design and retrofitting, urban design, developing suburbs that are more ecologically sustainable, and much else besides (Pearce & Stilwell 2008; Alexander & Gleeson 2019).

A GND must therefore include detailed plans for creation of green jobs across the full array of industries and workers' skills. In this process, the identification of what actually constitutes a green job needs careful consideration, of course, bearing in mind the complex relationships between material inputs and outputs that are involved in many types of work. The concept of green jobs does not necessarily imply sharp division between what is green and what is not. The distinction between 'light green', 'mid-green' and 'dark-green' jobs (Goods 2011) gives a basis for a rather more finely-grained assessment, also opening up more fundamental questions about the nature and purpose of work as a process that is intrinsically embedded in nature.

There are important choices to be made about how changes in the structure of industries and jobs should occur. Making a plan is only a start: driving the actual changes is much harder. Governments do not have direct controls over what jobs are actually on offer in the private sector of the economy. Businesses have to be 'brought to the table' through planning processes, given incentives to 'do the right thing', and/or made subject to regulations about what is not permitted. How the various potential policy instruments, such as carbon pricing, subsidies, regulation and public ownership, are chosen and combined requires careful analysis of their effectiveness (Stilwell 2012). Clearly, a hands-off approach to 'environmental fine-tuning' cannot suffice. Governments have to make tough decisions about closure of extractive and polluting industries – displacing capital and labour from forms of production and transportation that violate ecological sustainability. Prohibiting new coal mines, phasing out coal exports and closing coal-based electricity power stations are examples with obvious current relevance in the Australian case.

These considerations indicate the need for actively interventionist industry policy as a central feature within a GND. They also show the type of challenges that a GND makes to capitalist economic ideology and prevailing systems of belief, particularly the sterile 'jobs *versus* environment' view that has dominated public discourse and opportunist electoral politics for so long. Restructuring for sustainability must open opportunities to progress simultaneously on both fronts – jobs *and* environment. Indeed, a deeper reconsideration of the nature of work is implied. As Heenan and Sturman (2020: 193) argue: 'as we transform the rest of nature through our work, work and the environment cannot be considered separately'. If work comes to be seen as a regenerative process – not defined purely by the wage-relation – this opens up yet deeper issues about care-work and the need for social control over work. While resolution of such issues is not a precondition for getting started with a GND, it can be expected that, as it matures, they would come increasingly into focus, along with concerns about equity.

Green New Deal: how equitable?

Much is made in social discourse of appeals to equity or fairness. Indeed, it is on this terrain that the prospects for broad public support for a GND are likely to rest.

At a minimum, equity requires that a GND include policies to help workers shift from unsustainable 'old economy' jobs like coal mining to newly created green jobs. The effects of dislocations like these should not impact disproportionately on vulnerable sections of society – a requirement that has come to be known as ensuring 'just transition' (see also Crossthwaite this volume). First and foremost, it puts the spotlight on education and training. The skills needed for the new jobs would need to be systematically nurtured through the educational institutions, a process made harder in the Australian case by previous government policies that have reduced the capacities of the Technical and Further Education system. Fortunately, there are some exemplars among European countries that have developed effective processes for workforce training and retraining (Galgoczi 2019), thereby facilitating industrial transitions of the sort that a GND must drive.

Second, equity requires that financial assistance be given to low- and middle-income households to cope with the costs of energy-retrofitting and the other modifications to their patterns of consumption that are necessary for more sustainable outcomes. This issue has previously been an 'Achilles heel' for policies like carbon taxes that make basic necessities, like electricity and transport, more expensive. The design of appropriate compensation arrangements is a substantial fiscal challenge.

Third, a GND should finance the necessary public expenditures through progressive taxation, so that the costs are borne by those with the ability to pay. More than that, a GND opens up the prospect of comprehensive tax and welfare reform. This has been made more necessary by the increased income and wealth inequalities that have occurred during the last few decades, reversing the compression that occurred in the quarter century after the Second World War (Piketty 2014). The deeply troubling consequences of this have been well documented in international social science research, showing evidence of the negative impact of inequality on educational standards, crime and incarceration, mental and physical health, among many other social variables (Wilkinson and Pickett 2009, 2018). Perhaps most interesting in the current context is the evidence of significant connections between the extent of inequality and the incidence of environmental stresses – including higher *per capita* CO_2 emissions, levels of water consumption and waste production (Dorling 2017). The cross-country correlations are far from perfect but generally indicate that the more egalitarian societies have less environmentally damaging characteristics.

Inequalities can be reduced in various ways if there is the political will so to do. The most obvious means are progressive taxation and public expenditures targeted to benefit poorer people. Improved public services and infrastructure can also significantly reduce the adverse effects of existing 'market' inequalities on wellbeing. Other policies, such as setting higher minimum wages and capping executive salaries, can limit the extent of 'market' inequalities. Public provision of basic income also sits comfortably within a

GND agenda, both because of its equity effects and its role as a buffer against the recurrence of economic recession.

Green New Deal: engaging Indigenous peoples?

A ‘politics of recognition’, alongside an economics of redistribution, is also integral to the development of a GND. In the Australian case, this means, first and foremost, involvement of First Nations peoples. There is potentially much to be learned from Indigenous communities about wellbeing, emphasising the fundamental importance, beyond jobs and money, of culture, spirituality, relationships to each other and to the Earth. The Indigenous people of Australia lived in this continent for over 60,000 years in a sustainable manner, so their historical credentials in relation to reconciling social and environmental concerns are second to none.

Much has changed in modern societies, of course, but there are also potentially significant elements of continuity that can draw on the knowledge of Indigenous peoples. For example, the principle of effective stewardship of a common natural heritage, particularly land and natural resources, can provide the basis for developing viable alternatives to the dominant capitalist emphasis on private property rights. How to manage and extend the commons is also now a big issue in modern political economic discourse (Obeng-Odoom 2020). Cooperative enterprises, with which some Indigenous communities have considerable experience, also constitute a potentially attractive alternative to hierarchical capitalist organisational forms and could be a significant focus (Johnson 2020).

In launching the Australian Greens’ commitment to a GND the party leader’s statement emphasised the need to ‘recognise historical dispossessions and provide justice for First Nations peoples – which means treaty, voice and truth-telling – and a leading role for them in driving the transition’ (di Natale 2019). This was a conspicuous commitment in a statement otherwise light on other specifics. Giving it practical effect requires attention to the process by which First Nations peoples’ views are articulated and heard - having a Voice is essential. The appallingly insensitive rejection by the Australian Government of the Uluru Statement from the Heart was a terrible setback in this respect. It is a wrong that must be righted for there to be progress in coming to terms with a divisive past and creating an inclusive future.

Green New Deal: reducing trade dependence?

The implications of a GND for international trade are also significant. Among the lessons arising from the Coronavirus pandemic is that heavy reliance on trade, based on the mainstream economists' principle of 'comparative advantage', makes national and local economies more vulnerable to crises transmitted from elsewhere around the globe. Further difficulties result when those crises then lead to the interruption of trade. These are strategic economic reasons why GND should emphasise, wherever possible, 'local production for local consumption', thereby reducing vulnerability and increasing resilience. Of course, there are environmental reasons to do so too: local production for local consumption would tend to reduce the volume of resources allocated to transport and the size of 'ecological footprints'. While not requiring the cessation of all trade, such a policy reorientation would pose a direct challenge to the 'free trade' ideals currently accepted across much of the political spectrum. The Coronavirus crisis has especially shown the importance of food and energy sovereignty.

Whenever rival principles operate – such as self-reliance and regional specialisation – some balance must be struck. What is appropriate requires careful case-by-case consideration of different industry sectors. Therein lies an important opportunity for a GND to develop a planning process including representatives from business groups, trade unions, community and environmental organisations. Industry policies developed in this way could foster the development and diversification of local industries that would enable the reduction of trade dependency and the associated vulnerabilities.

Green New Deal: growing from grass roots?

Since the adoption of a GND would be a start on a journey of socio-economic change, not an end point, it is crucial to consider how it could become the basis for an effective program of reforms that endure over time. Regarded in this way, the initial GND proposals would need to function as part of a 'transitional strategy', opening up the possibility of moving subsequently to more radical transformations as the process develops. Therein lie potential pitfalls: as Bernes (2019) argues, it can be difficult to adapt institutions and expectations built around short-term goals to more radical purposes down the track.

However, there is little prospect of implementing a more radical de-growth strategy or an explicitly anti-capitalist alternative right away. No major political party would countenance that and, in any case, there is insufficiently broad public support – beyond committed environmentalists and political activists who would be unlikely to agree on what should be done anyway. A GND with an initially reformist character is at least a feasible start in the Australian case, capable of being adopted (suitably re-named, if necessary) by the ALP or by a Greens-Labor coalition of some sort. Then it would inevitably become an arena of struggle between those trying to curtail or derail it and those seeking to move on to yet more comprehensive change.

Developing a 'bottom-up' politics would be necessary for the latter to have the stronger influence. In other words, the 'green' element in a GND cannot be only a matter of creating green jobs: it is also necessarily a matter of grass-roots green politics. This is not to deny the important role for governments – federal, State and local - in implementing GND policies. Indeed, a 'top-down' politics and public policies are implicit in the Keynesian job-creation elements within a GND, for example, as they are for redistributive tax reform. But the 'bottom-up' process originating from local initiatives and struggles is at least equally important, solving local problems wherever possible and keeping the pressure on governments to stay on the course with the broader policy program. For this sort of effective popular participation and support to develop, the movement for a GND would need organisation focussed where people feel directly engaged. Typically, this means their locality.

For this reason, it may be better to think and act in terms of Green New Deals rather than a single GND. Different communities and regions normally have different priorities, leading them to varied demands and expectations. Regional forums, engaging local people in drawing up proposals and devising actions for what is to be done, can facilitate this aspect of GND politics. Workplaces can be venues too, especially if unions grasp the opportunity for local engagement. Seen like this as a political process drawing on local initiatives, the development of a GND could develop momentum and widespread support nationwide, even internationally. Encouraging Australian precedents, drawing together people from different walks of life in common struggle, include the well-known Green Bans movement (Burgmann & Burgmann 1998) and, more recently, the Lock the Gate Alliance that brought farmers and environmentalists together in local groups to develop strategies to defend their interests and shared concerns (Hutton 2012).

Conclusion

This chapter has: (i) emphasised the importance of dealing concurrently with the environmental, economic and equity challenges; (ii) argued that critique, vision, strategy and organisation are key ingredients in any program to deal with these challenges; and (iii) examined the characteristics of a Green New Deal as a potential response.

A Green New Deal is based on a *critique* of the economic processes that exploit nature for profit. It presents a *vision* of an equitable society underpinned by an economy restructured on a more ecologically sustainable basis. It presents a *strategy* linking grass-roots action with policy reforms. It requires an *organisation* based in a popular movement that links environmental activists with the labour movement and at least one major political party. Thus it may be seen as having the four necessary characteristics to be effective as a political economic program. It offers a big step forward from just criticising the *status quo* or dreaming about utopia without any idea of how to get from here to there.

Comprehensive political economic change does not happen overnight, however, nor even in a few years: it has to proceed step-by-step. The first imperative is to get started. At the time of writing, during the economic crisis triggered by the coronavirus crisis, a GND looks particularly opportune. The sudden onset and likely persistence of widespread unemployment makes a quick ‘return to normal’ implausible. Many people are saying that it is not their aspiration anyway. Indeed, shouldn’t a preferable ‘new normal’ embrace real action on climate change, create more secure jobs and reduce inequality? Moreover, if politicians take the advice of medical scientists during a health crisis, shouldn’t they be listening more to climate scientists from now on? This is a context in which the GND looks timely, appropriate and potentially effective in driving substantial political economic change.

So, while a Green New Deal may not enthuse all environmentalists, for reasons discussed earlier in this chapter, it looks like a program and process that, with sufficient political effort, we could actually get started on. It could then be a basis for moving on to more systemic change. As a practical means of restructuring the economy for a more socially and ecologically sustainable future, it has potentially strong appeal. In an otherwise politically barren landscape, just to hear about this possibility can feel like a breath of fresh air. I hope that this chapter may add to that momentum - because there's not much time to spare.

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Section III: More specific solutions

Chapter 11: ‘New Water’ for a dry continent: Costs, benefits and improved transparency for Australia’s coastal wastewater outfall upgrades

Boyd Blackwell and John Gemmill

Introduction: The Problem

This chapter presents the findings from a research project on the net benefits of upgrading Australia's 181 wastewater ocean outfall systems. Upgrading these outfalls presents a unique opportunity in Australian history for a more optimal and fair use of the scarce water and nutrient resources of a dry and nutrient poor land. This chapter contributes to the theme of this book on solutions in ecological economics by considering ways in which unethical situations such as these can be solved through improved transparency. Australia is both the driest and most nutrient poor continent in the world. Hence, for an ecologically sustainable future, we need to reverse a situation where we dump 62 percent of our urban fresh water use (calculated from NOD 2020 and BOM 2019) and nutrients offshore. Nutrient pollution is a serious environmental problem (Washington 2013) and the world is running out of readily accessible phosphorus (Whelan 2020). Nutrient pollution is also one of the nine Planetary Boundaries that society has exceeded (Steffen et al. 2018) and needs to be reduced rapidly.

Until 2018, very little was known about Australia’s coastal outfalls including: (i) how much waste water is disposed into receiving coastal waters; (ii) where the outfalls are located; (iii) what nutrients and toxins are contained in the disposed wastewater, and (iv) what impacts the outfalls have on people and the environment. The reason for this, in our view, was because our institutions for managing wastewater were not well developed, and problems persisted with no national approach to wastewater outfalls (Blackwell 2008).

The Clean Ocean Foundation (COF) was formed as a response to the inequity of disposal of a large volume of Melbourne’s wastewater at Boags Rocks, Gunnamatta Beach, Mornington Peninsula, Victoria. COF identified that there was not only a problem locally but around Australia’s coastline, particularly near population centres. Combined with this was a lack of information on the outfalls which was generally hidden in licenses privately agreed between the water authority and with the state or local authority (Perraton et al. 2015). COF came into existence to fill this gap in information and responded to the inequity resulting for people living and recreating near outfall locations. Combined with this lack of information, there is a need to reform the institutional and governance systems over wastewater, so they better serve the people that they adversely impact.

Discussions began between one of the authors (Blackwell), whom at the time was an academic with the National Centre for Marine Conservation and Resource Sustainability of the Australian Maritime College and University of Tasmania, and officers from COF. Due to these discussions, the National Outfall Database (NOD) research project was conceived to reduce the information asymmetry and to provide greater transparency over wastewater outfalls at a national scale.

Now that the NOD (2018) has been operation for a number of years, data is available for each outfall on the volume of disposed water and its contents. This new information has allowed a cost-benefit assessment (CBA) to be undertaken on each outfall, at a state scale and for the nation as a whole. This chapter presents the results from this research as an initial step that will help guide funding of upgrades into the future. Further case specific research at each location would be needed to have a more definitive result for any given outfall – these results are only preliminary and future research is required.

While the CBA method used in this chapter is a mainstream neo-classical economic tool used and endorsed by all state, territory and national treasury departments, it does not represent the ecological economics (EE) approach – other than ensuring that non-market benefits and costs are included in the analysis. Despite this, even where the CBA is used, the findings endorse what is recommended by EE, reinforcing the recommendations provided.

As can be seen from the recent history of wastewater outfall management in Australia, there is a lack of ethics in considering the impacts on local people and their environments (Blackwell and Iacovino 2009). This maybe intentional, but it may also simply be a blind acceptance that the current institutions are serving the community well. We believe considering ethics forms part of an EE approach to the problem.

Wastewater treated to a higher level provides a greater opportunity set of applications relative to lower levels of treatment. This can include potable supply and for use in growing food and fibre. Examples of reuse include pasture irrigation and agriculture, industrial and commercial use, supply to local residential properties (toilet flushing and garden irrigation), turf farms, tree irrigation and pumped to reservoirs for reuse at a later time (South East Water 2020).

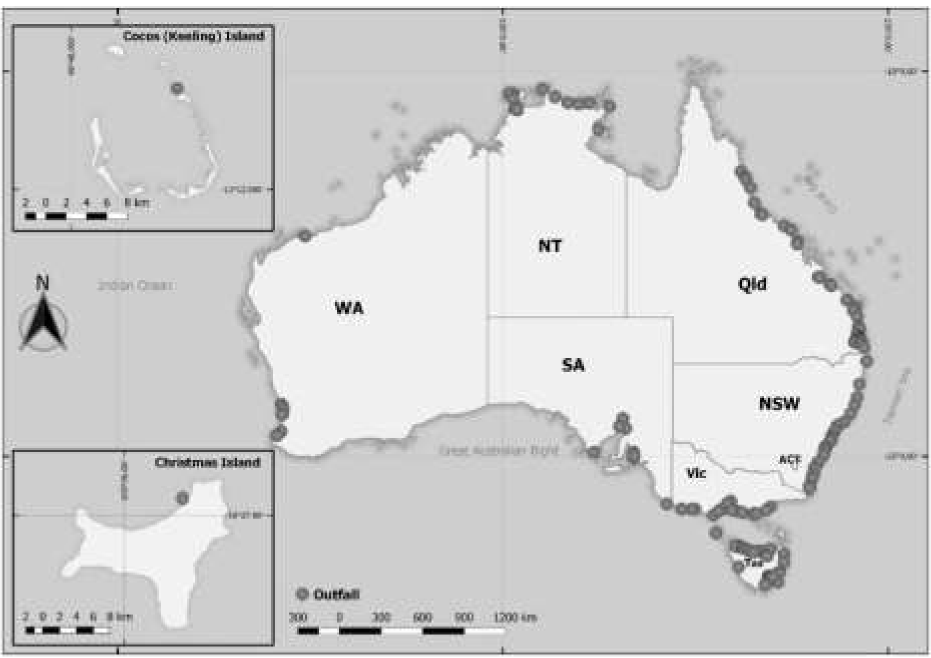
Higher levels of treatment also involve greater opportunities for resource recovery and as this chapter demonstrates, this includes recovery of nutrients such as phosphorous and nitrogen. Because these are important nutrients in agriculture, there are examples where these are captured and sold to farms as fertilisers (see Plenary Group 2020).Through the wastewater treatment process – moving from lower levels of treatment at level C and B to a higher level at A and A+, involves ultra-filtration and reverse osmosis which remove harmful organisms, salt and chemicals (Barwon Water n.d.). Disposing of these things into our oceans is at odds with EE principles as well as ethical treatment of coastal human (see Blackwell and Iacovino 2009) and non-human communities (see chapter by Washington in this volume). Higher treatment levels will reduce this tendency because the water and nutrients are reused, and harmful chemicals and other components are removed and disposed of responsibly – the creation of these chemicals in the first instance should be avoided if society upheld a consciousness of planetary boundaries.

The remainder of the chapter consists of five sections. Section 2 details some of the findings from the NOD to provide greater context to the policy problem and an outline of possible solutions including the need for a cost-benefit assessment (CBA) of upgrades. Section 3 provides the method of the CBA including the benefits captured and not captured in the study, how costs were estimated and the advantages and limitations of the analysis. Section 4 provides an outline of key literature findings undertaken as part of the study. Section 5 provides the results and Section 6 provides a discussion of the recommendations for improved transparency and equity. The chapter ends with a conclusion.

National Outfall Database Findings and Policy Context

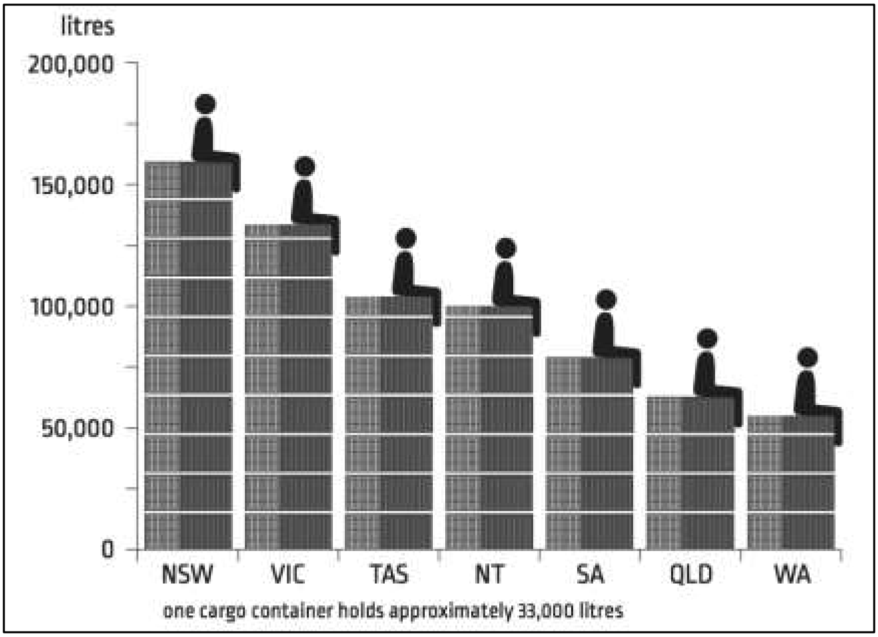
While wastewater impacts on the marine environment and ecosystems are obvious, these have not yet been properly addressed, and arguably this is because of poor institutional settings (e.g. see Blackwell and Iacovino 2009; Blackwell 2008). The NOD has identified that Australia has 181 coastal outfalls (see Figure 11.1) amounting to 1,350 GL of potential recycled water, almost equivalent to three Sydney Harbours (see Figure 11.2). Most, 99.9 percent, of the wastewater is freshwater, with 0.1 percent being nutrients and toxins, mainly consisting of phosphorous and nitrogen (Figure 11.3). While nutrients cause problems for the local marine environment, these are much needed inputs to agriculture. High pollution events have impacted coastal people from around the country, whom from the NOD's survey work (Rohmana et al. 2019a, b), believe there are problems in the communication of these events (i.e. transparency).

Figure 11.1: Australia's Coastal Wastewater Outfalls (Source: Gemmill et al. 2019)



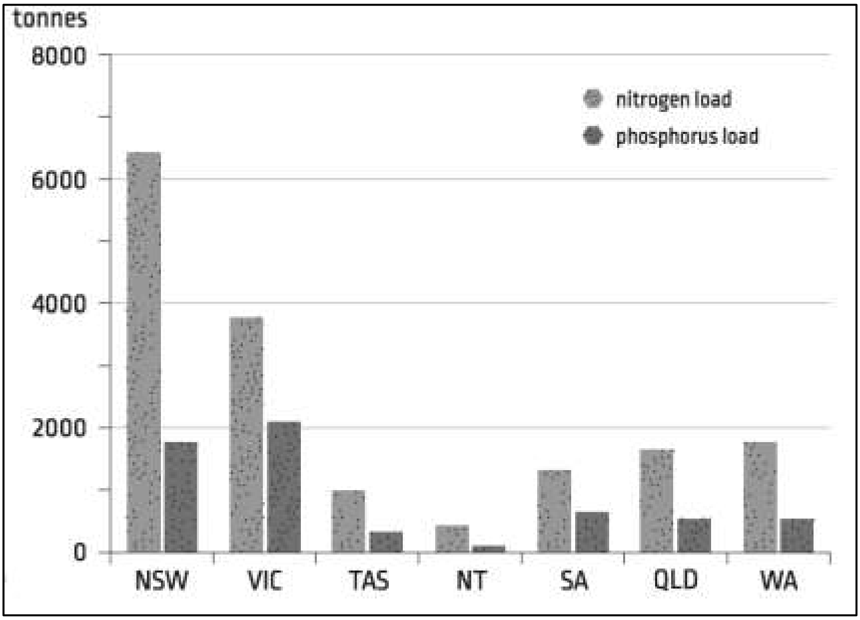
There is a concentration of coastal outfalls in capital cities (Figure 11.1) and the highest nutrient loads (lowest quartile) are concentrated near capitals and large population centres. Tasmania, given its relatively small population, is a particular poor performer (Figures 11.1 & 11.3). NSW presents the highest volume of wasted water per person (Figure 11.2) with high levels of total nitrogen (Figure 11.3) and Victoria has the highest levels of phosphorous (Figure 11.3).

Figure 11.2: State per person discharge, 2016 (Source: COF 2018)



Thirty seven out of a total 77 respondents interviewed observed between one and four water quality events in last 12 months (Rohmana et al. 2019b). Issues of water pollution were most likely caused by heavy rains, where stormwater was released (Ibid). Interestingly, more avid users of the marine environment did not observe more events or lead to greater awareness of the issues (Ibid). Sixty eight percent of respondents disagreed that they would expect to be notified of any water quality event and 75 percent believed they would not be informed in a timely manner of changes in water quality by local authorities (Ibid). Respondents who were aware of a local outfall believed they were not informed in a timely manner (Ibid). These findings point to problems of transparency in outfall performance and communication of pollution events.

Figure 11.3: State nutrient discharge, 2016 (Source: COF 2018)



The wasted water (62% of Australia's annual urban water use), is a significant resource in the world's driest inhabited continent with:

1. Severe drought which will have a long lasting impact on rural, urban and regional and remote Australia (even with the return of much needed rain, the stock numbers of most agricultural animals are well below the normal levels – meaning production will be down for years to come) (Jasper 2020)
2. Raging wildfire with catastrophic effects on people, property, wildlife and ecosystems as the various commissions of inquiry at the time of writing are beginning to reveal (NSW Government 2020; Royal Commission into National Natural Disasters 2020)
3. A shortage of water supplies (even after the return of rain) and
4. A high demand for tourism, recreation in marine and coastal environments with most of the population living near the coast (Paul 2020) – an immediate conflict results from pollution of local people's marine environments (COF 2020).

Given these compounding crises, what is the range of possible solutions? We outline a number of these along with their pros and cons in Figure 11.4. These solutions are listed from the easiest (5) to the most difficult (1) to implement given their adverse impacts on ecosystems and coastal human communities. This is done to reverse the order in which typical priority is given. Desalinisation and new dams present significant new hard infrastructure developments that replace or cause adverse impacts for ecosystems and coastal communities. Desalinisation has high energy costs. New dams have major adverse impacts on natural areas and downstream users. We argue that upgrades present the opportunity for use of an under-utilised resource, which uses the current infrastructure footprint, upgrades the current infrastructure system, removes impacts on the environment and society, and uses scarce resources more carefully. In fact upgrades can deliver a total of two thirds of the current use of water.

Figure 11.4: Re-prioritised solutions to meeting water demands

1. Upgrade wastewater outfalls to potable (A+)	2. Greenfield developments	3. Conservation/restrictions	4. Desalination	5. Build new dams
• Under-utilised resource ☑ • Uses current footprint ☑ • Upgrade current infrastructure system ☑ • Remove externalities ☑ • Use scarce resources more carefully ☑ • Can deliver total of 2 * current supplies ☑ • BUT…. ….What is the cost and what are the benefits ?	• Invest in new developments with 'closed-loop' water re-use ☑ • Prevents externalities from their source ☑ • Creates a new footprint ☒ • Requires an initial new allocation of water (with possible top-ups) ☒ • BUT… only marginal - mainstream not affected ☒	• Use current supplies more carefully ☑ • Invest in recycling opportunities ☑ • Quickly implemented ☑ • BUT…limited to current storage/supply levels ☒	• Can have water whenever needed and to volumes within the system ☑ • BUT…Very costly due to energy demands even with solar power ☒ • Externalities significant: loss of natural assets/large coastal footprint/displacement ☒	•Can create more secure supplies ☑ BUT…Significant cost ☒ •Might not work ☒ •Large footprint ☒ •Displaces current social, cultural and economic footprint ☒ •Significant impact on natural assets and down stream users ☒ •Time to build and commission ☒

As noted in Figure 11.4, the remaining question for upgrading wastewater outfalls is what is the cost to upgrade Australia's coastal outfalls, and what are the benefits? Because of this, NOD commissioned a study to undertake an assessment of the benefits and costs of upgrading Australia's 181 wastewater outfalls (Blackwell and Gemmill 2019). This represents a neo-classical economic (NCE) approach to assessing outfall upgrades, despite an ecological economic view that doing so is environmental heresy - throwing away water and nutrients in a dry and nutrient poor continent makes little ecological or economic sense.

Methods

Upgrades were assessed using cost-benefit analysis (CBA), an NCE approach which is mainstream in all states and territories and at the national level in Australia. In contrast, an EE approach would assess the long-term essential need to conserve scare resources (including water and nutrients) in the water and nutrient poor continent of Australia. Given the mainstream demand for a CBA as an NCE tool, we undertook this approach but are cognisant of the EE approach and are thus highlighting that here. Previously, a CBA was not possible, but now with the NOD, this assessment is possible.

The process of assessing the costs and benefits of outfall upgrades in Australia involved a number of key steps:

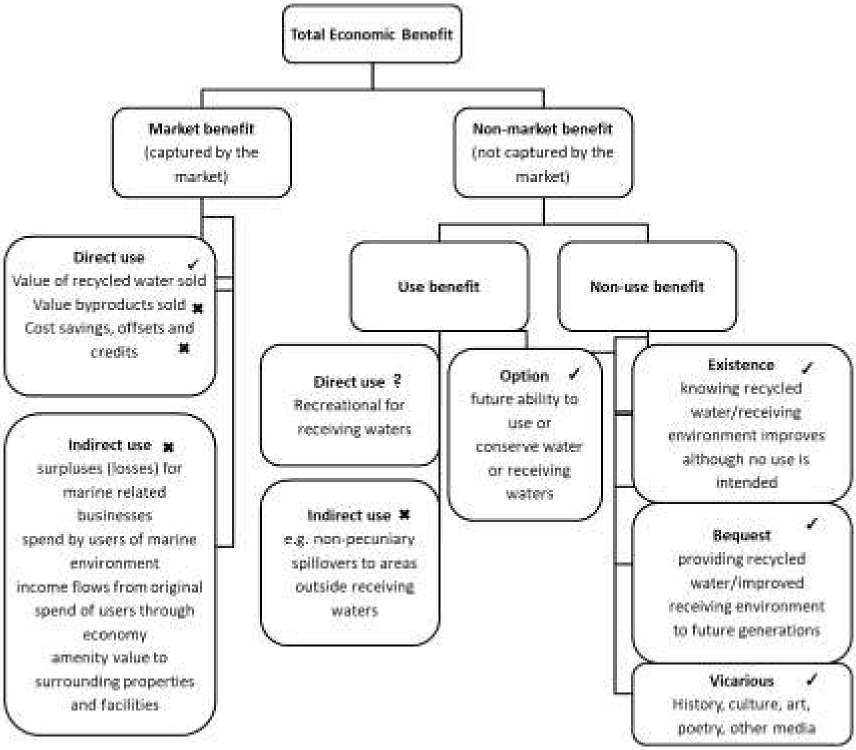
- Assess the benefits of reusing and recycling wastewater
- Estimate the costs of upgrades relying on capital and operating cost curves provided by East Water in Victoria
- Account for the time value of money through discounted benefit and cost flows
- Compare the costs to the benefits to see if there are net benefits [31].

Figure 11.5 outlines those benefits captured and not captured in this neoclassical cost benefit study using the transfer of values from Bennett et al. (2016). Market-related benefits involving the direct use of the value of the recycled water sold are captured but the value of by-products sold (nitrogen, phosphorous etc.) are not. The cost savings, offsets or credits created (e.g. reduced costs, reduced emissions etc. relative to base case) are not assessed by in the CBA. Non-market indirect use benefits are also not captured, as detailed in Figure 11.5 along with recreational benefits in the receiving waters. These non-market indirect use benefits interface with ecological ethics and the intrinsic value of nature and would be central in an EE approach. Option, existence, bequest and vicarious non-market and non-use values are included. Regarding Figure 11.5, it should be noted that because not all benefits are

[31] Net benefits are the difference between costs and benefits.

captured in the value transfer, the estimates provided of the benefits are conservative.

Figure 11.5: Economic benefits captured and not captured by the study. Notes and Source: Ticks represent benefits captured and crosses represent benefits not captured. Prepared by the authors.



The cost curves were provided by South East Water (Blackwell and Gemmill 2019). These curves were used to estimate the likely costs for any given outfall. These cost curves demonstrate the economies of scale in providing waste-water services, but as our literature survey demonstrated, there may be economies in micro-waste water treatment and resource recovery (Ibid).

There are several advantages and disadvantages associated with our approach (Blackwell and Gemmill 2019). The advantages include:

- First micro-scale assessment in Australia of the costs and benefits of coastal upgrades

- The estimates provide a comprehensive first pass assessment to help guide further research and
- Each individual upgrade should undergo a more detailed business case.

The limitations include:

- No transportation or pumping costs are included
- No distinction is made between primary and secondary treatment upgrades because all are upgraded to a tertiary A+ level of water quality
- Cost estimates are for a large wastewater service provider and therefore naturally advantage large scale recycling systems and
- Smaller scale systems maybe more efficient/effective despite economies of scale present in the cost curves (see Blackwell and Gemmill 2019 for greater discussion).

Key insights from relevant literature

The main findings from the literature review carried out by Blackwell and Gemmill (2019) include the following:

1) Switzerland, a land-locked country that sets world best standards in wastewater treatment, has undertaken a cost benefit assessment of micro-pollutants advocating that CBA is an appropriate methodology for assessing upgrades (Logar et al. 2014). Micropollutants have not yet been addressed in urban water treatment facilities in Australia, which from a human health perspective are concerning.

2) New circular economy views treat wastewater as part of the cycle of water and other constituents rather than viewing the end of a cycle being the disposal to the sea. Such a lifecycle approach to upgrade ranking is a preferred approach (Guven et al. 2018).

3) Rather than being called wastewater treatment plants, wastewater facilities should be viewed as and named ‘water management and nutrient and energy recovery plants’ (Apostolidis et al. 2011).

4) There is contradiction to the standard economic theory of economies of scale where micro treatment facilities exhibit economies in given contexts. It is likely that treatment upgrades may generate declining returns to scale,

though this should be assessed on a case by case basis for each location (Roebeling et al. 2016).

5) Cities and water authorities can attain the benefits of upgrades without investing their own capital up front through immediate long-term guaranteed cost savings and a 'Performance Contracting Funding Model' (Cavagnaro 2010, pp. 2, 7).

6) In the longer-term, rather than considering retrofitting centralised treatment plants, a broader set of more viable, possibly decentralised and incentive compatible solutions to sanitation should be included as part of a circular economy or a lifecycle systems view.

Results

Table 11.1 provides for each state and territory in Australia the number and type of coastal outfalls and upgrade flow. Australian urban water use in 2017-18 was 3,200 GL (BOM 2019). The total upgrade flows, assuming only 63 percent reuse, represents 62 percent of urban water use in Australia. The upgrade flow referred to in the table is only for plants that are currently treating to primary and secondary levels.

Table 11.1: Total 'New Water' Results by State or Territory

State	Estuarine (no.)	Ocean (no.)	Total (no.)	Upgrade no. percentage (%)	Upgrade Flow (GL)	Upgrade Flow / Total Flow (%)
New South Wales	-	29	29	64%	1,229	94%
Victoria	-	19	19	63%	84	13%
Queensland	40	11	51	53%	221	40%
Western Australia	-	12	12	83%	209	84%
Tasmania	27	14	41	85%	81	89%
South Australia	-	10	10	60%	113	67%
Northern Territory	-	14	14	100%	31	100%
Total	**67**	**109**	**176**	**64%**	**1,968**	**64%**

Notes and sources: NOD (2018); BOM (2019) and assumed 62% of urban water use is recycled drawing from the average of recycling projects across

Australia. There are 176 listed outfalls included here – this differs from the 181 stated at the beginning of this chapter because four further outfalls were identified in the NOD after the CBA was completed.

Nationally, the net benefits from upgrading Australia's primary and secondary grade treatment plants has a range of $12 billion to $28 billion (2019 dollars) for a cost of $7.3 billion to $10 billion (Blackwell and Gemmill 2019). With periods of 30 and 15 years and a discount rate of three percent, the net benefits or costs of outfalls are ranked by state totals in Table 11.2 (Ibid). The Northern Territory (NT) and Tasmania are the only states that have net costs. With a 15 year period of analysis Victoria joins the NT and Tasmania, exhibiting net costs. Regardless of the time period, the remaining states of New South Wales, Western Australia, South Australia and Queensland (ranked by decreasing size of net benefits) have net benefits sufficient to compensate the net cost states and still be better off. A full set of results including individual state and territory rankings and with other discount rates of six and nine percent are provided in Blackwell and Gemmill (2019).

Table 11.2: Net benefits and Costs of outfalls, ranked by state totals, 2019 $m, r=3%.

	30 years		**15 years**	
State/territory	**Net Benefits**	**Costs**	**Net Benefits**	**Costs**
New South Wales	18,769.8	6,959.4	10,118.5	5,552.2
Western Australia	5,318.3	767.3	3,060.0	646.5
South Australia	3,337.6	348.0	1,952.2	292.6
Queensland	726.5	1,003.3	182.5	871.1
Victoria	146.8	346.3	-0.5	300.8
Northern Territory	-46.1	109.2	-58.3	96.8
Tasmania	-457.4	588.5	-435.8	515.7
Grand Total	27,795.6	10,122.0	14,818.6	8,275.6

Discussion

This project is situated around two key issues – 1) water is scarce in the driest inhabited continent in the world; 2) nutrients are needed for agriculture and other uses in the most nutrient poor continent. The approach here has used a cost benefit analysis, a tool of neoclassical economics. This was used because this is what the funders of the research expected. We realise that a Cost

Benefit Analysis (CBA) has limitations and does not cover other issues that EE may consider. The point we emphasise is that even when using a CBA, the results show it is economically feasible to close ocean outfalls and recycle their water and nutrients. This is important, because it shows that change is possible even in the current economic system.

There are some key specific recommendations that result from this research and given the general policy context of a lack of institutions and transparency in wastewater management in Australia. A modified version of recommendations from Gemmill and Blackwell (2019) are:

- A target should be set for better performance and reduced waste such that all coastal outfalls around Australia are upgraded to meet the Tertiary Class A+ standard of recycled water by 2030.

- There is a need for adoption of National Standards for Reporting of Wastewater Treatment Plant (WTP) data including transparency criteria implemented as a prerequisite for WTP upgrade funding. It is recommended that an Initial 'Pilot' program be implemented for selected WTP upgrades. These could be in three locations around Australia for plants of different sizes and economies.

- To establish a working group to rapidly implement a set of key publicly available, National Reporting Standards relating to the operation of WTPs and their interaction with the environment. This group would comprise key industry, community, academic and government participants.

This would include standards to transparently evaluate:

a. Plant Performance:

1) Process Costs

This would ensure that the community and industry could understand whether a plant is reaching the upper limit of capability for operational costs and its impact on the environment and recreational users etc.

This is especially important for proactively identifying ageing infrastructure and the opportunity for capital upgrades involving options for recycling and climate change adaptation.

Parameters would include:

- Number of connections/population.
- Plant performance efficiencies measures such as operating costs, failures and remedial actions taken to ensure best practice nationally.
- Flows and composition and efficiency. Integration with real time, 24/7, publicly accessible data wherever possible e.g. bypass events and out of license discharges, number, and reason.

2) Environmental and Social Costs

Indicators of environmental monitoring e.g. the last time the outfall environment was monitored, and the results. This would include real-time assessments of the assimilative capacity of local receiving waters and whether these are being breached and the associated economic costs (e.g. losses in recreational, commercial and other values from lower levels of treatment).

3) National Standards and Management of Emerging Pollutant Issues

National standards are required for how WTPs engage and report on standards required for a framework to manage emerging pollutant issues (e.g. micropollutants).

- For transparency and community satisfaction with this issue, citizen science projects could be used in case examples for responsible agencies in better managing their outfalls and improved collaboration with communities. Examples include those from Chesapeake Bay in North America (Chesapeake Bay Foundation 2020). Other international and some domestic examples are also likely to be available.
- For potential economic incentives to accelerate this proposal, we suggest a review to help ensure greater incentives for transparency, and the building of trust and collaboration between wastewater stakeholders could be investigated including tradable pollution permit schemes. This review would naturally include an assessment of funding options for wastewater upgrades. Rather than being called wastewater treatment plants (WTPs), these facilities should be called water management and nutrient and energy recovery plants (WANERPs) (Halpern et al. 2012).

Conclusion

This chapter has shown that even when using a CBA that doesn't consider in detail key issues of ecological economics, upgrading Australia's coastal wastewater outfalls will deliver significant net benefits, and winners can compensate losers, and remain better off. This provides *prima face* evidence that there is inequity in the use of water and its disposal on our coasts. We suggest that this inequity is currently present, but that it becomes even more important when considering future generations and the ecological health of nonhuman nature in Australia. Considering the broader picture of an ecologically sustainable future, the recycling of water and nutrients in Australia is essential and would be a major step towards more sustainable cities (see also chapter by Lowe in this book) and towns across our regions, states, territories and nation.

Undertaking this first time assessment of the net benefits of outfalls around Australia's coast, has only been possible because of the establishment of the National Outfall Database (NOD) conceived by the Clean Ocean Foundation and funded by the Marine Biodiversity Hub and the Australian Government. Historically, very little information was available for wastewater outfalls but with the NOD, the amount of wastewater and its components can be documented. However, no long term commitment to the collection of this data has been made (though the Commonwealth government has committed funding for the coming financial year).

The situation also highlights several things that are important to the overall theme of this book. First is the need to recycle water and nutrients from ocean outfalls. Nutrient pollution from nitrogen and phosphorus is one of the nine Planetary Boundaries that society has exceeded (Steffen et al. 2018). The world also faces 'peak phosphorus' so we cannot afford to dump this resource off the shores of the world's most nutrient poor continent. Second is the need for improved transparency, and an overhaul of the institutional and governance settings for wastewater treatment and disposal. There is a substantial potential for providing 62 percent more water than is currently used (3 Sydney Harbours) by upgrading Australia's coastal outfalls. This chapter has suggested key steps that are required to provide the solutions to what is both an unsustainable and inequitable situation. These steps can form part of a National Policy to address these and provide areas where future research can targeted. Recycling outfall water and nutrients is thus a significant solution within ecological economics in Australia.

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Chapter 12: Just transition to a sustainable future without 'fossil' gas

Jim Crosthwaite

Introduction

Natural systems are dramatically changing as a result of human activity. Hydrological cycles, biodiversity, ocean chemistry, soil carbon and other systems are all deeply affected (Ripple *et al*. 2020). Overwhelmingly, the consensus of scientists is that greenhouse gas emissions, particularly carbon dioxide (CO_2) and methane (CH_4), are causing these problems, and that the world economic system needs to radically change by 2050 to avoid the catastrophic effects (IPCC 2018; Ripple *et al.* 2020).

Commonly known as natural gas, fossil gas is a big part of the problem because of both CO_2 and CH_4 emissions. Burning fossil gas produces 60% of the emissions per unit of energy compared to coal (IEA 2020). In addition, CH_4 is an extremely potent greenhouse gas that leaks during drilling, processing and transport (Ibid). CH_4 has a Global Warming Potential (GWP) up to 87 times higher than CO_2 over the 20 years before it oxidises (Balcombe *et al*. 2018). So CH_4 leakage over the next 10 years will have an impact up until 2050, the agreed date for reaching net zero emissions globally (IPCC 2018).

Fossil gas now comprises 22% of energy used world-wide, and by 2040 is forecast to grow to 25%, overtaking coal (IGU 2019). Moreover, it is receiving much attention as a transition fuel towards a net zero emissions future (ENA 2017a). This is highly problematic not least because methane leakage is greater than previously thought, expansion of gas production stimulates greater demand, and hence more emissions, and delays introduction of technologies for renewable energy and its storage (SEI *et al*. 2020).

Ecological economics, and its critique of neoclassical economics and its sub-discipline environmental economics, can help us to frame the issues at stake. The ecological limits to economic growth have been a central theme of ecological economics from its beginnings in the 1980s. Ecological economics defines welfare as applying within and across generations, and also emphasises the value of the natural world in its own right (Farley and Washington 2018). By contrast, environmental economics does not *consistently* accept the growth constraint, and it measures social welfare by aggregating the preferences of individuals, and treats pollution as an externality that can be priced (Spash 2019). Environmental economists (e.g. Garnaut 2019) give top priority to pricing CO_2 and other emissions, based on modelling that discounts future benefits to today's values.

Ecological economists, in modelling emission reduction strategies, call for conditions of ecological sustainability and equitable distribution of income and wealth to be satisfied *before* allowing allocation of resources through markets; the two approaches yield very different macro-economic outcomes (Lawn 2016). Considerations about ecological economics allow us to be clear about the necessary change, putting people and nature first, not profits. In other words, it should be a *just* transition. The idea of just transition grew from collaboration between union members and environmentalists in the 1980s; the focus was on protecting the welfare of workers in polluting industries threatened with closure (Stevis *et al.* 2019). In the late 1990s, the language of just transitions was adopted by climate campaigners, and over time broadened. For example, without any reference to workers or unions, Heffron and McCauley (2018) see the term as providing a unifying framework for three arenas of scholarship – energy justice, environmental justice and climate justice.

The aim in writing this paper is to focus attention on how fossil gas is integrated into our economic *and* political system, and to highlight solutions drawing on ecological economics. In order to mobilise widespread political support for transformational change, people have to be convinced that they will not be left behind now or in the future, as has happened in recent years (Barnes 2016; Maiden 2020). Hence the focus in this chapter is narrowly on the welfare, rights and agency of workers, and to a lesser extent, on consumers and communities that are connected to fossil gas. With a similar focus, Goddard and Farrelly (2018) have researched the potential for a just transition at Gladstone, a major hub for fossil energy in Queensland.

In the next section, we look at the fossil gas supply, its uses, the industry and its workers. Alternatives to fossil gas for households and business are briefly considered. Then governance of the gas industry is examined, and finally leveraging an end to the industry without leaving people behind. The scope of this chapter is fossil gas, not other potentially sustainable sources of energy such as biogas or hydrogen.

Fossil gas is embedded

Taking action against fossil gas is complicated because it is so well embedded into our economy and our daily lives, arguably more so than coal which primarily powers large coal stations. Fossil gas provides energy to millions of homes and businesses globally, through a large and diffuse workforce. Some of the world's largest corporations are involved in production, distribution and in financing gas investments.

Gas supply in Australia

The gas supply chain begins with exploration and production onshore and offshore. Domestic supply involves pipeline operations and storage, distribution and retailing. Export involves liquefaction and shipping. Gas to south-eastern Australia historically was mostly supplied from Bass Strait, Moomba and other lesser onshore and offshore fields. Pipelines, owned by just a few companies, criss-cross our regions and cities delivering gas to businesses and households.

Since 2016, production has escalated with the opening of new gas fields in northern Australia. Rival exporters built three export terminals for Liquid Natural Gas (LNG) at Gladstone in Queensland; together they cost an estimated $60 billion (Grafton *et al.* 2018). Australia now leads Qatar and the United States as the world's largest exporter, supplying massive quantities mainly to Japan, Korea and China (Robertson 2019). In 2018, exports accounted for 90% of the 1,386 petajoules of fossil gas produced in Queensland, while 443 petajoules was produced in the three south-eastern states (AEMO 2019). These exports were committed under long-term contracts. Unless some northern gas is reserved, other supply found or use of gas reduced, Victoria faces winter shortages in 2025, or even earlier, due to the exhaustion of the key gas fields in Bass Strait (AEMO 2020 cited in Forcey 2020). Lower quality gas from remaining fields is available, but its treatment will release significant amounts of CO_2 (Forcey 2020), an emerging problem also in northern fields (Robert 2020).

Figure 12.1 Gas pipelines in Australia. Source: ieefa.org, March 2020

Victoria has recently lifted a moratorium on exploring for gas onshore, which had been achieved after a long campaign by community, farmers and environmentalists (Walker 2018). An interconnector to bring gas from the Northern Territory, and drilling at Narrabri in New South Wales, are also planned or under construction (Grafton *et al.* 2018). Seeing an opportunity when fears of a supply shortage in southern states first arose, five companies began planning to build terminals to import and process LNG (Forcey 2020). AGL for example proposes a terminal in Westernport Bay, with AGLs former subsidiary APA Group building a connector pipeline to Victoria's main gas network. The extra cost, including transportation, terminal operating costs and pipeline charges, mean that prices will rise - not fall (Robertson 2019).

The industry as a whole receives direct subsidies of $12 billion per year from government (Market Forces 2019 cited in SEI 2020), while also benefiting from the activities of Geoscience Australia, fast-track project facilitation, and over $1 billion support for investment in infrastructure overseas (SEI 2020). State and territory governments are also important to supply because their approval processes governing exploration, development of new gas fields, pipelines and development approvals.

Domestic users

In Australia, industry uses most gas (254 petajoules (Pj) in 2018), followed by residential and commercial users combined (181 Pj), and then power generators (127 Pj) (calculated from percentages given in AEMO 2019). While 130,000 businesses use gas (ENA 2017a), most is consumed by large businesses, which are a logical priority for policies to reduce gas use. 70% is used by companies with 200 or more employees, 25% by those with between 20 and 199, and companies with fewer than 20 use only 4% (ABS 2019). A few very large companies use gas to produce alumina and other non-ferrous minerals, polyethylene and ammonia (BZE 2018). Making of food, paper and petroleum products are also important uses. From the perspective of this chapter, the small and medium size businesses across retail, manufacturing, mining, transport and construction are also important as they account for many workers and may be affected by changes in energy markets and government policy.

In 2014, 4.5 million Australian homes were connected to mains gas supply and 1.8 million used bottled gas (ABS 2014). Uses include cooking, heating water and space heating. Residential use is greater in the colder southern states. 29% of households outside of capital cities used bottled gas compared to 14% in capital cities (ABS 2014). Many community organisations use gas. Open space warehouses and offices are likely to also use gas. In the 10 years to 2015, connections nationally grew from 3.8 million to 4.8 million, at an average of nearly 100,000 per year (ENA 2019b). As the industry proudly states, rollout of gas infrastructure to new suburbs continues (OGT 2019).

Gas workers

Planning a just transition, in the meaning used in this chapter, away from fossil gas requires knowledge of who the gas workers are and where they work. If gas use is to be rapidly reduced, market forces will not guarantee a just transition for the many gas workers spread across many industries. Apart from exploration and drilling for gas, workers operate floating platforms, pipelines, LNG plants and ships. They distribute and retail gas to households and businesses. Gasfitters install and work on gas mains and on-site piping and appliances. In manufacturing, specialised workers operate gas-fired processes, or maintain and repair gas-fired equipment. Other specialist occupations include petroleum engineers, geophysicists, civil engineers, and safety inspectors. Many do technical or clerical work.

Consolidated figures that group all gas workers are not available. It is likely that between 50,000 and 100,000 people work in occupations related to gas. Some statistics include other workers, and some relate to just part of the supply chain. The oil and gas supply industry claims around 80,000 'direct and indirect jobs' (Murphy 2019). Another source reports that the 'Gas Supply industry employs over 14,000 workers nationwide across its four subsectors in gaseous fuel storage and distribution, gas retail, transmission operators, and distributors' (AIS 2019). The above categories include only some of the 6,800 specialised gas fitters reported in the 2016 Population Census (cited at https://joboutlook.gov.au/A-Z), while many general plumbers are also trained in gas fitting.

Gas workers are covered by at least seven unions depending on the nature of their work (abbreviated titles are AMWU, ASU, AWU, CFMEU, MUA, PPTEU, and TWU). Several of these unions have taken climate initiatives, which are highlighted on their web pages. Mobilising gas workers around a just transition will be difficult because of the dispersed workforce in different industry segments, the many occupations, and representation through several unions.

Gas industry governance

Understanding how the gas industry is connected to the state is critical to finding a speedy and just pathway to decarbonisation:

> The east coast of Australia is just about the only region in the world that allowed unrestricted exports in a liberalised gas market. (Sims 2019)

The gas industry depends on the state for its authority to operate. The state in turn helps to create favourable conditions for its operation (see Baer 2016 on coal). More generally, the state creates conditions favourable to profit-making (Jessop 2016), which over the last 40 years has included reducing the capacity of labour to organise (Greenwell 2018) and facilitating capital flows (Pettifor 2019).

Privatisation of the gas transmission and distribution systems (that were once managed by each state) was accompanied from the 1990s by the creation of a single market on the east coast. Oversight, regulation and monitoring have since passed to at least five national authorities, the same ones responsible for electricity. These are the Australian Energy Market Regulator, Australian Energy Regulator, Australian Energy Market Operator, Energy Security Board and Australian Competition and Consumer Commission (ACCC). In a nutshell, the aim in privatising the energy sector was to get out of the way of business, provide rules that all agreed to follow, and to regulate with a light touch (Richardson 2019). The International Energy Agency has guidelines for such a market (Shi and Grafton 2018).

In this environment, the gas industry is very active in promoting the industry, setting out its future vision and engaging government, as shown by the websites of the seven industry associations. They include Australian Gas Association (TAGA), Australia New Zealand Industrial Gas Association (ANZIGA), Australian Petroleum Production & Exploration Association (APPEA), Australian Pipelines and Gas Association (APGA), Energy Networks Australia (ENA), Gas Appliance Manufacturers Association of Australia (GAMAA), and Gas Energy Australia (GEA).

Regulators preoccupied with supply

Critical problems have emerged in the fossil gas market. Information asymmetry between producers, pipeline operators, wholesalers, retailers and end users hinder competition, and monopoly owners of pipelines are extracting rents from the market (Shi and Grafton 2018). In part the problems arise because of the new links to the export market. International prices now set the floor for domestic prices, which have moved from under \$4/gigajoule, lowest in the developed world, to one of the highest at over \$8/gigajoule. This has caused headaches for manufacturers unable to easily switch fuels, and created difficulties for low income or indebted households (Robertson 2019; ACCC 2020). Moreover, electricity prices are higher because gas provides much of the shortfall at peak times. A $1/gigajoule increase in gas price leads to the price of gas-generated electricity rising by $11/megawatt hour (ACCC 2018 cited in Garnaut 2019, p.87).

Many refinements to the regulatory system governing gas producers, pipeline operators and retailers have been initiated (ACCC 2020). However, inherent weaknesses in the market limit what can be achieved (Shi and Grafton 2018).[32] Moreover, gas and other fossil fuel corporations are finding their way around weak climate mechanisms such as trading emissions under caps in the Safeguard Mechanism (Mazengarb 2020). New research shows that governments are likely to manipulate health, safety or environmental standards to benefit industries in difficult times (Aisbett and Silberberger 2020).

Removing supply constraints is the priority of officials like Rod Sims, head of the ACCC (Sims 2019). Regulators do not seem prepared to examine carefully how demand-side management might be introduced, whether through energy efficiency and conservation, pricing mechanisms or incentives to shift to renewable energy. The most recent report from the ACCC forecasts demand for gas, but does not mention demand *management* (ACCC 2020). Likewise, AEMO in its Victorian Gas Planning Report Update (March 2018), does not investigate opportunities to reduce gas use, but focuses on augmenting supply, storage and transmission (AEMO 2018).

Gas corporations and power

Edwards (2019) helps to clarify the task ahead in challenging the state-industry nexus in relation to gas. In her book, she focuses on the mining tax, banking and other reforms that large corporations successfully weakened or defeated over the last 15 years in Australia. Edwards argues that large corporations exercise three forms of power - structural, ideational and instrumental (*ibid*). Structurally, major resource-based corporations are enmeshed in how the Australian economy currently operates, using inputs from many other sectors and generating much of the country's export earnings (Langcake & Poole 2017).

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[32] See also the commentary on governance by Bruce Robertson at https://ieefa.org/author/bruce-robertson/

In the realm of ideas, the gas industry engages actively in normalising their own role, through shared research programs, detailed submissions and public debate. Currently their research programs, conferences and lobbying focus on hydrogen-based energy, which is now regarded as central to the future of both the industry and the country. The joint industry 2050 vision sees fossil gas as an unavoidable transition fuel to a hydrogen future (ENA 2017a). The new *Future Fuels Cooperative Research Centre* (https://www.futurefuelscrc.com/), with governments, universities and 60 gas and pipeline companies participating, is focused on new fuels and utilising the existing gas infrastructure.

Finally, instrumental power is used to great effect: '… through engendering sympathy, reciprocity and shared interests' as well as donations, threats and corruption (Edwards 2019, p. xviii). Party organisations may be more susceptible to the harder forms of power than politicians and their staff who are encouraged to align themselves with the corporations (*ibid*). Economist Ross Garnaut refers to 'the wholesale regulatory capture of the regulator by the industry' with few exceptions (Parkinson 2019). Industry analyst Bruce Robertson has exposed how the authorities continued in 2019 to favour the industry in allowing expansion of the industry in the Northern Territory (West 2020). Investigative journalists have recently exposed ACCC staff taking presents from the regulated companies, including gas producer Energy Australia (Miller and Vedelago 2019).

Alternatives to fossil gas

Given the industry's powerful reach, credible energy alternatives are needed to bring about the rapid end to fossil gas use. I believe there is sufficient evidence that households and businesses connected to the electricity grid can more cheaply cook, heat water and heat spaces by using electricity than fossil gas (BZE 2013; Lombard and Price 2018). Households off the electricity grid may face higher costs in installing sufficient capacity to generate and store electricity, but biogas may be a realistic option for them. Australia's biogas potential is equivalent to almost 9 percent of Australia's total energy consumption of 4,247 PJ in 2016-2017 (ENEA Consulting 2019).

An Australian-first project to test whether renewable hydrogen derived from excess solar and wind energy can be used in existing gas networks and appliances to replace natural gas is underway in the Australian Capital Territory (Vorrath 2018). Replacing fossil gas with hydrogen and biogas and delivering them through the current pipeline system is being promoted by the industry (ENA 2017a). Currently at most 15% hydrogen can be added to the blend (Melaina *et al.* 2013; Ogden *et al.* 2018).

There is enormous potential for energy efficiency upgrades to residential and commercial property in Australia. The Energy Savings Industry Association estimates 120,000 jobs could be created over ten years, providing a very real opportunity to find alternative employment for workers in the fossil gas industry (ESIA 2019). There are upfront costs and transition hurdles that can be overcome with strong government programs. Residents and retail business owners can be told of the advantages of electrification when buying new appliances, and if necessary shown how to use them well. Forcey (2015) argues that policies and regulations that still equate gas to electricity as a fuel source need to end, and so do rules and subsidies supporting expansion of the gas grid.

There is a strong case for manufacturing to seize advantages offered by renewable energy, as identified by Beyond Zero Emissions (BZE 2018). Processes can be electrified in manufacturing steel, aluminium castings, plastic making, brick making, glass making and much more (*ibid*). Big reductions in gas usage may be achieved by focusing on the companies and industries that use the most. Hydrogen converted to ammonia and then reconverted at end destination could also replace gas use in industry (Garnaut 2019) with the cost now being competitive with fossil gas (Vorrath 2020). Drastically reducing gas use in other industries, namely mining, transport, building and electricity generation is also technically feasible, as Beyond Zero Emissions and Climate Works Australia have shown in their many reports (for example CWA 2020).

Leveraging a change

Ecological economics, leadership and narrative

Ecological economists can provide a narrative for our leaders that a better life is possible for all *without* fossil gas. At the broadest level, ecological economists can show that this is possible with the right public investment, but without further economic growth. A steady state economy (Daly 1991;

Washington and Maloney 2020) allows for the necessary public investment in the energy grid, ecosystem repair, shared transport systems, housing upgrade and culture that make improved wellbeing possible for all global citizens. This theme can be seen as central to the Green New Deal in its more radical formulations (see especially Aronoff *et. al*. 2019; Pettifor 2019).

Ecological economics can provide a bridge to new ways of thinking for leading activists in environmental groups, who may be influenced by neoclassical economics. We believe that most activists are familiar with elements of ecological economics that overlap with their world view – the role of an ecological ethics, a duty of care towards for nature, and use of the precautionary principle. However, obstacles abound. Spash (2020) warns of the problems of a pluralism whereby ideas and tools of neoclassical economics are uncritically used in a way that weakens ecological economics. Likewise, Aronoff *et al.* (2019) warn of the risks of compromising with elites in a soft version of a Green New Deal. Pettifor (2019) argues that steps towards a steady state will founder unless the state exerts public control over the financing of the Green New Deal, reduces the power of the finance sector and subordinates monetary policy to fiscal policy.

I draw on the work of Lawn (2016) and Pettifor (2019) to argue that ecological economics can help plan the transition away from fossil gas in roughly the following order, but emphasising first the ecological limits to economic growth, and with market mechanisms last:

- Helping develop a staged pathway for Australia to rapidly move off fossil gas, and to identify the public resources required as part of the transition.
- Setting of stringent targets for quantitative restrictions on the maximum amount to be drilled, and sold domestically and for export.
- Appropriate modelling of emission reduction strategies specifically for fossil gas.
- Proposals for effective demand management and energy efficiency measures.
- Guidance on revaluing infrastructure, fully accounting for negative externalities caused by gas emissions, and on possible future uses (e.g. pipelines).

- Reviewing gas market structures and operations in light of ecological economic principles.
- Using available powers to ensure arrangements between the large energy corporations and the financial sector are in the public interest.
- Proposals for taxes on profits or mechanisms to ratchet down emissions over time through tradeable permits or auctioning of rights to continue selling fossil gas, and how to best use the funds to equitably assist households and business in energy efficiency and adopting renewable energy.

This framework of thinking about our future economy is I believe the starting point for very positive messaging as an alternative to the current pro-growth narrative that supports the gas industry. Implicit messages from a new ecological economic framework are that fossil gas is not necessary for households and businesses, gas is a poor transition fuel, the state has viable alternatives to support instead of this industry, there are viable alternatives for gas workers, and the wellbeing of all can be safeguarded. Ecological economists can advise on options for coordination of economic management between all levels of government, workers and community groups, such that the latter remain empowered (Aronoff *et al.* 2019). The 2019 Australian election result suggests that many in the electorate have been deeply affected by structural change, have insecure work, are worried about their future, are risk-averse, and do not trust their leaders (Maiden 2020). Opportunities for opposition will be reduced if people connected to fossil gas are engaged in planning for a fast transition.

Giving workers a future

Stevis *et al*. (2019) argue that the spirit of the just transition concept requires union power to represent workers. This power comes from the legal rights to associate, bargain and take industrial action. They argue that these rights have been critical in the past to how the benefits of change are distributed. In examining the potential for a just transition at Gladstone, Goddard and Farrelly (2018) strongly argue for workers and unions to be part of the 'actor networks' planning for energy transitions, or otherwise risk backlash. Key to a just transition in the gas industry are job guarantees and worker transfer schemes where workers are transferred from companies undergoing closure into other viable enterprises. Cooperative ownership may also be feasible for smaller gas enterprises and groups of gas fitters and other workers to find alternative work. Earthworker Co-operative which manufactures hot water systems provides a relevant model (https://earthworkercooperative.com.au/).

Adjustment programs can be designed to ensure that workers and their families are not left behind or in precarious situations. As the textile and car industries closed down, many workers remained jobless, others worked fewer hours than previously, were paid less, and had to hold multiple jobs to make ends meet (Barnes 2016; Toscano 2019). There are precedents with better outcomes; in the 1980s waterfront and printing workers secured redundancy protection in the face of technological change, though only after protracted industrial campaigns (Deery 1982). Unions can potentially coordinate action by gas workers to secure their future. However, in the absence of a nationally coordinated campaign, this may not be a priority for them where their members are widely dispersed across many industries.

Alternatives for business

Climate change has lifted the stakes in regard to reducing business consumption of fossil gas. Co-ordinated government policy on demand-side management (DSM) for gas and electricity can make a major difference if it encompasses energy efficiency, energy conservation, demand response, on-site generation and behind-the-meter storage (Warren 2019). Industry can become more efficient profitably and reduce use of gas, as identified in a collaborative industry-government project, although relatively little action by government was proposed (CEFC 2018). Important barriers that could hinder take up of opportunities without substantial assistance or incentives included: lack of management skills and experience, long payback periods for investments, complexity of the changes and, especially for small business, the cost of hiring external expertise (which may outweigh the private gains).

Conclusion

The IPCC (2018) has argued that humanity has 30 years to act on climate change and reduce net carbon emissions to zero. However, each year brings the prospect of crossing over key climate tipping points. Solving the problem requires rapidly ending fossil gas production and widespread use. Using fossil gas as a transition fuel is not sustainable. However, fossil gas is everywhere.

The neoliberal thinking that prioritises free markets will not directly address its extensive use, or the needs of the people connected in one way or another to the industry. Government action is currently driven by the needs of corporations, and the regulatory framework is manifestly weak. Bringing about change requires a deep understanding of what the industry's leaders, workers and customers are thinking and doing, as well as the mechanisms through which the industry is supported by the state.

As outlined, ecological economics offers a framework for analysing and explaining the issues, setting priorities and identifying the tools to bring about a rapid transition away from fossil gas. It sits well with the narrow sense of 'just transition' as used in this chapter, and with mobilising communities of people across Australia in support of ending the use of fossil gas.

I believe an ongoing priority for ecological economics is how workers and households can be engaged in, and protected during, the transition to a sustainable future. Other areas for further ecological economics research include the international dimensions of fossil gas, the linkages of the industry to the financial sector, and the sustainability of a pathway that uses biogas and hydrogen instead of fossil gas.

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Chapter 13: Transitions stories in ecological economics from the Australian 'bush'

Anne Jennings

Introduction

This chapter discusses a study that is one component of a broader project, *Kimberley Transitions*[33]. The project includes five PhD studies that cover a diverse range of themes, exploring whether: 'solutions to Kimberley problems are in Kimberley-based knowledges and ways of knowing, doing and being' (Wooltorton et al 2019 p. 4). The unifying thread through the studies is transformation to a more socially and ecologically just society for current and future generations.

Essentially, *Kimberley Transition's* vision is for people:

> … to learn to live and work as if the future matters – every person's future – properly informed by locally inclusive knowledges of caring for Country: living in deep, intertwined relationships with land, rivers and saltwater places, and with each other. An intertwined vision is also to learn from post-settlement Kimberley stories, persons, events and activities (Wooltorton et al 2019, p. 5).

Aligned with that vision, this paper advocates for grassroots ecological economics approaches to social and ecological change. Progressives[34] are calling for change 'embedded in interdependence rather than hyper-individualism, reciprocity rather than dominance, and cooperation rather than hierarchy' (Klein 2019, p. 98). One place to do this, it is proposed, is by and with community - both human and non-human community (Maloney 2017; Poelina 2019; Washington & Maloney 2020). Whilst I'm concentrating on exploring activity within the human community, the non-human community is implied, recognising their intrinsic importance as encapsulated in Aboriginal 'First Law'. Poelina (2019, p. 144), a Nyikina Traditional Owner in the West Kimberley, explains First Law comprises people's relationships: 'with each other, our neighbours, and most importantly our family of non-human beings –

[33] The Kimberley region covers the north west of Western Australia – see the 'Broome town and Kimberley region' section in this chapter.
[34] Klein's term.

animals and plants'. Washington and Maloney (2020) concur, calling for consideration of a new approach to ecological economics, one that moves from 'Nature's Contributions to People' to 'People's Contributions to Nature'. Further, the *Kimberley Transitions* process recognises the cultural beliefs and practices, intellectual life, wisdom and experiences of generations of Aboriginal people, whilst acknowledging continuing post-settlement efforts to maintain and strengthen cultural knowledges and ecological narratives (Wooltorton et al 2019).

The practice (ways of doing) framework for this paper is Community Development (CD). CD, which includes communities of intent, interest and/or geographic location, is the process whereby people organise to inform, skill and empower each other to take collective action on jointly identified needs (Kenny 2013; Ife 2013; Muirhead 2020). Those needs can necessitate a wide range of actions to overcome social disadvantage through to climate change mitigation. As Ife (2013 p. 2) defined:

> Community development represents a vision of how things might be organised differently, so that genuine ecological sustainability and social justice, which seem unachievable at global or national levels, can be realised in the experience of human community.

Overall, CD involves strengths-based approaches that:

- Begin with a focus on the strengths of community.
- Recognise that development can be community-or outsider-initiated as long as it is by the community, *for* the community.
- Build the capacity of members to drive their own development by starting with what already exists.
- Apply a social justice approach by building inclusive and resilient communities.

(Kelly et al 2017, p. 101).

Broome town and Kimberley region

Broome is located in the Kimberley region in the north west of Western Australia (WA), 2,240 km north of the capital city Perth. The landscape includes large areas of wilderness characterised by unspoiled deserts, semiarid savanna, rugged ranges, spectacular gorges and a largely isolated coastline, which is home to significant, and unique topography and biodiversity. The 2016 Census figures indicate Aboriginal and/or Torres Strait Islander people make up 41.6% of the Kimberley population, compared to WA state average of 3.1%, with the total for Australia being 2.8%. The Broome town site has a permanent population of 16,000 people, which expands to around 40,000 during the peak of the tourist period, the 'dry season' - when it is winter in southern areas of the continent.

Case Studies

There is a call in many towns across Australia and beyond for community-based economies that can respond to concerns relating to declining local and regional economy, environment and lifestyles (Dodson et al 1999; Kenyon 2005). This can include efforts to move away from the dominant neoliberal economy to multitudes of sustainable local economies by embracing new activities such as mutual financial societies, employee-owned firms, community development and social enterprise agencies. Various scholars argue that alternative approaches should be backed by governments at all levels, to support financial shifts from transnational corporations into local efforts (e.g. Klein 2019). I recognise however that in today's political environment this is certainly challenging.

The following case studies provide examples of small-town revitalisation projects (Kenyon & Black 2001). These initiatives exhibit valuable social, economic and environmental efforts resulting in local change. The case studies provide contextual data relating to what is happening, then moving beyond the descriptive by exploring surrounding contexts and determining relevant causes and effects. This section commences with provision of a previous Broome example that commenced 50 years ago, before moving on to a diverse selection of current activities.

Historical Case Study - Bishop Raible Cooperative

The Bishop Raible Co-op was established in Broome during the early 1970's, at a time when criticism of both Church and government for past actions was increasing. Such criticism included lack of respect for Aboriginal language, law and social structures, and forced separation of many Aboriginal children and their natural parents (McMahon 1992). Government was then engaged in the top-down dominant welfare system, with the Catholic Church seeking to return to the more spiritual approach, reducing hands-on practical assistance (Ibid).

The Co-op started when two local Aboriginal women successfully sold second-hand clothing to fund Kimberley people travelling to a Church Congress in Melbourne (McMahon 1992; Wood 2004). About the same time an Aboriginal man approached Fr. McMahon with an issue relating to a hire purchase agreement. The Church assisted with a loan to tide him over. This led the priest to explore raising money to lend to buyers so they could make purchases and repay the program, with no danger of having them repossessed. These two occurrences triggered the establishment of Bishop Raible Cooperative, starting with microfinance and the second-hand shop. Previously, there was no retail furniture outlet in the town so one was soon added, proving an instant success.

Formality was kept to a minimum; members paid a $10 fee and they received interest free loans. In 1974 a funeral operation was launched. At the time it was not uncommon for backhoes to be used to fill in the graves, which for Aboriginal people was culturally inappropriate, especially when mourners were still in attendance. This new service enabled the community to take control of this essential spiritual and cultural event (McMahon 1992). It was later expanded to the whole community when the other service closed down. The Co-op grew, developing Aboriginal management and became a significant employer of Aboriginal labour. Legal incorporation followed, independent from, but working closely with, the Church. A food store, named 'Mungarri' - a local Aboriginal word for food (Ibid) - was also established. As well as the town, remote Kimberley-wide communities were able to purchase goods at reasonable cost.

Fr. McMahon reviewed the project in 1992, as he was leaving Broome. He lamented Aboriginal people had not adequately benefited from employment in the broader community, as their population distribution should suggest. McMahon (1992, p. 21) felt that: 'probably the solution lies in more Aboriginal-run and -controlled enterprises which will bring direct economic benefits and employment opportunities to these people who are such a significant group in Kimberley society'. Further, he concluded (p. 18):

> My experience in Broome has led me to the deep conviction that liberation theology has much to offer the Aboriginal people. I have come to this conclusion on both practical and theoretical bases. Poor people, because they lack lines of credit, are wide open to exploitation. Poverty forces people to go without things that others take for granted.

Time moved on. By 2004 many of the Cooperative's original functions ceased, due to the growth of the town and its services - all except for the funeral service. This function was finally replaced by a new commercial one, with the Cooperative's legal status being cancelled in 2008. Local Aboriginal and non-Aboriginal people continue to pay tribute to the changes the Co-op made to their lives - culturally, socially, economically and practically. Overall, the Cooperative assisted in developing a community ethos based on people from mixed backgrounds working collaboratively to generate social and economic change for themselves and their wider community.

Current Case Studies

Agunya Ltd.

Agunya is a locally initiated not-for-profit (NFP) social enterprise that offers young Aboriginal people opportunities to develop practical skills and training in carpentry, building and construction, creative woodwork and related craft proficiency, plus personal development and communication skills. The enterprise has been described as a community creation franchise focused on supporting social enterprise, health, ecological sustainability, self-empowerment and equality (Agunya n.d).

Mr Andy Greig Agunya's founder, a non-Aboriginal person, works both independently and collaboratively with other organisations and businesses to upskill the young people on their journey to becoming contributing members of their communities. The organisation receives little direct government funding, usually irregular one-off grants, however many trainees are referred to Agunya from, for example, the Transition to Work program operated by *Nyamba Buru Yawuru*, the Traditional Custodians and Native Title Holders of Broome. Agunya also works closely with *Many Rivers*, a microenterprise NFP that provides support to Indigenous and other Australians who are excluded from economic involvement due to a lack of financial or practical business support. With its partner organisations Agunya walks alongside participants to assist them achieve positive outcomes.

One example occurred in early 2018 when Broome experienced its 'wettest wet season'[35] recorded, where nearly two metres of rain from cyclones and tropical storms fell in less than two months. This resulted in majestic old trees being damaged and/or uprooted. Agunya worked closely with the local Shire Council to identify trees that were retrievable, providing valuable sources of timber. Young trainee artisans learnt to use a mobile timber mill and their skills development followed through to the point where they turned the raw product into one-off creative works of furniture and art. This is an example of the resourcefulness of this social enterprise, which also collects old cast iron agricultural and industrial machinery parts to use for inspired pieces of art, as well as in conjunction with timber to create stunning furniture (if you're in Broome check out their remarkable outside furniture at Matso's Brewery).

Agunya is now working to establish a sustainable food garden they are developing in central-Broome, to facilitate community programs aimed at alleviating anti-social behaviour and providing participants with an opportunity to engage in meaningful work. Young people who have worked with Agunya over the last couple of years will not only assist, using their increased skills base, in its establishment but will also mentor new participants in the project.

Saltwater Country Inc.

Saltwater Country is a NFP community organisation founded by Ms Cara Peek, a Yawuru/Bunuba (Broome/Fitzroy Crossing) Traditional Owner. The project vision is to empower young Aboriginal people to improve their social, emotional and economic wellbeing. The group, involving both Aboriginal and non-Aboriginal people in its organisation, uses the sport of rodeo as a change making tool to create opportunities for trainees. Strength-based approaches are treated as rites of passage for young Aboriginal people, using rodeo as the medium to train, work and compete together - showing the world what they can do. Saltwater Country is especially committed to assisting participants to be their best selves, in a culturally appropriate and relevant way (Saltwater

[35] How local people describe it.

Country n.d).

This approach builds on the symbolic power of the Aboriginal cowboy in remote Australia, a position of strength, where the freedom of the cowboy can reflect freedom for Aboriginal people and their communities, assisting them find their own way (Saltwater Country n.d.). The group's major rodeo is held annually in Broome, attracting more than 100 Aboriginal competitors from across the Kimberley. The organisation is also establishing the *Saltwater Academy* to operate clinics for Bull Riders, involving young and older participants and facilitated by a three-time world champion who travels from Brazil to share his knowledge and experience from the elite, world class level. *Saltwater Eats* has likewise been created to train young Aboriginal people in the events hospitality industry. In addition, Saltwater Country has connected with a local Aboriginal radio and television NFP company, Goolarri Media, to produce *Saltwater Stories*. Those stories capture the excitement and passion of young people involved in rodeo, building on the legacy left by previous Aboriginal stock men and women.

To enhance her role in Saltwater Country Ms Cara Peek was awarded a 2019 Churchill Fellowship. This involved travelling overseas to learn from First Nation and African American owners of rodeo circuits in both North and South America, investigating the social outcomes that result from involvement in those events (Waddell 2019, p. 9). Further, Cara was awarded the Western Australian Rural Women's Award in April 2020, receiving a business development financial award to further the establishment of the Saltwater Academy project. She will represent WA in the Australian award finals later this year.

Broome Courthouse Markets

Broome Courthouse Markets (n.d) is a project of a NFP association that comprises market stallholders. They manage and promote local endeavours and events that are staged at weekend and evening markets. Notably 'profits' generated from this source are annually distributed to community groups, encouraging community responses to locally identified needs around the town.

As well as providing opportunities for local artists, craftspeople and others, Broome Markets also organises regular 'Youth Markets'. Young people (under 18 with the support of adults) are encouraged to unleash their creativity, use their talents and test their ideas through the provision of promotion and availability of market stalls. This also allows outcomes from initiatives at schools, and with youth groups, to follow through to create greater public exposure and point of sale opportunities. Others who utilise the Markets to promote and/or sell their products include various Aboriginal artists; NGOs including Agunya, Environs Kimberley and Broome Bird Observatory; Kimberley Wild Gubinge (local Aboriginal name for Kakadu Plum), and of course pearls, to name just a few.

Broome also has a significant multicultural population, with many people being dependents of earlier pearling families who came to Broome from neighbouring countries to the north of Australia. Meals offered at their food stalls at the Markets provide evidence of this by way of delicious cultural cuisine, which not only attracts tourist patronage but also strong, continued support from local residents year round. Who needs multinational takeaways when we have this in our own 'backyard'!

Theatre Kimberley

The arts have long been associated with community development, economic viability and sustainability. NFP Theatre Kimberley (n.d) has an exemplary history in this area. One of their major annual activities is '*Worn Art'*, an extravaganza of costumes, storytelling and dance. The wearable art event is an exceptional drawcard with exotic costumes, made from recycled materials, reflecting Broome's diverse artistic and cultural population, telling tales from the early pearling industry years in Broome. Theatre Kimberley also established and facilitates the Sandfly Circus, where young people are trained in circus arts. Their major show for 2019 was the '*Circus Rabbie – To Save the Planet'!* The main prop was a shopping trolley and the rubbish collected in it, with young acrobats displaying amazing circus while visually telling the story.

The group also presented the *Shorebird Quest* last year– which involved an evening outdoor show with giant illuminated puppets, made by volunteer attendees at local workshops. This provided stunning recognition of overseas and local birds and other wildlife, particularly from the waters of the Roebuck Bay. Created in conjunction with the Parks and Wildlife Department and the Yawuru Rangers, the show was held along the foreshore of Broome's

Roebuck Bay. The Bay, which has 330 bird species verified and recorded, is also an international RAMSAR[36] migratory bird site (Broome Bird Observatory n.d). The artistic Shorebird Quest highlighted the life of the small wader birds who travel 5,000 kms to Broome each year to produce young, and fly home to Siberia and China – flying without touching the ground. This year (2020) 20,780 of these birds were counted leaving to fly that amazing distance, providing spectators an incredible visual display of nature at its finest.

Kimberley Community Scheme

A unique local project involves a collaboration between the Western Australian government entity, Water Corporation and service organisation, the Lions Club of Broome. It involves the Water Corporation diverting treated wastewater to a property not far from town, where it is utilised to irrigate tropical Rhodes Grass for hay production. The hay is then sold on locally. Profits generated go into the Kimberley Community Grants scheme, jointly managed by the Corporation and Lions Club.

Funds are dispersed annually, to:

- Support the long-term vitality of the Kimberley.
- Build appreciation of nature and awareness of the preciousness of water.
- Provide the opportunity for community to identify and respond to local issues.
- Empower the community to take an active role in improving their quality of life.
- Foster community involvement and wellbeing.

Since its inception in 2016 the program has funded a total of $185,807 to the Kimberley region (Water Corporation n.d). Projects that received funding include:

[36] RAMSAR = The Convention on Wetlands of International Importance

- Mowanjum Aboriginal Art and Cultural Centre (Derby) – for the Song Weavers Water Project, to bring the community together to share stories about the preciousness of water and its cultural value.

- Broome Bird Observatory – to install a solar power system for their new RAMSAR interpretive public education centre.

- Djarindjin Aboriginal Corporation (on Dampier Peninsular near Broome) – to promote healthy eating and community connectedness by providing fruit trees to community families to care for, harvest and enjoy.

- Broome PCYC[37] – to support working with at risk youth to build and maintain an edible and waterwise garden.

- Society for Kimberley Indigenous Plants and Animals – to showcase at community events the diverse range of bush foods and native plants endemic to the area, and

- Broome Primary School – to promote inclusion by installing ‘buddy benches’ around the school and work with an Aboriginal artist to develop artwork around the concept of *belonging*.

Discussion and Way Forward

Can local, bottom-up community efforts make a difference to society and the environment that supports it, given the global challenges we have before us? Klein (2019), recognising the exploitation of people and planet, strongly advocates for international structural change. She does (p. 134) however acknowledge that: ‘[t]his is not to belittle local ... Local is critical. Local organizing is winning big fights’. Notably, she concludes (p. 135) it is: ‘not that one sphere is more important than the other’.

People and their associated communities in these case studies answer that call. Their creativity and tenacity clearly identify them as active shapers of their stories and history. The case studies have demonstrated practical approaches

[37] Police & Citizens Youth Club.

that enable change. The Bishop Raible Cooperative rejected the conservative approach held by both government and the Church at the time and opted for a solidarity and liberation agenda to cater for local needs. Overall autonomy and self-reliance laid the foundation for later community social and economic activities in Broome.

Agunya and Saltwater Country hold similar aims when catering for young Aboriginal people. Their distinctive approaches are in line with the theory presented by Bessarab and Forrest (2017), which is that of the ‘third space’. This is a space where cultures intersect, while focusing on commonalities. These project’s outcomes are unique, from Agunya salvaging ‘dead’ or damaged trees and repurposing them into distinctive furniture while engaged in skill development, to Saltwater Country urging participants to develop resilience as well as quality health and fitness via competitive rodeo activity. The end result in both cases is trainees that are involved in creating their own positive futures. Other outcomes include Agunya reusing and reinventing damaged and/or rejected natural and industrial resources, within a context of justice for both human and non-humans alike. In addition, Saltwater Country’s involvement in creating intergenerational equity, whilst encouraging healthy people, healthy animals and a healthy economy, demonstrates knowledge of ecological limits in their region.

Both Broome Courthouse Markets and Theatre Kimberley contribute to the local economy, via interconnected local systems. The Markets provide strong support for local artisans and youth while stimulating their community and economic prospects; while Theatre Kimberley, with its extravaganza productions, promotes interdependence between shore birds (non-humans) and humans, via portraying the migratory story. The Broome Courthouse Markets also stimulate creative social and economic exchange by, for example, being an outlet for household and small enterprise production, through to providing opportunities for local NFP volunteers to share their stories to a broad audience. Overall the Markets demonstrate both monetary and non-monetary actions are economic, not separated from community, and are valuable. Theatre Kimberley’s outcomes are similar, as they visibly demonstrate making more with less, and promote the value of both art and culture to the human populace, while supporting decreased consumerism and demonstrating the intrinsic value of the natural world.

Added to that, the Kimberley Community Scheme illustrates how government and a community organisation can establish inventive, successful partnerships. This is quite unique, especially given the Water Corporation is not only a government entity, but specifically a business-for-profit venture of the state government. Overall, while projects drew on local settings and material resources; human creativity, relationships and collaboration are key to the emergence of locally instigated change projects that support healthy living within health ecosystems.

I believe these cases have much in common with Trainer and Alexander (2019), who argue for a post-growth and post-capitalist economy by transitioning to a ‘Simpler Way’. An integrated Simpler Way economy, they maintain, has the potential to generate sustainability, economic justice and quality of life. Processes adopted include commons assets and vision, sharing of surpluses, mutual assistance, small social enterprises and economies based around crafts and home food production. Society, they envisage, can then transcend the current growth paradigm, and encourage positive pathways that involve expanded mutuality and reciprocity (Ibid).

So - where to from here? It is understood other communities are undertaking similar actions; however they are often stand-alone efforts that lack opportunities to share ideas and experiences. Consequently there is little opportunity for peer support and sharing of ideas and practices, nor for collective growth of this promising sector. There is now a call for them to unite. The *Global Tapestry of Alternatives*[38] seeks to establish networks and alliances amongst Simpler Way type enterprises. The process begins with interaction between local projects, moving on to the regional, national and then the global scale. It is:

> … about **creating spaces of collaboration and exchange**, in order to learn about and from each other, critically challenge each other, offer active solidarity to each other whenever needed, interweave the initiatives in common actions, give them visibility to inspire other people to create their own initiatives and to go further along existing paths or forge new ones that strengthen alternatives wherever they are, **until the point in which the critical mass of alternative ways can**

[38] See www.globaltapestryofalternatives.org

> **create the conditions for the radical systemic challenges we need.** (my emphasis)
>
> (Kothari et al 2019, pp. 339-340).

Rose (2018, p. 201) challenges us by asking:

> Are we going to be active shapers of our own history and creative narrators of our own stories? Or are we going to be passive observers, spectators of the historical process as it is written and shaped by the currently dominant actors?

This paper shows that small groups of community activists can undoubtedly contribute towards improved outcomes for both current and future human and nonhumans living in our common home (Pope Francis 2015). The people introduced through these case studies aim to live within, and promote, ecological limits. Indeed, hope for a sustainable future involves grassroots activities just like these.

As anthropologist Margaret Mead (n.d) clearly articulated:

> Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.

I respectfully acknowledge the Yawuru People, Native Title Holders and Traditional Custodians - past, present and emerging - of the land on which I live and prepared this paper.

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Chapter 14: The Yarra River through the prism of history: Providing life for a city

Judith Buckrich

This chapter looks at the history of the Yarra River in Melbourne and how past actions have affected the sustainability of a river system in the city and beyond. Melbourne's Yarra River twists and turns through 238 kilometres of city, suburbs, farmland and bush. Before European settlement it was, for thousands of years, the homeland of the Wurundjeri people who – unlike Europeans – saw it as an aggregate of water and land with its flora and fauna, husbanding it to hunt and gather food and create their culture. Water from the source of the Yarra at the Yarra Ranges and various reservoirs 'on the way' remain Melbourne's chief source of clean water.

Much of what has been done to the river and its surrounds since European settlement predicates the actions and attempts towards 'renovation' during the last 60 years. Hence it is important to review the history of how the river has been changed and damaged. Without understanding the past, people looking at the river now – in any of its segments – have no understanding of it as an entity and its importance as our lifeline, not just as a resource but as a reflection of the way we live. Since European invasion in 1835 the river has been used and abused by agricultural, industrial and post-industrial economic development. This contaminated and destroyed life in many parts of the river and its basin and 'alienated' it to such a degree that many city people were and are ignorant of the river beyond Melbourne's port, industry and suburbs.

None-the-less there has always been a passionate interest from some quarters in its natural history and protection and regeneration of native flora and fauna. As early as 1900 efforts were made to 'clean' the river and make it ecologically healthy (The Age 1900). Still, it remained threatened by over-development in the city and logging and clearing further up-river. Tasmanian Europeans who came to Port Phillip in 1835 were primarily looking for pasture land for sheep and cattle, having 'run out' of space in Tasmania.

French and English explorer ships had come into Port Phillip Bay thirty years earlier and a convict settlement was attempted at Sullivan Bay near what is now Sorrento in October 1803 by Lieutenant-Colonel David Collins. The two ships under his command were the *Ocean* carrying 18 free settlers and their families and '*…an ample supply of everything that could be suggested as likely to be of advantage to their undertaking…' and HMS Calcutta* carrying 300 convicts, 16 convicts' wives, some convicts' children (including John Pascoe Fawkner who would be one of the two leaders said to 'settle' Melbourne in 1835) as well as sixty Royal Marines and civic staff. The party lasted at the site for just a few months because of insufficient fresh water and left in two groups, the first in January and the second in May 1804, for Tasmania (NHS n.d.). During their short stay 30 people died and 21 convicts escaped, one of whom, William Buckley, would turn up in Melbourne in 1835 (Flannery et al 2007).

Collins' settlement was just sixty kilometres south of the Yarra River where Melbourne would be established. In fact the Yarra and the Maribyrnong Rivers had been 'discovered' on 2 January 1803 by Charles Grimes' party, months before the arrival of the Sullivans Bay colonists. But Collins was not aware of Grimes' findings. The men whose parties established themselves at Port Phillip were John Batman and John Pascoe-Fawkner. There were two very different men from different backgrounds who were loosely allied with the colonial pastoralist and up-and-coming middle class respectively. They and their friends quickly established themselves on large blocks of land on the Yarra River, others 'taking up' large tracts of land further away from the bay. In 1836 there were just 200 Europeans in the Port Phillip area but there were already 30,000 sheep. Travelling up the river in 1839, Daniel Bunce (1839: 61-65) noted:

> As was usual with those who arrived for the first time in Hobson's Bay, the captain of our vessel took the ship's boat up the Yarra Yarra. The river was then densely covered on both banks with mellaeuca [sic] or tea-tree, and the monomeeth parbine [probably coastal banksia (*Banksia integrifolia*)]. …Flocks of wild ducks were disturbed by our boat, as we glided up the stream. …Lofty eucalyptus or flooded-gum trees formed a background to the natural plantation of tea-tree. As we approached the site whereon Melbourne has been built, the echoes from a blacksmith's shop, and the unmistakable odour of a fellmonger's yard, reminded us that the elements of civilization had preceded our arrival. In the latter part of the year one thousand eight

> hundred and thirty-nine, we landed on the low muddy bank on the north side of the river, the site known as the wharf.

Bunce walked to Westernport Bay from Port Phillip with three Woiwurrung men, including Derrimut and Benbow who were often mentioned in early writings about Melbourne. According to Bunce, Benbow and his wife Kitty lived in a hut in Mr Batman's garden. This was situated to the west of the Falls on what was a hill that was later removed entirely to make way for rail yards. His description of the country is detailed and perceptive (Bunce 1839: 64):

> Proceeding on our projected excursion on foot, we crossed the Yarra Yarra by a punt, at the place where Prince's Bridge has been built, and passed up the river to Gardiner's Creek. …On that side of the river there was a swamp or marsh, edged with a natural plantation of swamp broom. Gardiner's Creek, at its confluence with the river, rushing through a dense mass of tea-tree like water bubbling from the neck of a bottle. In this neighbourhood I saw many new plants, of a totally different character from those which I had previously had an opportunity of observing in Tasmania. *Dodonea, goodenia*, and the brilliant spikes of reddish purple blossom of *lithrum spicata*, enlivened the banks of the creek.

By 1840 the European population of Port Phillip had risen to 10,291, double that of 1839 (SR 1911). The Yarra valley was a floodplain, the main rivers originally called the Freshwater (Yarra) and Saltwater (Maribyrnong) with hundreds of tributaries and nearby streams and creeks joined in wet seasons over swampy ground to the south and west of the rivers and flooded much of the vicinity.

Land close to the Yarra was much sought after as a location for houses, farms and early industry, because above the Falls, at what is now Queen Street, the water was fresh above the Falls with an abundance of fish, waterbirds and wildlife, while below the falls there was a 'pond' or 'turning basin' that was used by smaller ships to access the new settlement. Land around of the river and near Port Phillip Bay was easily accessible for use as pasture for sheep and cattle, but these animals soon trampled the land hard and much less able to able to absorb the extra water that inundated the area every few years.

The Woiwurrung and Boonwurrung people who had lived by the river and the bay before European settlement knew it and used it, making sure that plants like the Murnong (*Microseris lanceolata*) whose yam-like roots formed a staple food, were regenerated each year in areas like Albert Park which, before being made into a park, was a swampy area rich in water birds, fish, eels, shellfish and other edible flora and fauna (APLMP 1994: 11). All around the river the Woiwurrung hunted kangaroos, possums, kangaroo rats, bandicoots, wombats and lizards. The skins of animals were used to make cloaks, and all the equipment needed for life was made with local materials or sometimes from articles that had been traded from other parts of Australia (Woiwod 2012: 23-60).

It was not long before the land on the north bank of the river of the growing metropolis was cleared of trees and indigenous plants and polluting trades set up. The south bank was 'wild' for a while longer but clearing occurred to an extreme degree when cattle were brought on to the land. Fences were also erected changing the way indigenous plants and animals inhabited the land.

The river and its delta were also dramatically changed by efforts to deepen and widen it. After the Victorian goldrush of the 1850s the population exploded growing from 97,489 in 1851 (when Victoria separated from NSW and became an independent colony) to 551,388 in 1862 (SR 1910). The pressure on Melbourne and surrounds was tremendous. The water from the Yarra River had become so polluted by woolwashers, fellmongers, abattoirs and other toxic trades that an artificial reservoir was created at Yan Yean, 30 kilometres north of the city on the Plenty River, a tributary of the Yarra. Construction began in 1853 soon after gold was found in various areas mostly north west of Melbourne, and was completed by 1857.

Gold discoveries were made at Anderson's Creek, a tributary of the Yarra at Warrandyte in 1851 (EM Yarra n.d.), works were undertaken there to create tunnels through and near the river.. At the time of Yan Yean's completion it was the largest artificial reservoir in the world holding 30,000 megalitres of water. Water was piped into the city in stages but it created an even greater problem with disposal of waste including nightsoil which ran off from the streets or was illegally dumped by the night soil men. A sewerage system was not constructed in Melbourne until 1901, by which time the population was more than one million (SR 1910). During the nineteenth century there were many brickworks along and near the river, Melbourne was largely built of local bricks.

The morgue was built south of the river near the original Princes Bridge and remained there until massive river works were undertaken and a new bridge built in 1888. Until that time there were large swampy areas near the bridge and the morgue was prone to being flooded. In the 1880s the river was widened, deepened and rerouted to make for better access for ships from Hobson's Bay. Melbourne's port was and remains Australia's busiest. An entire network of docks was created by the Port Authority in the 1880s to cope with cargo ships. Mostly dug out by hand and steam shovels from the West Melbourne Swamp, it connected ships on the river to the enormous network of rail yards at Spencer Street. Large sheds were built along piers and docks from which cargo could be easily transferred to trains, some of these had rails that turned so that engines could enter and exit.

Melbourne had the first railway in Australia linking the city to Port Melbourne, built in 1854. Factories of every kind were built along the river at Richmond, Abbotsford, South Melbourne, Port Melbourne, Fisherman's Bend, Newport, Yarraville, Seddon and along the Maribyrnong. Melbourne's residential suburbs also expanded along the river as far as Kew and then much further during the twentieth century. Further upriver from Heidelberg there were market gardens, vineyards, farms and bushland, depending on the terrain and quality of the soil. The famous Heidelberg School of artists used the unspoilt bushlands of the area for painting camps during the 1880s and 1890s (Lane 2007).

Until the 1960s there were blocks of bush and cleared land that were undeveloped, people were able to keep horses on government land. During the first half of the twentieth century not much attention was paid to the ecosystems of the Yarra delta, though some of the obvious polluters like abattoirs were removed. People still swam in the urban parts of the river as late as the 1950s when residents of Richmond seemed to have no qualms about letting their children swim out to Herron Island (Kaye Reed). One friend of this author remembers doing regularly and that her brother would dive to the bottom and see abandoned cars and other items. The river was always used by criminals to get rid of bodies. Unwanted babies were also disposed of in river, and it has been a place for suicides for as long as there have been bridges high enough to jump from (e.g. TH 1898).

Further upstream is a different story. The river was not so much affected by pollution and reconstruction as by clearing and misuse. Building of suburbs always meant the creation of drains and effluent from building ran off into the river. Urban stormwater rubbish was much worse before Melbourne Water started to build infrastructure to filter and clean stormwater drains in the 2000s. The farms and vineyards further upstream inevitably destroyed local flora and fauna. The corridors of natural growth allowed to remain were narrow and able to maintain little more than remnant natural growth.

In the 1980s much of Melbourne's strong manufacturing sector became defunct due to globalisation, the factories on the south bank of the river at South Melbourne closed. The area now known as Southbank became part of the State Government's renewal programme. The 'give the Yarra a go' campaign intended to create an area of public use, rather than the city 'turning its back' on the river under Planning Minister Evan Walker. One of the first projects was the construction of a footbridge, the first such bridge in the city. Nearly half the area was owned by the State Government or its agencies. The completion of the Arts Centre across Princes Bridge was followed by the creation of the Southgate 'Arts and Leisure' precinct which opened in 1992. In 1993 building of the Crown Casino began and was completed in 1997. To many Melburnians' amazement they found a pleasant river running through the city. Until this time there were no riverbank walkways in the central business district, the city had its back to the river, though there were plenty lounging on the lawns on the Eastern side of Princes Bridge.

As far as the whole of the river is concerned there have been many efforts to create continuous corridors of open space and trail networks along the river. The MMBW – now Melbourne Water – began the process of reserving open space along the Yarra in the 1950s (PV 1954). The city planning blueprint for Melbourne's future growth, released in 1954, had virtually ignored the Yarra, but Melburnians did not. In 1958 a proposal to subdivide the old Banyule Estate into residential blocks attracted considerable opposition (HHS n.d.). A Save the Yarra Valley League fought a partially successful campaign. This was the first step in addressing decades of environmental degradation along the river. By the 1970s planning policies came to recognise that the Yarra

River and its environs should be primarily classified as recreational and nature reserves (EM Yarra n.d.; HHS n.d.)

Public interest in environmental issues emerged strongly in the 1970s through organisations such as the Save the Yarra League. A Statement of Planning Policy issued in 1971 which set out conservation and recreation as planning objectives, was a landmark in the process of preserving the Yarra (DTPLI 2014). The Age (1980) launched a public campaign to ‘Give the Yarra a Go’. This led to the preparation of the first comprehensive plan for a major section of the river - Planning Opportunities along the Lower Yarra River from Punt Road to Dights Falls (ELWP 1980).

Since the 1990s there has been a clear emphasis on leisure and domestic building in suburbs along the river – which now range as far as Eltham, once a rural retreat for artists and hippies. The growth of Melbourne’s suburbs since the post war period of migration and baby boom with the ideal of home ownership on a quarter acre block led to almost every family owning at least one car by the 1980s. Freeways were built right next to the river beginning with the Monash Freeway of which the section initially known as the South Eastern Freeway was completed in the mid-1960s. The section from Burnley to Toorak Road runs along the Yarra.

Another issue rising out of increased population and expansion of suburbia was the attempt to create new dams. In 1974 local protest groups saved vast areas of bushland around the Yarra at Warrandyte where a new dam was proposed by the State Government. This massive dam was to inundate the land extending some 20 km as far out as Yarra Glen, which would have flooded large numbers of properties, farms, and orchards, as well as destroy recreational access to the Yarra. Water was to be pumped from this new dam to the higher level Sugarloaf Reservoir in the Christmas hills. Concrete foundations had begun to be poured when the dam was abandoned. Only the Sugarloaf Dam went ahead (WH n.d.).

Since the 1960s many organisations have been taking a keen interest in the welfare of the Yarra River. These include Parks Victoria, Melbourne Water, the various Shire and City Councils on the Yarra and the Victorian State Government. In 2017 A Yarra River Act was passed and in 2020 a strategy plan published in which included a Wurundjeri Foreword and Executive Summary (EV 2020: 6):

> As a 10 year strategy, the Yarra Strategic Plan sets the foundation to achieve the Yarra River 50 Year Community Vision and deliver on the aspirations contained in the Wurundjeri Woiwurrung Cultural Heritage Aboriginal Corporation's.
>
> **The Birrarung: our lifeblood, our shared history, our river**
>
> Over tens of thousands of years the Yarra River, Birrarung, has shaped the lives of those around it.
>
> The river is our lifeblood, providing water to drink, places to socialise, parks for play, nature to experience and landscapes to explore.
>
> As our city grows and the climate warms there will be more demands placed on our iconic waterway and its parklands. For the Yarra to thrive under these pressures, our river needs more from us.
>
> With changing practices, and the efforts of stakeholders and the community, the condition of the river has improved considerably over recent decades. However, in its lower reaches the Yarra remains a polluted river facing unprecedented population growth, climate change – and an uncertain future without significant intervention. We must act now to protect the river and ensure it continues to support our healthy city and environment.
>
> To deliver this plan we will work with the Yarra's Traditional Owners, whose interdependent relationship with the environment provides us with a blueprint for holistic management of the river and its lands.

There were many non-government organisations who have fought over decades to protect the river. These include:

Friends of Stony Creek established in 1993 has worked to restore the native vegetation along the creek, often on land that was formerly quarried and is now kept as open space.

Landcare Groups: Landcare is a community-based movement that began in Victoria in 1986, when Joan Kirner, then Minister for Conservation, Forests and Lands, and Heather Mitchell, then president of the Victorian Farmers Federation joined forces to create what was then called Land Care. It now involves thousands of Victorians and more than 600 groups working together to shape the future of our land, biodiversity and waterways. Among the groups around the Yarra are:

- **Upper Yarra Landcare Group** established in 2009 to maintain and preserve the environment in the McMahon's Creek/Reefton area.
- **Friends of the Helmeted Honeyeater** formed in 1989 when the population of Honeyeaters reached a critical low point of 50 birds. It is Victoria's bird emblem They are still critically endangered – 200 birds in 2018.
- **Mt Toolbewong and District Landcare Group** covers a wide area around Healesville encourages the eradication of introduced plant species and aims to increase awareness of the importance of biodiversity.

Achieving the community's vision for our river - together

The Yarra Strategic Plan was the first integrated corridor plan developed collaboratively by representatives from the Wurundjeri Woiwurrung Cultural Heritage Aboriginal Corporation, as well as the 15 state and local government agencies involved in managing the river (EV 2020; WC n.d.). It is arguably the first of its kind and sets the foundation for incremental change. As a 10 year strategy, it identifies immediate actions for the river, and enables long-term collaborative management between agencies and Traditional Owners. The four objectives represent the changes being sought for the river (Ibid: 7):

- A healthy river and lands
- A culturally diverse river corridor
- Quality parklands for a growing population
- Protecting the natural beauty of the Yarra River Corridor.

Having completed a detailed questionnaire on this strategy, this author noted that the ability to fulfill these aims in more than a most basic way, depends on much greater funding from local councils and the Victorian Government's various agencies than is at present being spent on improving and recovering the river. The outcome of previous inquiries and studies, such as those done after extreme flooding, has usually depended on the likelihood of benefit to the built environment and not to the long term wellbeing of the natural environment.

Indeed until very recently, the approach of a strategy for the long term health of the river and its basin has been tried in no more than an ad-hoc fashion. Some of the improvement to water quality during the last 50 years has not been the result of purposeful action so much as a massive decrease in the number and kind of industries using the river. Most polluting industries have disappeared because of economic changes not because of greater consciousness about the health of the river. Even the developments at Southbank would not have occurred if the many factories previously located there had not stopped functioning.

The most important community development of recent times has been the establishment of the Yarra Riverkeeper Association (http://yarrariver.org.au/). Set up in 2005, it is the result of a union of independent individuals and groups who work solely in the interests of the river. It is part of an alliance of 150 waterkeepers worldwide. As well as community involvement, it is supported by key government and non-Government agencies – Melbourne Water, EPA Victoria, Parks Victoria, the RACV, the Cities of Yarra, Stonnington and Boroondara, Yarra Ranges Council, Lord Mayor's Charitable Trust and Korowa Anglican Girls School. These groups have committed to improving the river and its environment. The Riverkeepers' aim is: 'To protect and restore the Yarra River and its tributaries, from source to mouth, for current and future generations' (http://yarrariver.org.au/). This alliance is much stronger and more focused than any previous organisations working on improving the river, not only because of its clear aims but because it includes the whole river and so many aspects of its use, where previous efforts have been aimed at just one part of one problem.

Its recent projects have include a now complete two year 'Yarra and Maribyrnong River Blitz' during which 38,000 kilos of were rubbish collected by volunteers (a video was developed encompassing everything learned); the Polystyrene Project, looking at ways to reduce and deal with polystyrene pollution; the ‘Litter and Flows Project’ and the creation of the remarkable ‘Yarra Catchment Atlas’ to: ‘…build knowledge within community networks…to assist our understanding of the cultural heritage, biodiversity, and health of the Yarra Catchment and their links with Port Phillip Bay.’ (http://yarrariver.org.au/). The Yarra Catchment Atlas (https://www.yarraatlas.org.au/) notes it:

> … is the place to go to when you want to learn about the Yarra River and its catchment. Essential spatial data for the river and its catchment has been collected in one place. The layers of data can be interrogated and analysed to understand the Yarra Catchment. The Yarra is presented in all its complexity. There are layers for everything from groundwater to biodiversity to heritage.

Andrew Kelly, Yarra Riverkeeper concludes (https://yarrariver.org.au/who-we-are/):

> We advocate for the River: for green spaces, for water quality, for biodiversity, for the birds, animals, insects and reptiles along the River, for good planning decisions, for the tributaries, for the parklands, for appropriate recreation; and for an understanding of our river and its role in the life of the city of Melbourne. We lobby governments and we educate the community. We tell the story of the River.

Conclusion

Clearly the next years are crucial to changing the way we use our natural heritage. Changing the way developers and farmers see the land is not an easy task, and will require new local and state legislation and policing as well as much greater education within the community. Ideas about the importance of forests and open spaces for recreation seem to be difficult enough to communicate, let alone if money is involved. One can only hope that the plans that have been put in place will have teeth. This will only be the case if the community demands this. Our relationship with nature has been so alienated that we have all but destroyed what we need to do more than exist (Ripple et al 2017). I can only personally hope that perhaps the recent fires all over Australia, and even the Corona Virus pandemic will cause some consciousness raising and a more nuanced understanding and reaction to our problems. Problems that affect us as a community and individually – and finally economically.

The history of the Yarra since European settlement has been mostly a story of the destruction of nature, and a lack of understanding of its importance. Some of the recent history reveals attempts at renewal as a solution within the area of ecological economics. More than ever we need to remember our history - and learn from it. We need to increase community awareness and find the best strategies for positive change. There is no going back to the country as it was before colonisation, but the ability to understand what has gone before can strengthen our resolve for an overall change to a sustainable future, and this is something that ecological economics should foster.

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Chapter 15: Therefore Change: introducing ecological economics into the New Zealand high school curriculum

David Hay

'Therefore Change' is the title of a project I have initiated, to introduce ecological economics (EE) into the New Zealand High School curriculum. The title refers to a quote attributed, perhaps incorrectly, to John Maynard Keynes: 'When the facts change, I change my mind. What do you do, Sir?' (Quote Investigator 2011).

EE addresses a broader, and different, set of 'facts' than those encompassed by orthodox economics, and the purpose of this project is to 'change the minds' of people who teach and learn economics in New Zealand high schools. At time of writing the project is a work in progress. This chapter summarises what I have learned so far and outlines a proposal for EE course content at high school level.

The New Zealand Curriculum

The New Zealand Curriculum is a flexible framework which provides schools with a broad discretion over course content and internal assessment. The curriculum expresses a *Vision* for the education and development of young people, and *Values* they will be encouraged to embrace. Part of the *Vision* is that young people will '... seize the opportunities offered by new knowledge and technologies to secure a sustainable social, cultural, economic, and environmental future for our country'. Among the *Values*, students will be encouraged to value '…innovation, inquiry, and curiosity, by thinking critically, creatively, and reflectively' as well as '... ecological sustainability, which includes care for the environment' (Ministry of Education 2015a)

The curriculum covers eight *Learning Areas*: English, the Arts, Health and Physical Education, Mathematics and Statistics, Science, Social Sciences, and Technology. Each school's Board of Trustees is responsible for delivering programmes of learning in all these areas. The subjects 'Education for Sustainability' and 'Economics' can be found within the Social Sciences learning area. For each Learning Area, there are one or more *Teaching and Learning Guides*. These are non-prescriptive, as the Ministry of Education (2019a) says:

> These guides have been designed to help teachers develop quality teaching and learning programmes at levels 6–8 of The New Zealand Curriculum (2007). They should be understood as resources rather than syllabuses or prescriptions.

Teaching and Learning Guides specify *Achievement Objectives* for a Learning Area. In economics, for instance, one of the Achievement Objectives (Ministry of Education 2016) is:

> 6.2: Understand how the different sectors of the New Zealand economy are interdependent.

Each Achievement Objective has an *Indicator*. In this case (A student): 'Identifies the different sectors of the New Zealand economy and explains how they are interdependent'. And for each indicator there a one or more *Possible Context Elaborations*, such as 'How do natural resources, for example, fish or logs, become final goods such as fish fingers or furniture?' (Ministry of Education 2015b).

Up to this point, a school Board – comprised of the Principal, elected Parent Representatives, and one Student and one Teacher representative – can interpret and apply the curriculum in a way that it believes will best fulfil students' learning needs. However, that flexibility is significantly reduced when a subject is to be assessed for national high school qualifications. Students in years 11, 12 and 13, study for *the National Certificate of Educational Achievement* (NCEA), the main secondary-school qualification. The NCEA is administered by a government agency known as the New Zealand Qualifications Authority (NZQA). The NCEA enables students to gain credits 'from both traditional school curriculum areas and alternative programmes', which are recognised by employers and used as the benchmark for selection by universities and polytechnics (NZQA 2020a).

To obtain the certificate a student must be able to demonstrate that they have met several *Achievement Standards*, each of which has an assigned number of credits. Students must achieve a certain number of credits to gain an NCEA certificate. Each Achievement Standard supports an Achievement Objective, and NZQA (2011) provides a detailed specification for what an Achievement Standard must include. All the Standards are downloadable from the NZQA website (e.g. NZQA 2020b). Every Achievement Standard is accompanied by one or more *Assessment Resources*, which provide guidance for teachers in the form of a template for teaching and assessing a subject. The 'NZQA approved' Assessment Resources are published by the Ministry of Education on another website, called Te Kete Ipurangi (TKI): 'the online knowledge basket'. All Assessment Resources for internally assessed NCEA Achievement Standards are downloadable from the site (Te Kete Ipurangi 2020).

The process of change

I hope the description outlined above, of the curriculum structure and its various elements, is reasonably clear. It took some hours of research to produce, because the information is distributed over three websites, two published by the Ministry of Education and one by NZQA, and I could not find a single coherent description of the structure on any of them. The process for amending the curriculum was completely obscure: I could not find a description of the process for amending or updating the curriculum, or any indication of how one might become involved in it.

My first clue came from a Twitter conversation that popped up on my time-line, about the introduction of Civics education into the curriculum. An online search led me to the Civics Education Trust and a telephone conversation with Isaac Eustace-Smith, the past secretary of the trust (on 8 May 2020). Mr Eustace-Smith, along with Cate Bell and Sarah Heffer, had established the trust in 2015 because they felt that civics was an important subject which, although it formed part of the Social Studies curriculum, was rarely taught in practice. They set out to promote civics education by creating a curriculum and 'toolkit', which they promoted directly to schools. They recruited student volunteers to join in the effort and eventually had 12 people working on the project, which they organised using online software for Customer Relationship Management (CRM) tracking. They sent out flyers, made telephone calls, and arranged face-to-face meetings with teachers and school representatives. They organised the timing of calls and meetings to fit with the school calendar, so as not to interfere with exam periods or school holidays.

The effort eventually paid off when the Ministry of Education invited them to join a civics education working group, which was working on a 'School

Leavers Toolkit' resource funded by the Ministry. By 2020 the trustees felt the trust had achieved its objectives and had become effectively redundant. The Civics Education Trust was not alone in supporting civics education. The NZ Political Studies Association established a 'Civics, Citizenship and Political Literacy Working Group' at its AGM in 2014, which produced a discussion paper including eight short articles (NZPSA 2018). The McGuinness Institute, a private 'non-partisan think tank working towards a sustainable future for New Zealand' has also taken an interest in civics education, establishing the CivicsNZ project and a website, supporting research and publications on the subject, mostly in 2017 and 2018 (McGuiness Institute 2020). Mr Eustace-Smith acknowledged the work done by these other groups but said that much of the academic media and material was 'behind the curve'. They found teachers receptive to the idea of teaching civics, but one of the group's key insights was how important it was to 'make it easy for the teachers', by providing modern high-quality materials and teaching resources. Academic articles were not suitable, so the Trust worked at producing materials that were.

I later had a conversation with Dr Bronwyn Wood, a Senior Lecturer in the School of Education at Victoria University of Wellington (15 May 2020), who pointed me to a survey by Sinnema (2015), which said that the non-prescriptive approach to local curriculum development in New Zealand was dissimilar from most countries (apart from Scotland). This provided a convenient way for the curriculum to be flexible and adaptable without Ministry of Education involvement. So, while there has been little development or change to the national curriculum, there could be a great deal happening within schools and in fact the Social Studies curriculum was constantly changing. She commented that this approach had generally worked well, but since the NCEA was introduced in 2012, teachers and students 'have avoided difficult learning, controversial topics and there is an emergence of huge gaps in students' knowledge.' This issue has been raised in the recent government report (Ministry of Education 2019b).

Dr Wood also agreed that the most effective way to introduce change was to approach teachers directly, as the Social Studies curriculum was largely driven by teacher choice and student demand, and that non-government organisations and advocates often produced the necessary teaching resources. High school teachers also collaborate on curriculum development through voluntary associations. The two most relevant for EE are the New Zealand Commerce and Economics Teachers Association (NZCETA 2020) and the New Zealand Association for Environmental Education (NZAEE 2020). Either or both might be approached to engage with the 'Therefore Change' project.

In summary, New Zealand's approach to local curriculum development presents an opportunity that might not be available in other jurisdictions that have centrally-directed national or state curricula. The keys to success would appear to be 'making things easy' for high school teachers, by providing the teaching and assessment resources they need to teach EE, and by creating draft versions of the various curriculum elements in conformance with Ministry of Education and NZQA expectations and/or specifications. That work would involve:

1. Introducing one or more new *Achievement Objectives* into the *Teaching and Learning Guide* for economics.
2. Developing of one or more *Achievement Standards* which define learning outcomes for ecological economics.
3. Developing suitable *Assessment Resources* for each of those Achievement Standards.
4. Creating and promoting a set of 'fit for purpose' lesson plans and teaching materials for teachers to use.
5. Maintaining and reviewing all the above, from time-to-time, as necessary.

The Therefore Change project

My presentation to the 2019 ANZSEE conference included an 'argument' for the description and content of three Achievement Objectives, to be taught alongside the existing Achievement Objectives at Levels 6, 7 and 8 of the current economics curriculum. There are currently six Achievement Objectives for the economics curriculum (Ministry of Education 2016). These are:

Level 6	Level 7	Level 8
6.1: Understand how, as a result of scarcity, consumers, producers, and government make choices that affect New Zealand society.	7.1: Understand how economic concepts and models provide a means of analysing contemporary New Zealand issues.	8.1: Understand that well-functioning markets are efficient but that governments may need to intervene where markets fail to deliver efficient or equitable outcomes.
6.2: Understand how the different sectors of the New Zealand economy are interdependent.	7.2: Understand how government policies and contemporary issues interact.	8.2: Understand how the nature and size of the New Zealand economy is influenced by interacting internal and external factors.

Reading through the materials that support these objectives, in my estimation the current economics curriculum reflects an orthodox approach which treats neo-classical economic theory and analysis as 'received wisdom'. It does little to support the value of 'thinking critically, creatively, and reflectively' about economic theory, and less to support the value of 'ecological sustainability'. Introducing Achievement Objectives for EE would address both shortcomings because, as Daly and Farley (2011, p. 23) put it:

> Where conventional economics espouses growth forever, ecological economics envisions a steady-state economy at optimal scale. Each is logical within its own preanalytic vision, and each is absurd from the viewpoint of the other. The difference could not be more basic, more elementary, or more irreconcilable.

At the ANZSEE 2019 conference I proposed three Achievement Objectives that could sit alongside the six existing objectives. These are:

Level 6	Level 7	Level 8
6.3: Understand the difference between sustainability and growth as objectives of economic theory and policy.	7.3: Demonstrate an understanding of the Real Economy and how the laws of thermodynamics apply to economic theory and policy.	8.3: Demonstrate the use of scenarios and systems dynamics modelling to explore the ecological consequences of economic decisions.

I have outlined my argument for including each under separate headings below. For each, I present one or more pictures, mindful of Kate Raworth's statement in her book 'Doughnut Economics' (2017, p. 12), about the power of pictures:

> …the most powerful stories throughout history have been the ones told with pictures. If we want to rewrite economics, we need to redraw its pictures too, because we stand little chance of telling a new story if we stick to the old illustration.

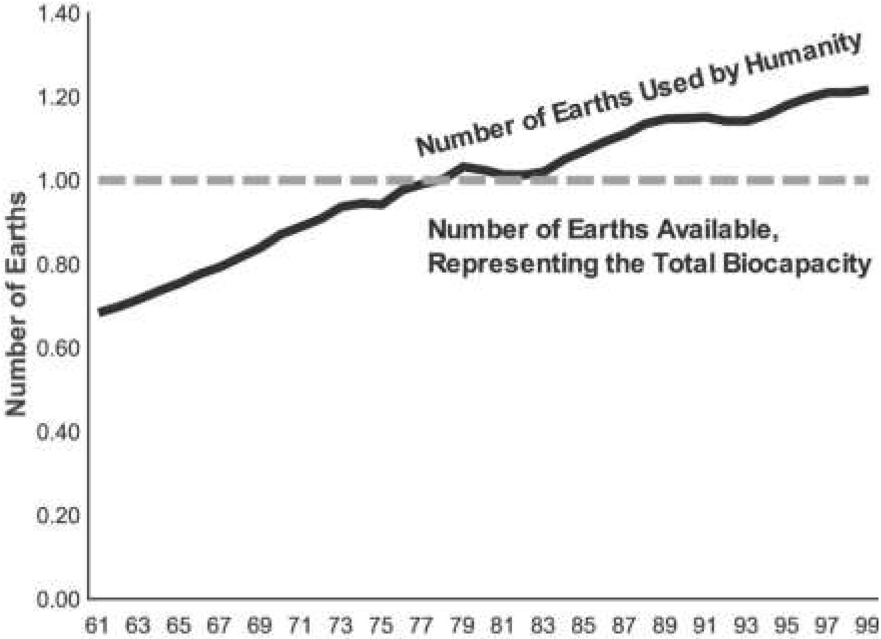
The three parts are designed to build on each other, over three years of high school teaching. Combined, they might also provide the framework for a first-year university course in EE.

6.3: Understand the difference between sustainability and growth as objectives of economic theory and policy.

This objective is about the irreconcilable difference between the pre-analytic visions of conventional economics and ecological economics, outlined by Daly and Farley (2011).

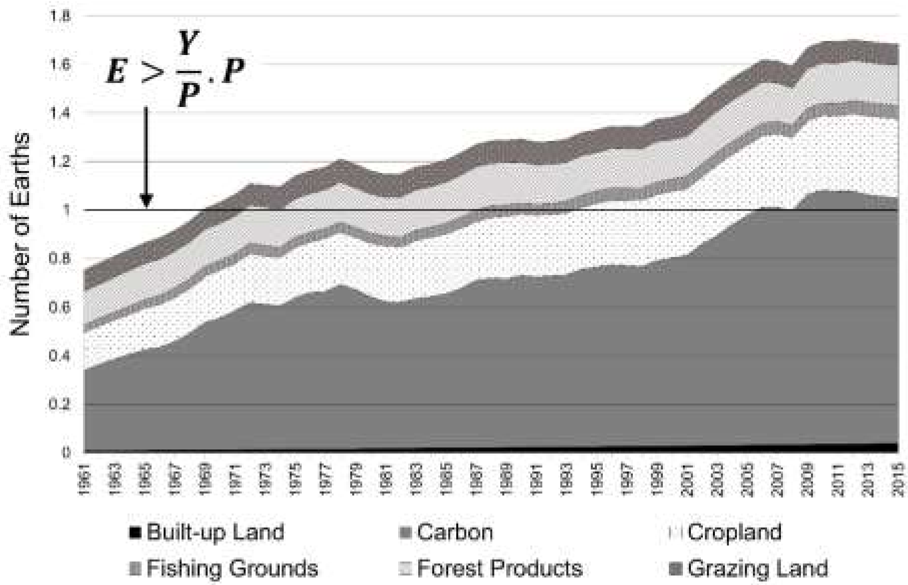
For me, the picture that best introduces the nature of that difference shows the number of 'planet earths' being used by humanity, produced by the Global Footprint Network (Wackernagel et al. 2002). It is reproduced below with the permission of the publisher.

Figure 15.1 Time trend of humanity's ecological demand (Source: Global Footprint Network)



The image is simple, compelling, and was published in the Proceedings of the National Academy of Sciences – an impeccably reputable science journal. Mathis Wackernagel founded the Global Footprint Network, which has continued to develop this method of measuring humanity's impact on the biosphere. The Network now provides a public dataset, on an open data platform (Global Footprint Network 2020), which is periodically updated, and would make an excellent teaching resource. The dataset can be downloaded and used to produce graphs like the one below, showing the components that make up the number of planet Earths used by humanity.

Figure 15.2 The Strong Sustainability Equation. (Source: The author)

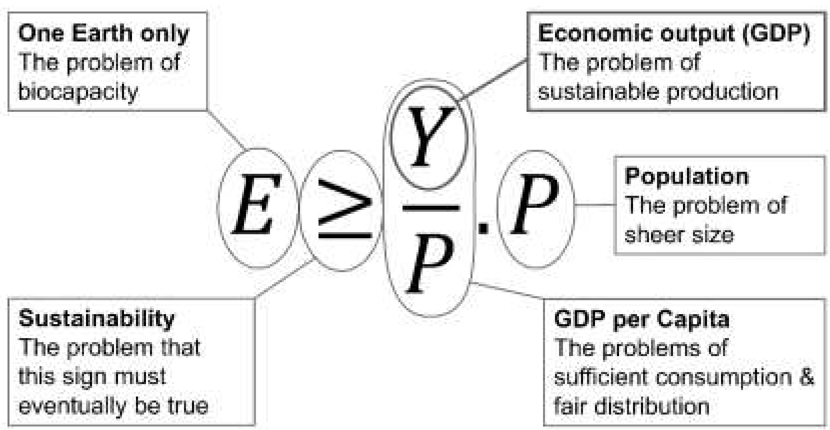


The Strong Sustainability Equation

I have added an equation to the graph, which I call the 'Strong Sustainability Equation' (SSEQ), to bring the picture squarely into the realm of economics in a way that should be immediately comprehensible to conventional economists. The SSEQ is similar to the I=PAT equation, familiar to ecological economists (York et. al. 2003), but I prefer it to the latter for teaching purposes. I do not have enough space, in this article, to fully explain why – other than to say that the 'I' (for Impact) in I=PAT is a variable, whereas E is a constant (at any point in time) and therefore a 'hard constraint' that requires a solution to the right-hand side of the equation. The inequality symbol in the SSEQ is also important because this equation must eventually become true. That view is supported by The Global Footprint indicator and other measurements of human impacts on the ecosystem, such as the Millennium Ecosystem Assessment (MEA 2005), which were not available when I=PAT was formulated. I have previously used the following diagram, of my own design, to explain how the SSEQ combines five teachable problem domains:

1. The problem of failing to act, when E is ‘less than’ the combined elements on the right-hand side of the equation, as it is currently.
2. The problem of preserving and/or restoring the biocapacity of the Earth (E).
3. The problem of reducing the gross volume of economic production, and/or increasing the total factor productivity of economic output (Y), including the use of energy resources.
4. The problem of how economic output is allocated within existing nations, among nations, and between current and future generations (Y/P).
5. The problem of regulating the total size of the global population (P).

Figure 15.3 Teachable elements of the Strong Sustainability Equation (Source: The author).



Not all these problems could be explored in a single high school course, but the purpose of this Achievement Objective was to develop an understanding of why continuous ongoing growth is unsustainable. The ‘Number of Earths’ picture and the SSEQ, taken together, provide a robust framework for developing that understanding, as well as the multiple dimensions of a problem which EE might contribute to solving.

7.3: Demonstrate an understanding of the Real Economy and how the laws of thermodynamics apply to economic theory and policy.

This Achievement Outcome reflects the content of Chapter Two of Daly and Farley's (2011) ecological economics textbook. At Level 6 of the current New Zealand economics curriculum students are introduced to circular flow models

of the economy. Daly and Farley (2011, p. 24) describe the ubiquity, and standard application, of such models:

> Given that standard economics has a preanalytic vision of the economy as the whole, what is its first analytic step in studying this whole? It is depicted (as)… the familiar circular flow diagram with which all basic economics texts begin. In this view, the economy has two parts: the production unit (firms) and the consuming unit (households). Firms produce and supply goods and services to households; households demand goods and services from firms. Firm supply and household demand meet in the goods market (lower loop), and prices are determined there by the interaction of supply and demand.

These 'circular flow' models are simplified representations of the System of National Accounts (or SNA), the internationally agreed method for measuring Gross Domestic Product and Gross National Product (UN Statistical Division 2009). The SNA acknowledges that certain events, issues and activities fall outside the scope of that measure, because GDP is not a measure of welfare (Ibid, pp. 12-13). These include:

- Unpaid Services, including domestic services, an omission Marilyn Waring (1999) criticised from a feminist perspective.
- The Impact of external events, including (for example) 'an influenza epidemic'.
- The impact of externalities: such as 'air and water pollutants' causing 'a loss of welfare to individuals living nearby'.
- Non-economic impacts on welfare: including 'personal and family circumstances, health, lack of employment'.

The authors of the SNA say (p. 13): 'It is difficult to imagine an objective way in which factors such as these could be quantified *and more difficult to* *imagine the usefulness of including them in a system designed primarily to facilitate economic analysis*' (my emphasis).

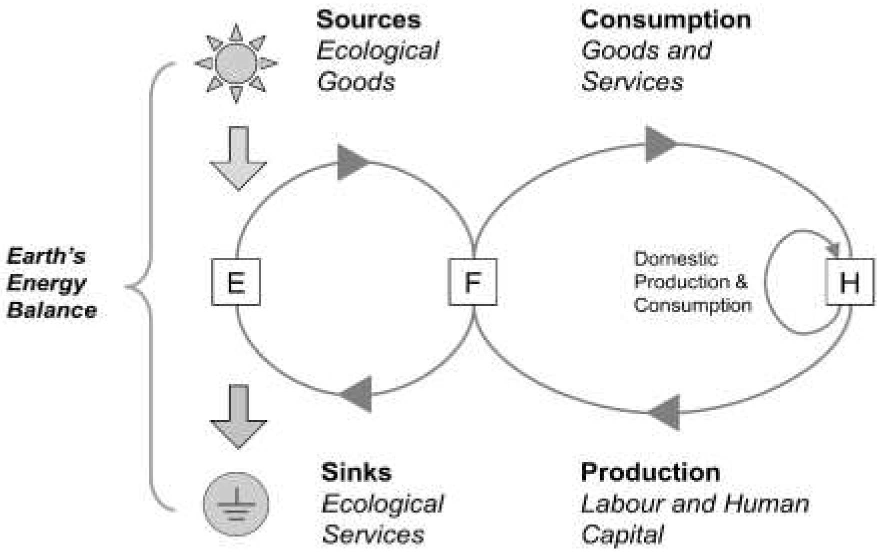
The Real Economy

One of the crucial omissions of the SNA, and from the circular flow models of the economy, is the ecosystem. Natural resources, if they are mentioned at all in a circular flow model, are described as factors of production, and said to be owned by households. This is a throwback to 18th and 19th century economists such as François Quesnay and Adam Smith, and the idea that the factors of Land, Labour and Capital were contributed by three distinct social classes: the owners of those factors, and they were most interested in how national incomes was to be shared among those classes in the form of rents, wages, and interest or profits (Ekelund and Hebert 1975).

Hence the circular flow models tend to focus on the flows of money within the economy, and not the 'real economy', which economists refer to when discussing all the things that money can buy, as well as all those that it cannot (e.g. unpriced externalities) or does not (e.g. unpaid domestic labour). There are very few equivalents of a circular flow model for the Real Economy. The most comprehensive is the World 3 model developed for the Limits to Growth (Meadows et. al. 1972), but it is complex and would be inappropriate for teaching at this level. I drew the following simplified picture of resource flows in the real economy for my presentation at the 2019 ANZSEE conference.

It shows resource flows in the real economy, and it reflects and reinforces the Strong Sustainability Equation introduced above: E (the ecosystem) provides ecological goods and services, Y (GDP) is measured at Firms, while all human beings (P for People and Population) all live in Households, consistent with conventional 'circular flow' models.

Figure 15.4 Resource flows in the Real Economy (Source: The author)



The connection between economy and earth is represented as two flows: **Ecological Goods** (or Sources) is the flow of natural resources from the earth to the economy, and **Ecological Services** (or Sinks) is flow of waste products, including carbon emissions, from the economy to the earth. The diagram includes Earth's energy balance; the difference between the solar energy absorbed by the biosphere and that radiated into space, which is regulated by atmospheric greenhouse gases. Thus, the Earth is represented as a 'closed' thermodynamic system - one that only exchanges energy with its environment.

Economics and the laws of thermodynamics

The following quote is from a textbook recommended by Auckland University for first year economics students, when I studied there (Baumol and Blinder 1986, p. 635):

> It is a plain fact that the earth is endowed with only finite quantities of such vital resources as oil, copper, lead, coal, and many others. This fact has fascinated pessimists throughout the years. In 1972 extreme pessimism assumed its most scientific guise in a publication by the Club of Rome called *The Limits to Growth*.

The authors go on to explain that when demand for any natural resource exceeds supply prices must rise, calling new sources of raw materials into production or the development of substitutes. The opposing view from EE can be found in Chapter 2 of Daly and Farley (2011, pp. 30-31), which is that Earth is a *closed* thermodynamic system and therefore (emphasis added):

> By the **First Law of Thermodynamics**, the conservation of matter and energy, … all raw material inputs eventually become waste outputs. The throughput has two ends: depletion of environmental sources and pollution of environmental sinks. Ignoring throughput is the same as ignoring depletion and pollution.
>
> (and) … the flow of throughput is not circular; it is a one-way flow from low-entropy sources to high entropy sinks. This is a consequence of the **Second Law of Thermodynamics**, the entropy law. We can recycle materials, but never 100%; recycling is a circular eddy in the overall one-way flow of the river. Energy, by the entropy law, is not recyclable at all.

In short, the earth will not bring into existence new ecosystem goods and services in response to price signals or human ingenuity. To have a sustainable economy we must use what the earth provides, more efficiently and more sparingly. Students must learn, as early as possible, that economic theory cannot violate the laws of thermodynamics. They should learn to question or reject economic hypotheses or models that permit unlimited growth in a closed system, or assume an unlimited supply of cheap energy, or the costless conversion of chemical elements, or that Earth has an unlimited and inconsequential capacity to absorb the waste products of human activity. More broadly, one could say that economists should pay much more attention to, and show more respect for, the natural sciences.

Teaching and learning

There are many teachable elements in this Achievement Objective, some of which should be present in the existing economics curriculum already, such as the System of National Accounts and what it includes and omits. I will argue here that the grey 'arrow heads' on the diagram above represent the most interesting and relevant issues for students to explore: the problems of how the ‘real economy’ inputs and outputs circulating within this model should be allocated and regulated. These include:

- Intergenerational equity and the long-term economic consequences of future generations’ inability to ‘bid’ for ecosystem resources in contemporary markets.
- How human institutions other than markets have been used to effectively manage the commons (Ostrom 2018).
- Approaches to the regulation, including rationing over time, of depletable resources (e.g. Heinberg 2006).
- The difference between property rights (unequally distributed) and human rights (equally distributed) and why economists ought not conflate or confuse them (Tobin 1970).
- The legal rights of nature (e.g. Stone 1988).
- In New Zealand; a bicultural perspective of how concepts embodied in the Maori world view, such as Kaitiakitanga (guardianship), or Hau and Utu (reciprocal gift exchange), differ from the western paradigm of ‘rights’ (e.g. O’Connor 1991; Hay 1996).

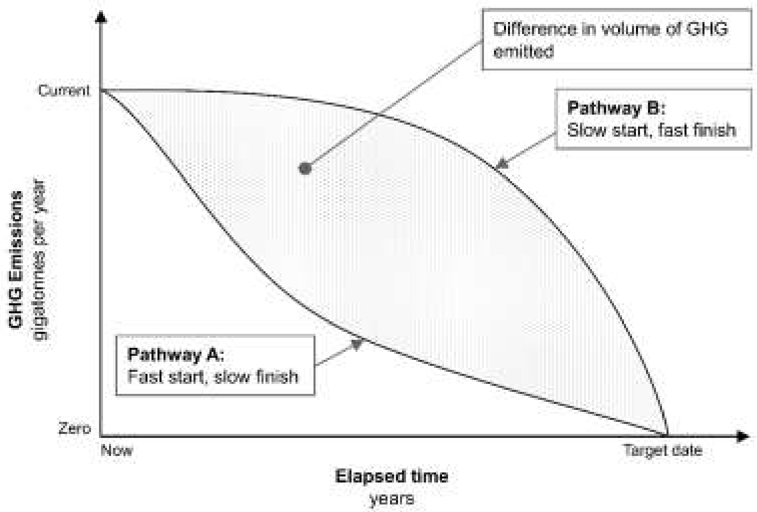
However it would also be possible to use the real economy model as a basis for exploring less abstract issues, which have a more obvious connection to vocational opportunities for students, such as: their local water supply, wastewater and stormwater disposal systems and how these are financed; or how domestic rubbish is disposed of and/or recycled; or examining local businesses that claim to have a sustainable approach to resource use.

8.3: Demonstrate the use of scenarios and systems dynamics modelling to explore the ecological consequences of economic decisions.

The third Achievement Objective focuses on decisions, decision-making, and solutions to the issues explored in the first two Achievement Objectives. This achievement objective focuses on providing students with tools and methods for engaging with ‘futures thinking’, rather than introducing them to policy prescriptions for sustainability that already exist. I propose this approach because one of the lessons learnt from exploring the introduction of civic education to the New Zealand curriculum was that ‘civics’ is a less contentious subject than ‘citizenship’ (NZPSA 2018). The former, being descriptive of the systems and institutions that already exist, was a less contentious subject than the latter, which had a normative or more 'political' aspect. If we want to make it 'easy' for government officials to introduce EE into the curriculum, the less contentious path might be preferable.

The compelling picture I would choose to illustrate this Achievement Objective was presented at a conference I attended in Wellington around 2010. Although I have long forgotten the conference, I can easily redraw the picture from memory because of the clear message it conveys: setting a target date for achieving zero carbon emissions is useful, but not enough. The difference in Greenhouse Gas (GHG) emissions between any two chosen paths will have profound consequences for global warming.

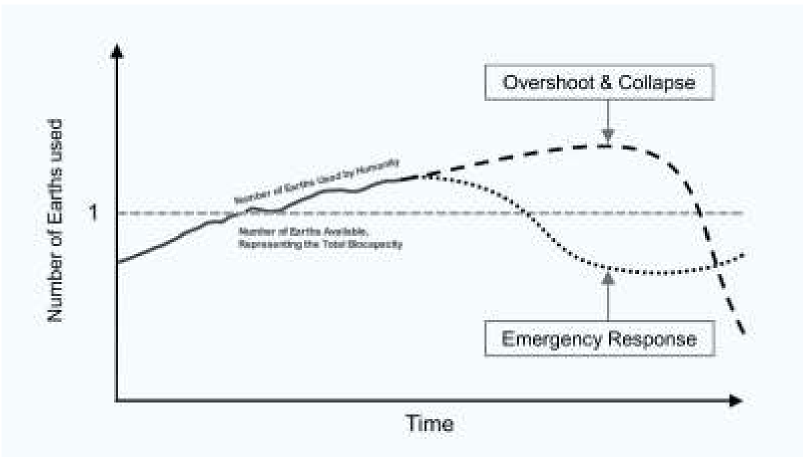
Figure 15.5 Greenhouse Gas Emissions Pathways (Source: The author)



This returns us to the first Achievement Objective and the problem that the SSEQ must eventually become true, and hopefully provides students with the hope that their own decisions and actions can make a difference, as shown in Figure 15., below. The difference between one pathway and another could be the difference between the collapse of human civilisation as we know it (Diamond 2011), or the possibility of a sustainable future and perhaps even some long-term improvement – although that might require an 'emergency' response, with attendant economic and other consequences.

Developing scenarios

The question students should be asked to address are: What future do they want? and How could we create that future? During 2009 and 2010 I was part of a team at Manukau City Council that designed and delivered the *Towards 2060* project, under the leadership of Dr Maggie Lawton (Towards 2060 2010a). The overall framework we used was the 'ABCD' strategic planning framework published by The Natural Step (2020). One of the workshop tools we used, shown in Figure 15. (below), was a group of four scenarios created by posing two questions:



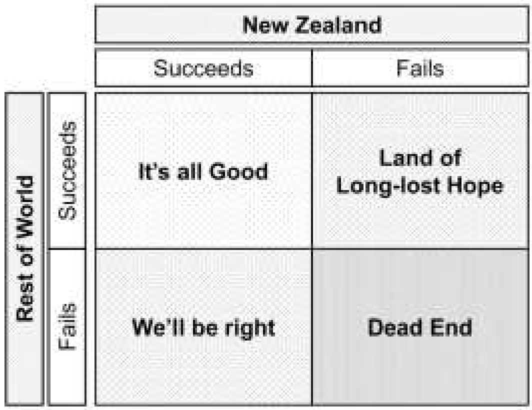
:

Figure 15.6 Two scenarios for humanity's future (Source: The author)

- What if New Zealand succeeds or fails (at achieving a sustainable future)?
- What if the rest of the world succeeds or fails?

This scenario grid was based on the 'game theory' approach to addressing climate change published in a YouTube video by US high school teacher Greg Craven (2007). We gave each quadrant an evocative title, similar to the scenarios developed by Landcare Research (Taylor et al. 2007).

Figure 15.7 Scenarios – a tool for Futures Thinking (Source: The author)



The workshop consisted of asking people, working together in groups, to write and/or draw descriptions of those four visions for the future, and then discuss the decisions a society might make to arrive at those futures. Some of these workshops were conducted at high schools in Manukau City, and were well-received by students and teachers (Towards 2060 2010b).

Systems Thinking and Systems Dynamics Modelling

Kate Raworth (2017) outlines a robust critique of the mechanistic or 'Newtonian' approach of orthodox economics and exhorts 21st century economists to 'get savvy with systems'. Students of economics in present day should not be taught 'general equilibrium' theories and economic models but instead should get to grips with complexity theory and models of complex systems. Teaching *Systems Thinking* means students should learn to draw simple cause-and-effect diagrams and get to understand systems archetypes, the ideas of positive and negative feedback loops, and what it means for a system to be operating within control limits or to be 'out of control'. Teaching *Systems Dynamics* (SD) means students should learn to use modelling tools to make SD models. The picture of a real economy, in Figure 15. (above), can be thought of as a simple systems dynamics model, with stocks of natural resources, and flows among the Ecosystem, Firms and Households, while the arrow heads represent measurement points and/or potential regulatory mechanisms. Appropriate modelling software is freely available:

InsightMaker, developed by Scott Fortmann-Roe (2020) provides both SD and Agent-Based Modelling on a free online and open-source platform. Professor Steve Keen and Russel Standish (2020), have created the Minsky economics SD modelling package, available free for download from Sourceforge.

Teaching and Learning

In this Achievement Objective I have outlined a set of conceptual tools for thinking about the future; how it might unfold, and how that process might be influenced for better or for worse. They include:

- Scenarios
- Game theory
- Strategic Planning
- Systems thinking
- Systems dynamics modelling.

These tools would be useful in other contexts, including business development and management or public administration. In that sense, using these tools as part of an EE course has a 'vocational' aspect, which is less likely to draw criticism for leading students toward policy solutions promoted by some political parties and not others.

Conclusions

New Zealand's curriculum framework, because it favours local curriculum development and design, may present a greater opportunity for introducing EE into high school teaching and learning than might be available in other national or state curriculum systems. The main challenge is to make it easy for teachers, by providing teaching and learning resources of high quality that are fit for purpose. The Ministry of Education and NZQA will want to know that an EE curriculum demonstrates: (1) that it reflects the vision and values of the New Zealand Curriculum, and (2) that it conforms with the published specifications for Achievement Standards and Assessment Resources.

In this chapter have mapped out three Achievement Objectives for an EE high school curriculum that I believe would form a coherent whole, taught over three years to high school students. Taught together as a single course, they might provide a framework for a first year university paper. In doing this, I hope to have provoked further discussion within the community of EE scholars about the key elements of EE that could be taught at an introductory level. It is not my intention that EE should be integrated, or reconciled, with the current orthodox economics curriculum because I believe the pre-analytical visions of EE and orthodox economics cannot be reconciled. Rather, EE should be taught alongside an orthodox economics course to provide a critical dimension to how economics is currently taught.

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Chapter 16: Greenprints and bioregional governance – ecological economics in practice?

Michelle Maloney

Introduction

This book asks how we can find ways to create an ecologically sustainable economy. In this chapter, I outline a grass roots initiative called 'Greenprints' which takes a practical, multi-disciplinary approach to helping communities understand how to live within their ecological limits, and along the way, how to engage in discussions about, and activities aimed at building, an Earth centred, sustainable economy. I begin by outlining briefly some of the key elements of ecological economics (EE). I then provide an Earth-centred critique of environmental governance in Australia, to provide context for the creation of, theoretical foundations for, and practical steps involved with, the Greenprints approach.

I then describe the pilot phase of the Greenprints initiative, and compare the approaches being used by communities in Greenprints, to some of the theoretical elements of EE. I suggest that Greenprints offers a useful example of one of the many ways that key concepts within EE can be used in practice, to build an ecologically sustainable economic system.

Ecological economics – Key elements of a diverse tradition

EE can be seen as an 'antidote' to the illnesses associated with neoclassical economics (NCE), including NCE's: complete separation from any acknowledgment of the biophysical realities of the ecosystems on which it depends; narrow definitions of monetary wealth and GDP; absence of any requirements for distributive or economic justice, and its compulsive obsession with material growth. However, as Washington and Lawn note in the Introduction to this book, defining EE can be challenging, as it has been interpreted and re-interpreted by many different schools of thought and 'means different things to different people'. Washington and Lawn also state that:

> … for ecological economics (EE) to provide genuine solutions to humanity's current predicament, it must convey a **clear picture and understanding of reality**. It must cover the **connection between**

> **economy and ecosphere**, and the reliance of the former on the latter for sustenance. It also must cover the important role played by **society's institutions**, which exist at the interface between economy and ecosphere. It must consider **ethics**, which should not only guide policy-setting with regard to fairness and equity in an anthropocentric sense, but **shape our spiritual connections with, and our treatment of, the natural environment** in and of itself. (emphasis added)

In addition to this outline of what EE must do to be of use in the current ecological crisis, there are several elements that need to be present, for an economic system to be within the frame of EE. It must aim to function within ecological limits, challenge the material growth paradigm, and address human population as well as consumption and production levels. (Daly 1991; Dietz and O'Neill 2013).

A further issue is the need for EE to move beyond anthropocentrism and champion ecological ethics (Washington and Maloney 2020), and this issue is addressed in the analysis of Greenprints.

Earth-centred critique of Australian environmental governance

The Greenprints initiative has been created as a response to significant gaps in the current environmental governance system within Australia. By 'environmental governance' I refer to the combination of economics, politics, law and regulation that helps shape the management of 'natural resources' or 'the Earth community' (the definition of nature depends on your world view) in Australia. Looking at the legacy of environmental governance in Australia since 1788, it is clear that the British, and then the Australian, legal and economic systems have failed to care for the living world across the Australian continent. Today, Australia's economic system is structured in such a way that future governance will continue to fail to protect the living world unless significant, systemic changes are made.

Every 'State of the Environment' report in Australia over the last two decades, has pointed to deteriorating environmental indicators (e.g. CoA 2018). Australia has the shameful record of the highest rates of mammal extinctions in the world (Woinarski et al 2015). We have cleared more than half of all the continent's original vegetation and are listed as one of the top 10 worst offenders for deforestation in the world (Preece 2019). Australia is one of the highest per capita CO_2 emitters in the world. On a per capita basis, Australia's carbon footprint, including exports, surpasses China by a factor of 9, the US by a factor of 4 and India by a factor of 37 (Australian Conservation Foundation 2019). Australia's ongoing nationally supported and subsidized policies for coal and minerals extraction have created a 'plutocracy' within Australian politics that makes the rights of large corporate interests paramount in any implementation of environmental protection laws.

Reflecting on the core elements of EE as briefly summarised above, I suggest in the following brief overview that Australia's economic and broader environmental governance system fails to meet the basic criteria of EE, for the following reasons:

- **Australia's ecological governance and economic system is anthropocentric and ignores ecological limits.** Our legal, economic and political system is focussed on supporting a narrow, anthropocentric definition of human economic and material growth and does not acknowledge ecological limits. From colonial times when expansion and extraction were fundamental goals of imperialism, to the present day, where neoliberal ideologies dominate our policy space and support the commodification of and extraction from the living world, Australia's environmental governance system has continually prioritized the growth paradigm. Further, Australia has no governance rules or pathways outlining *how* we can live within our limits – we have no road map or way to do this within the public policy or law sphere. This is one of the important gaps that Greenprints is aiming to address.

- **Australia's legal and economic system is 'top down' and does not use the principle of 'subsidiarity' to ensure local communities – or even Local Governments – have the critical decision making role in the future of their local ecosystems**. Control over natural resources lies predominantly with State Governments, with some environmental protection powers lying with the Federal government and Local Councils (Bates 2019). Laws relating to resource extraction, environmental protection and protected areas continue to be managed in a 'top down' manner in Australia.

- **Australia's economic system does not encourage the reduction of human use of raw materials for consumption and production.** While efforts have been made since the late 1980s/early 1990s to support 'sustainable development', the focus has continued to be on 'development' and as a whole the Australian political and economic system is driven by an insatiable demand for economic growth and high levels of consumption, and the legal system supports this. Indeed, the model of sustainability that emerged from the 1992 Rio Summit, and which influenced Australia's sustainability discourse and action, was profoundly flawed (Washington 2015). After the 1992 Rio Summit, the concept of 'ecologically sustainable development' (ESD) gained traction in Australian policy and legal frameworks, and was reflected in the 'Intergovernmental Agreement on the Environment' (IGAE), that was created to improve environmental cooperation between all levels of government in the Australian Federal system (CoA 1992). However, this policy framework has ultimately failed, because ESD was implemented within a 'business as usual' economic growth paradigm. ESD proposed that the 'three pillars' of sustainability – ecology, society and economy – were equal, and needed equal attention. Within a pro-growth cultural, legal and economic system, the use of ESD wasn't - and isn't - enough to stop the relentless destruction of the natural world. Ecology, society and economy are not equal – we must fit the human economic system and broader society into the limits of our ecological systems. Instead of ESD, we need to aim for a focus on 'living within our ecological limits' or living within the productive capacity of the living world.

- **A 'colonial mindset' continues in 'mainstream' Australian culture, law and economics, and it directly affects environmental governance.** In Australia, much could be achieved if we had government leadership and public discourse that directly opened up inclusive and compassionate discussions about the impacts of colonization on First Nations peoples, and ways forward into the future together. Much could also be achieved if we explicitly encouraged conversations about what our human governance systems would look like if we embraced the biophysical realities of Australia, and moved away from the colonial mentality that continues to impose European influenced agricultural, extractivist and development practices across the continent. This colonial mentality created, and is supported by, mainstream Australian culture, economics and law. Developing EE in Australia will require Australians to accept and embrace the remarkable and unique ecological system within which we live, work and play.

The Greenprints approach

The name ‘Greenprints’ came from the observation that although we have ‘blueprints’ to guide careful construction of engineering and building projects, we don’t yet have ‘greenprints’ that help guide industrialised societies to build regenerative economies and communities, within healthy ecological limits. The Greenprints initiative addresses this gap by providing a practical methodology – literally a step by step guide – to help communities understand ecological limits and Planetary Boundaries; downscale Earth Systems science concepts for local relevance; understand the unique ecology and healthy limits of their local bioregion and community ecosystems; analyse past, present and possible future human economic activity within their bioregion (including land use, consumption, production, carbon and other emissions etc.); and develop bioregion-specific strategies for transitioning to new, regenerative economic systems, that are supported by ecological law and governance (Garver 2013).

The Greenprints approach is being designed as a direct response to the urgent need for Australia to transition away from its anthropocentric, ‘top down’, pro-growth governance system, and to build ecological governance approaches that are uniquely suitable for the Australian continent. Greenprints is both a process (a step by step guide) and an output (a series of scenarios and plans). It provides a methodology that can be tailored to any bio-physical area in Australia, with a focus on bioregions and/or sub-bioregions as the most appropriate scale. Greenprints is also tailored to the unique cultures, communities and peoples who live in the relevant bio-physical area.

Greenprints doesn’t aim to ‘reinvent the wheel’, but rather aims to offer a pathway through the maze of existing sustainability approaches, so that appropriate tools can be selected by communities, with the additional element of embedding these approaches within a local, bounded 'space' such as a bioregion. This 'pathway' includes encouraging participants to review – and where appropriate adopt - elements of a range of approaches, including (but not limited to): the Transition Town movement, the Ecological Footprint Method, 'One Planet Living' methodologies, Industrial Ecology, Planetary Boundaries, Steady State Economics and Doughnut Economics, and engaging with the practical approaches within the new economy and localisation movement.

Theoretical framework – Earth jurisprudence and ecological limits

This and the next section are largely similar to part of my chapter (Maloney 2017) in the book 'Positive Steps' (Washington 2017). This is with the permission of the publisher and editor. The creation of Greenprints was inspired by the theory of Earth jurisprudence. Earth jurisprudence, a term coined by cultural historian and 'Earth scholar' Thomas Berry, is a theory of Earth-centred law and governance. Berry argues that the underpinning governance and institutional structures of contemporary industrial societies – law, economics, education, religion – are human centred and have fostered the belief that the natural world is merely a collection of objects for human use (Berry 1999). In contrast, Earth jurisprudence suggests a radical rethinking of humanity's place in the world, to acknowledge the history and origins of the Universe as a guide and inspiration to humanity and to see our place as one of many interconnected members of the Earth community (Swimme and Berry 1992). By 'Earth community' Berry refers to all human and 'other than human' life forms and components of the planet – animals, plants, rivers, mountains, rocks, the atmosphere – our entire Earth (Berry 1999). He suggests that 'our great work' is to transform human governance systems to create a harmonious and nurturing presence on the Earth (Berry 1992).

From an Earth jurisprudence perspective, the reasons for humanity's failure to transition to societal rules that help us live within our ecological limits are complex, but three key barriers stand out. The first barrier is the powerful combination of two belief systems in industrial societies: anthropocentrism, the idea that humans are the centre of all things and are superior to or more important than all other elements of life, and the belief in the necessity of unlimited economic growth. The idea that unlimited growth is critical for the health of national economies developed during the Industrial Revolution and continues to dominate modern political, economic and cultural life (Alexander 2011). The combination of these two world-views has been a significant barrier to the mind shift necessary to accept and act on the reality of our ecological limits (Berry 1999).

The second barrier to human societies living within their limits is the unequal power structures created and perpetuated by the vested interests who control much of the Earth Community, or the planet's 'natural resources' and currently prevent those concerned with the health of the Earth from transforming our societies. There are now many claims that modern western societies are plutocracies rather than democracies (Burdon 2014; Alexander 2014; Preston 2014) and are governed by the interests of wealthy individuals and corporations, who wield disproportionate power in development of State-sanctioned policies. The lengths to which private interests have gone to protect their financial interests in industries as diverse as tobacco and fossil fuels have now been carefully documented (Oreskes and Conway 2011). An increasing number of investigations also show the interaction between powerful private interests and their control over the public policy agenda (Sachs 2011). Such power structures mean that the vast majority of the world's population, including civil society and other groups who want to live sustainably and within their ecological limits, are excluded from key decision making roles. This 'pathology' of a society dominated by vested interests and disconnected from its physical realities is a powerful and all-pervading reason why we do not live within our limits. Recognizing these power structures, naming them and directly addressing them is crucial.

The third barrier is that industrialized nations have functioned for hundreds of years, and particularly since the Industrial Revolution, *without* any concept of ecological limits, and this means that living *within* limits is new and challenging for our governance and legal systems. Our existing governance systems – our institutions, legal and regulatory systems, environmental laws and 'environmental management tools' – are all built to support, or only gently mitigate, human-centred growth, and are not yet sufficiently sophisticated or in tune with the Earth Community to help us live within our limits. Strong protections of national sovereignty and private property rights have further entrenched this barrier.

Greenprints addresses all of these barriers by aiming to make it easier for people to: engage in ecocentric thinking and actions; understand and connect with the wider Earth community; appreciate ecological limits in their local ecosystems, bioregions and broader Earth system, and ultimately work to create the culture, ethic and societal rules, that will build regenerative, ecological societies. The approach is designed to offer hope and positive alternative ways forward; which are critical elements when tackling the first and second barriers outlined above.

Greenprints as a practical pathway

As a practical methodology, Greenprints provides a step by step guide to help communities and connected stakeholders understand their local ecological systems and transition their economies so they can live within ecological limits. These steps are outlined below.

Given that the current political and economic priorities of Australia's governments continue to be 'growth and jobs', the author and the Australian Earth Laws Alliance (AELA) do not have any expectations that the Greenprints approach will be taken up by State or Federal governments in the immediate future. For now, the Greenprints Handbook being developed as the primary source of information about the Greenprints approach, is aimed at civil society – individuals, community groups and organisations – as well as enlightened local governments. AELAs aim is that these groups use the Greenprints approach as a starting point and guide for moving their town, city and bioregion into a zero-carbon, biodiverse place for human societies and the wider Earth community. However, once the Greenprints Handbook is completed in early 2021, we will – to demonstrate optimistically that an alternative system is possible – present it and advocate about it, to governments at all levels. The journey toward systemic change will take years, and Greenprints may be redesigned as we go, but AELA is committed to the work and believe that we can in fact create governance systems that enable humans to build a more harmonious relationship with the wider Earth community, and thrive within the productive capacity of the non-human world. A quote regarding the creation of a 'right relationship' with the Earth economy, is relevant to the development of Greenprints:

> This cannot be a plan only for experts and policy makers. People from all levels of society must be involved. Grounding and clarification about the need to cherish and protect the commonwealth will take hold through experiencing nature and after earnest conversations among people who care for each other, and not merely discussions in environmental governance think tanks. Designing a rational new approach to economics will only work if people with diverse life experiences participate in dialogue about what they aspire to in their daily lives in a whole earth community (Brown and Garver 2009: 141).

Thus, community action and ownership of the process is at the heart of Greenprints.

The first pilot project

In 2019, after two years developing the Greenprints methodology, including the first stage of an online mapping tool, AELA began working with a group of community members from the Sunshine Coast in the State of Queensland, to develop the first Greenprints project. The community participants ('the Greenprints Sunshine Coast Team', or 'GPSC Team') all reside in the northern sub-regions of the South East Queensland Bioregion. The GPSC Team represent eight place-based organisations committed to caring for the local environment. The AELA Team and GPSC Team meet on a regular basis, check in with the Greenprints scientific and First Nations advisory groups, and have been developing several streams of work together. This work includes conducting multi-disciplinary research, hosting events for local communities, developing a 'Greenprints Workbook' for the Sunshine Coast and developing a 'Greenprints Master Handbook' to help guide other communities to explore and work through the steps in the Greenprints approach. In simplified terms, the Greenprints approach currently includes the following:

Step 1 – Thinking differently – a focus on ecocentrism and ecological limits.

The first 'step' in the Greenprints approach is to *change the way we think* about our place in the world. If we accept that humans are simply one part of the wider, interconnected community of life on this planet, and we accept that all of life and life-supporting systems have the intrinsic right to exist, thrive and evolve, then our expectations of how we should live change dramatically. And our starting place for transitioning to a healthy future is in fact the Earth itself (not us).

In this first stage of the Greenprints process, participants explore ecocentric theories and governance approaches through a range of interactive exercises, peer-to-peer learning and workshops and activities featuring experts and special guests. It includes engaging with local First Nations peoples, and wherever possible, working together in a culturally appropriate way, that ensures First Nations peoples' perspectives and knowledge are respected and they themselves are advisors and participants in the longer term project, should they wish. The first stage of the process also introduces the concepts of Planetary Boundaries, ecological limits, and a range of economic theories and approaches that can inform the transition to an economic system that can 'fit' within ecological limits, including: Steady State Economics and Doughnut Economics. However this first stage of the process isn't just about accumulating knowledge – it's also about connecting with the human spirit, connecting with people's love of their local plants, animals and ecosystems, and finding ways through ethics, eco-spirituality and the arts, to enable people to explore their interconnection with the wider Earth community.

Greenprints differs fundamentally from many other planning processes. In Australia and other industrialized nations, planning processes typically focus on how to achieve pre-determined human objectives, while maximizing financial gain and minimizing environmental and social 'harm'. This approach is built on the flawed foundations of a cultural world view that neither respects nor understands the inherent limits or long-term regenerative capacity of the living world. In contrast, the whole approach of Greenprints is embedded within a framework of respect for understanding and living within limits.

As noted above, it has been argued that 'ecologically sustainable development' as a concept and practical model, has largely failed (Klein 2014; Washington 2015). One of the key reasons it failed is that governments and corporations embraced the idea that ESD was all about 'balancing' the three pillars of human society – environment, society and economy. Unfortunately our existing culture and governance systems ensured that we focussed predominantly on the modern notion of an 'economy' (especially that it must grow perpetually) and the environment and society often lost out. ESD was also treated largely as a process of continual improvement – it had no end game, no outer limits, no parameters within which to achieve success.

In contrast, Greenprints is based on the notion of 'nested' sustainability – that is, that we must 'fit' human societies, and human economies, into the regenerative capacity of the living world. This may appear blatantly obvious to those of us who have been working on sustainability issues for a very long time. But again, at present our governance systems are not built this way – narrowly defined, unjust economic interests are valued above all else, while the environment and social justice deteriorates.

Step 2 – Defining the boundaries of our ecological limits

Greenprints is based on the idea that if we are to transition industrial societies away from their current abuse and overconsumption of the natural world, we need to start by focussing on the health of the natural world. But what 'scale' or 'unit of analysis' is the best way to start? What are these ecological limits that we need to work within? A useful 'starting point' for mapping out what Earth-centred governance can look like, is a *bioregion*. A bioregion is an area of land or sea defined by common patterns of natural characteristics and environmental processes (such as geology, landform patterns, climate, ecological features such as plant and animal communities). A bioregion's borders are defined by natural boundaries such as mountain ranges, catchments and soil types (rather than the political boundaries of many maps). Each bioregion has a unique collection of ecological communities as well as different patterns of land use and threats to biodiversity (NSW Government 2016).

A bioregion is smaller than an ecoregion, but larger than an ecosystem or catchment area. Australia has a widely accepted classification system called the Interim Biogeographic Regionalisation for Australia, version 7 (IBRA7, DAWE n.d.) which has created 89 bioregions. While some conservation and land management groups in Australia use catchments (or watersheds) rather than bioregions, in conservation projects, catchments fit within bioregions and the Greenprints scientific advisory group confirmed that bioregions and sub-bioregions are the best unit of analysis for the project.

A distinction should be made at this point, between bioregions (defined above) and 'bioregional*ism*'. Bioregionalism is a body of thought that evolved to: 'reconnect socially just human cultures in a sustainable manner to the region-scale ecosystems in which they are irrevocably embedded' (Aberley 1999). It has a rich, vast literature and despite its critics, has created an enduring legacy. Greenprints draws on some of the powerful ideas from the bioregionalism movement, but unlike the movement itself, does not place a priority on re-drawing our current political boundaries to comply with bioregional boundaries. Greenprints proposes that bioregions offer the best way for us to create long term, understandable 'ecological limits' within which we can redesign our governance systems.

The benefits of a bioregional approach are threefold. By using bioregional ecological health as a starting point for human governance, we can: (1) implement a key aspect of Earth Jurisprudence, that is, we can develop our understanding of place and connection with the unique qualities of our local Earth community; (2) map out what nature needs to thrive within specific, definable boundaries (in contrast to broader definitions of sustainable development which seem to relate more to 'continual improvement' than living within ecological limits); and (3) redesign human culture and society so that economic, social and political systems all work towards the same, life-sustaining ecological goals.

So for the remaining 'steps' in the GreenPrints method, the work carried out is focussed within a bioregion. Local community members are invited to explore what ecological health looks like within their local area, sub-region or bioregion.

Step 3 – Building deep understanding of the unique characteristics, bio-physical properties and resources of the bioregion and/or sub-bioregions.

The third stage of the Greenprints process focusses on developing a deep understanding of the geology, soils, topography, biodiversity, climate, water cycles and local seasons of the local bioregion and sub-regions. It includes a review of existing scientific literature, First Nations peoples' knowledge (where it is appropriate to access and learn from such knowledge and only where First Nations peoples are collaborators in the knowledge sharing process) and the knowledge of local organisations actively involved in ecological restoration, care and protection. This stage sees local participants working with local and visiting experts, and hosting collaborative events such as workshops and webinars, to bring an ever increasing number of people into the process. It also includes an in-depth review of present and predicted future impacts of climate change on the bioregion. The GPSC Team is currently working with AELA to plan a multi-day bioregional knowledge festival in early 2021, so that people can be invited to join a collective knowledge sharing process – and celebration of the living world – in their bioregion. The whole process will assist the development of the Greenprints Handbook.

Step 4 – Understanding human impacts in the bioregion – starting the economics discussion

This step requires past and present human economic and settlement activities to be understood, based on an objective assessment of the current ecological condition and current patterns of human activities in the bioregion. Much of this research material can be gleaned from existing NRM (Natural Resource Management) bodies and Catchment Management Authorities, in different States and Territories. This step in the Greenprints approach includes reviewing First Nations' peoples' relationship and interaction with the bioregion, the colonial settlement history of the bioregion, and current economic activities undertaken in the bioregion. The impacts of past and current activities are analysed, including land use changes since colonization, and the various impacts on the bioregion's ecological health. The Greenprints mapping tool is particularly useful in this stage, as it includes the layering of a number of datasets that show in some detail how the bioregion has been and is being used and impacted by human activities.

While this stage includes an introduction to different economic theories and an analysis of different economic activities being carried out in the bioregion, *it does not focus on neoclassical economic frameworks that measure the monetary value of what the 'economy' has achieved or is achieving*. The starting point for this step within the Greenprints approach, is to understand how human activities have changed the landscape since colonisation, and which changes have supported the functioning of biodiverse, healthy ecosystems and which changes have *not* supported – but rather have altered or entirely destroyed – the functioning of biodiverse, healthy ecosystems in the bioregion. In this way – by assessing human impacts based on their impact on biodiversity and ecosystem health - the Greenprints approach critiques, and quite often strips away, the NCE pretence of concreting monetary value over the top of living systems. Instead, Greenprints invites an analysis of past and present human economic activity based on its impact on the living world.

The GPSC Team is about to enter this phase of the pilot program, and one of the many activities that is being planned, is a bioregional 'New Economy Network Australia' (NENA) Symposium, that will bring as many people from the bioregion together as possible, to explore and discuss different economic theories, to showcase sustainable economic initiatives that already exist and discuss future possibilities. NENA is a civil society network involving thousands of Australian individuals and organisations, who are working to transform the economic system by ensuring that ecological health and social and economic justice, are the foundations and primary objectives, of the economic system. It operates within a pluralistic world view, where diverse, local, community based economies are privileged and pivotal to the movement.

Step 5 – Reviewing the ecological limits of the bioregion within interconnected ecoregions and Planetary Boundaries

This step involves a detailed analysis of the current and future ecological limits within which human activities must operate. This includes using the 'I=PATE' framework where 'Impact' = Population, Affluence and Technology, and E is ethics, as decisions should be made within an ethical framework (Brown and Garver 2009: 76-84). The focus includes the very specific parameters of the local bioregion, and a range of tools and methods are explored at various scales for determining obligations of local communities to manage and share the global commons. This includes the Ecological Footprint Method to calculate local consumption and approaches linked to downscaling the concept of Planetary Boundaries (Häyhä et al. 2016; Häyhä et al. 2018).

Step 6 – Scenario planning.

The Greenprints approach then encourages the development of a number of possible 'scenarios' for the future of a particular bioregion. 'Business as

Usual' examines what the impacts would be of continuing to carry out existing growth oriented economic activities, with details specific to the bioregion in question. Such activities might include destructive industrial scale agricultural practices, mining, water consumption, logging, rapidly growing populations and residential and urban developments and other activities. Other scenarios will then be developed, to show how economic activities could be transitioned to ensure human activities fit within ecological limits. The goal is to examine what could realistically be done in a region, across various time frames, that would ensure living systems regenerate and continue to support human societies indefinitely. The Greenprints land use maps and scenarios will be powerful tools for 'showing' what Earth-centred governance options exist. The ultimate decisions about which 'scenario' to aim for will be made by the communities involved.

Step 7 – Planning for the implementation of optimal scenario/s.

Once optimal scenarios are developed, specific action plans will be developed, to explore advantages and disadvantages of optimal future approaches. These action plans will include funding proposals, the types of law reform needed and other reform and transition plans.

An important part of this stage of the Greenprints approach is reviewing and reimagining the legal and governance rules that govern the bioregion. As noted earlier in this chapter, Australia's environmental governance system is 'top down', and most resource management takes place at the State or, less often, Federal level. By working through the Greenprints approach, and developing place-specific, bioregionally suitable law and governance recommendations, Greenprints will be able to help communities advocate for radical law reform over time. Instead of a top down system, Greenprints will enable people to advocate for the implementation of principles of subsidiarity and community based ecological governance, in order to more effectively protect and manage ecosystems and bioregions, than distant, nationally and state 'standardized' laws (AELA 2020).

Step 8 – Resources and community building.

While the development of a Greenprints approach in a sub-region or bioregion means that community members and experts from a variety of fields (including First Nations peoples' knowledge, science, history, environmental management, etc.) are engaged and brought into the process from the beginning – and throughout – the process, the final stage is about developing an advocacy plan and societal reform process, for making the changes necessary to implement optimal scenarios and change how people live, work and play in the bioregion.

Conclusions

Greenprints provides a practical approach to building an Earth-centred culture and ecological governance system that includes elements of EE. Built on the foundations of respecting, understanding and working within the regenerative capacity of the living world, it offers a way for local community members to understand (and articulate to others) how to shift from human to Earth-centred governance, how we can live within our ecological limits, and how the legal and economic system can be transformed to support Earth-centredness, subsidiarity and local ecological custodianship.

It could be argued that amidst the many discussions and debates about the definition, meaning, relevance and future of EE, the steps being taken at the community level, by people engaged in the Greenprints approach, are making headway in exploring and implementing EE in a very practical way. This empirical work is surely critical to the future of EE if it is to contribute to making real change.

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Chapter 17: Towards sustainable and equitable solutions through responsible innovation and the circular economy

Anna Phelan

In this chapter we take a closer look at the concepts of responsible innovation and the circular economy. Although unrelated, both concepts have been identified as promising mechanisms for solving grand societal challenges (Forum 2016; Khavul & Bruton 2013; Owen et al. 2012; Stilgoe et al. 2013). Grand societal challenges are massive social and environmental issues that transcend national borders and have potential or actual negative effects on large numbers of people, communities, and the planet as a whole, and, therefore, need to be tangibly addressed through collaborative efforts (George et al. 2016; Whiteman et al. 2013). I believe that incorporating the base principles of ecological economics, responsible innovation, and the circular economy can help steer business model innovation towards more sustainable solutions.

Ecological economics emphasizes the economy as a subsystem of the Earth's ecosystem; the preservation of natural capital; and the goals of sustainability, equity and human well-being (Costanza et al. 1991; Farley et al. 2005). Historically, conventional economic thinking and development policy have largely ignored the essential contribution of healthy ecosystems to human wellbeing in decision making (Costanza et al. 1997; Daly 1968; Freeman et al. 1973; Gómez-Baggethun et al. 2010). Ecological economics has shaped the understanding in academic literature that natural and social systems provide benefits that support human wellbeing and the rest of nature, and therefore should be valued and protected (Braat & De Groot 2012; Costanza et al. 2017). It also raised awareness of the relationships between nature and quality of life (Costanza et al. 2007; Díaz et al. 2015; Pascual et al. 2017).

Some writers in the ecological economics literature point out that the world is complex, adaptive system, with thresholds, tipping points, and surprises (Costanza et al. 2014), and that the connections between ecosystem processes, functions, and benefits to humans are non-linear and dynamic (Costanza et al. 2017; Hamel & Bryant 2017). Furthermore, services from ecosystems do not simply flow to human wellbeing without the complex interactions between natural, human, built and social capital (Costanza et al. 2014). Building on the three principal goals of ecological economics (Ibid) – ecologically sustainable scale, socially fair distribution, and economically efficient allocation (allocation that leads to prosperous, high quality of life that is equitably shared and sustainable) – I introduce responsible innovation and circular approaches, and their potential to influence managerial and business decision-making towards more sustainable and equitable solutions.

Responsible Innovation

Integrating sustainability within each step of the innovation processes is not easy, it requires an awareness of direct and indirect impacts on the user, affected stakeholders, society, environment and future generations (Brundtland et al. 1987; Hediger 1997). I believe that as the magnitude and severity of grand societal challenges grows, the need for business to incorporate processes that steer innovation towards long-term sustainability is ever more salient. Enterprise-led innovation can help society grapple with grand societal challenges through Responsible Innovation (RI) (Aguilera et al. 2007; Khavul & Bruton 2013; Owen et al. 2012; Stilgoe et al. 2013). The factors that distinguish the RI approach from traditional innovation for business include ethical acceptability, inclusivity of societal actors, and, societal desirability of the innovation process (Von Schomberg 2012). Some suggest (Owen et al. 2013; Von Schomberg 2012) that related concepts such as 'responsible development', 'responsible research', and 'responsible knowledge-based innovation' directly point to society's increasing demand for solutions, oriented not just towards short-term sustainability but a collective commitment of care for the future.

Initially the notion of RI was used quite narrowly to explore the responsibility of science with respect to human ethics, research integrity, intellectual property, socio-technical integration, and social implications of scientific innovation (Owen et al. 2013). More recently, however, one sees application of a broader perspective on innovation processes that take in to account the variety of actors both inside and outside the research and the development space (Pansera & Owen 2018; Stilgoe et al. 2013; Voegtlin & Scherer 2017). At its core, RI can be said to bring the awareness of responsibility towards future generations throughout the whole innovation process (Xavier et al. 2014). Uncertainty and potential for undesirable and even harmful impacts of innovation have led to the two philosophical cornerstones of RI - care and responsiveness (Owen et al. 2013).

The construct of RI implicitly bonds the notion of responsibility to the innovation process by reflecting on the purpose of the innovation as well as focusing on avoiding negative societal implications (Stilgoe et al. 2013). The widely accepted framework for RI consists of four integrated dimensions: anticipation, reflexivity, inclusive deliberation, and responsiveness (Owen et al. 2012; Stilgoe et al. 2013). In RI literature, these four dimensions underpin the flow of the innovation process and are understood as:

1. Systematic thinking about any possible implications of the innovation that is being developed – *Anticipation* (Norman & Verganti 2014; Owen et al. 2013)
2. Critically scrutinising assumptions, limitations, understandings and activities related to the innovation – *Reflexivity* (Owen et al. 2013)
3. Upstream engagement of stakeholders and the wider public – *Inclusion and Deliberation* (Lubberink et al. 2017; Owen et al. 2013)
4. Capacity and willingness to change the direction of the innovation in response to the feedback from the stakeholders and the wider public – *Responsiveness* (Owen et al. 2013; Stilgoe et al. 2013)

It has been argued that at its core this normative framework aims to ensure organisations consider the future products and services they are striving to create through a responsibility lens while remaining true to sustainability outcomes (Ashworth et al. 2019).

However, understanding how this framework is relevant to businesses is not without its challenges or ambiguity. The essential and critical role of business in technological innovation, including the development of technological solutions for long-term societal challenges, has been widely debated (Fagerberg 2017; George et al. 2016; Mazzucato & Semieniuk 2017; Whiteman et al. 2013). Research in business and management literature has a long history of extensively exploring corporate social responsibility (CSR), including corporate practices and their roles, and responsibilities within complex political and socio-economic systems (Carroll 1991; Chen & Bouvain 2009; Compact 2013; McWilliams et al. 2006). Whilst dimensions of social justice, inclusion and sustainability are actively discussed in management and sustainability literature, limited attention has been given to the practical implementation of RI activities (Blok & Lemmens 2015).

Blurred lens of corporate responsibility

The debate about the responsibility of organisations in society has a long history and here I review what responsibility means in the context of business and commercially-driven innovation, reflecting on the purpose and motivations of corporate innovation that go beyond risk mitigation. In the 1960s, a form of philanthropic performance emerged as companies distributed aid to communities affected by their operations based on organisational preference rather than societal need (Baranga et al. 2015). The transition to strategically-directed philanthropy in the early 1980s saw businesses leverage resources to address social problems that aligned with their organisational objectives (Scherer & Palazzo 2011). Corporate (social) responsibility subsequently emerged from recognition that corporate initiatives must go beyond the narrow boundaries of profit (Argenti & Forman 2003) and regulatory requirements (Carroll 1991) to enhance social welfare and improve the environment through philanthropy and community-focused development initiatives (Blowfield 2005; Miska et al. 2014).

Creating shared value (CSV) arguably further nuanced the corporate social responsibility debate. CSV is based on the principle that companies will succeed when they find ways to create social value first while creating economic value for themselves and their shareholders (Porter & Kramer 2011). It is argued that the concept of CSV applies to both business and society interactions and addresses how value is created for different stakeholders (Donaldson & Preston 1995). The theoretical crux of CSV has been said to be to enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates (Porter & Kramer 2011). In particular, CSV emphasises prescriptive morality of ‘doing good’ over the proscriptive morality of ‘avoiding harm’ as the higher order ethical standard of responsibility to which organisations should hold themselves (Porter et al. 2011; Stahl & Sully de Luque 2014).

The incentive for businesses to avoid unethical behaviour (‘do no harm’) was initially motivated by the threat of decreased economic performance and punishment by stakeholders (Creyer & Ross 1996). Doing no harm was viewed as a responsibility or imperative duty to mitigate the negative aspects of a company's day-to-day operations (Idemudia 2008). However, increasing demand from consumers to directly address the impact of business products and processes has resulted in a shift away from the passive 'do no harm' statements of the 1990s and early 2000s towards proactive 'do good' actions (Brei & Böhm 2011). Doing good has been said to require active corporate involvement and accountability, and whilst the belief persists that organisations should only 'do good' to gain a social license to operate (Demuijnck & Fasterling 2016), lack of accountability and failing to 'do good' may ultimately undermine public support.

> The concept of 'do no harm' reframes CSR as a series of deliberate and discretionary decisions made by individuals within organisations to avoid the negative externalities of doing business (Crilly et al. 2016). It has been said to aim to minimise harm to employees, consumers, the wider community and natural environment (Crilly et al. 2016). As the responsibility to avoid harm is distinct from the mandate to obey society's laws and codes, it is the economic obligation to generate profit for stakeholders that may motivate organisations to refrain from harm (Carroll 1991). Organisations debate the need for *necessary* evils as causing harm without diminishing from the value created by innovation (Coumans 2017; Margolis & Walsh 2001). However, attenuating risk without fully eliminating damage to society and the environment may have the unintended effect of increasing public awareness of the harm caused by doing business (Crilly et al. 2016; Phelan et al. 2017).

Circular Economy

A circular economy can be described broadly as 'an industrial economy that is restorative by design; minimises, tracks, and eliminates the use of toxic chemicals; eradicates waste; and aims to rely on renewable energy' (MacArthur 2013). In addition to being supported by low carbon footprints, the circular economy approach minimises resource input, waste, emissions, and energy leakage by slowing, narrowing, and closing material and energy loops (Geissdoerfer et al. 2017). Achieving an economic system of this type requires shifting industrial processes from a linear system characterised by waste and disposal, to a circular system. In a closed loop system resources are reused, remanufactured, refurbished, and/or recycled. A resource loop is the circling of materials, from their extraction, to their use, and reuse. Closing the loop results in less materials being wasted or discarded. Within the circular economy paradigm; communities, municipalities, and industries are encouraged to organize, and subsequently link resource loops for water, materials, and energy recovery (Geissdoerfer et al. 2017).

According to the Ellen McArthur Foundation (2017) a circular economy is guided by three key principles: to design out waste and pollution, to keep products and materials in use for the longest time, and to regenerate natural systems. At its simplest, a circular economy aims to generate business profit and economic growth, deliver benefits to consumers, radically increase resource productivity whilst also regenerating, rather than depleting natural capital such as soils, ecosystems, and water which play a crucial, but often undervalued role in many economic and social activities (Lacy & Rutqvist 2016; MacArthur 2013).

Circular business models

A circular economy is dependent on circular business models. For managers this presents an innovation challenge, they need to redesign existing business models, potentially develop new products and services, and deliver them in new ways that capture value (Geissdoerfer et al. 2018). Circular business models strive to maximize the preservation of the economic and environmental value that is embedded in products when they are originally produced (Velte & Steinhilper 2016). For businesses, circular economy principles can potentially help hedge against upstream risks including raw material availability and price volatility, and can help address their consumers' expectations (Bocken et al. 2016). Many advocates of a circular economy argue that it helps to decouple environmental pressure from economic growth (Ghisellini et al. 2016; however see also Introduction in this book).

Currently, we are witnessing how the knock on effects of the global Corona virus pandemic are disrupting businesses worldwide. This is a timely reminder of the complexity of modern supply chains. Supply chain disruptions are anticipated for many sectors. Circular economy approaches can help mitigate against supply chain risk (Gaustad et al. 2018). In particular, circularity can help minimize the dependence on overseas resources and low-cost manufacturing. Generally, circular-economy business models fall in two categories: those that foster reuse and extend service life through repair, remanufacture, upgrades and retrofits; and those that turn used or old goods into as-new resources by recycling the materials (Stahel 2016).

Research has identified many strategies to realize a circular economy by improving the way resources are extracted, used, and disposed of. These strategies include: narrowing the resource loop, slowing the resource loop, and closing the resource loop (Geissdoerfer et al. 2018). *Narrowing the loop* seeks to design and manufacture with fewer number of resources or substituting with recycled parts. *Slowing the loop* seeks to extend the useful life of a product. *Closing the loop* seeks to extend resource value by designed systems in which products that can be either reused or disassembled.

Benefits to businesses in adopting the circular economy model include new job creation; competitive advantage; reduced material, procurement and production costs, environmental benefits and reduced risk (Lacy & Rutqvist 2016; Lewandowski 2016; Mont et al. 2017; Whalen 2019). In a circular economy, the value of products, materials, and resources is maintained in the economy for as long as possible, and the generation of waste is minimised (Commission 2015). For municipalities, circular economy development involves the phase-out of the heavy polluting industries and businesses in favor of light economic activities, and the redesign of the infrastructure system delivering services (Ghisellini et al. 2016). For businesses, business model innovation is a key tool for transitioning to more sustainable systems (Chesbrough & Rosenbloom 2002; Doleski 2015; Geissdoerfer et al. 2018; Osterwalder & Pigneur 2010).

Conclusion

Achieving ecologically sustainable scale, socially fair distribution, and economically efficient allocation is a formidable goal. This chapter provides neither a toolkit nor a manifesto, but rather one input into a broader discussion of ecological economics. As pointed out by Aguilera and colleagues, business, and corporations in particular, are 'important and necessary social change agents' (2007, p. 857). The private sector is increasingly seen to have a critical role in developing solutions to the grand societal challenges. Complex problems require complex answers. As a transdisciplinary field, ecological economics seeks to integrate the study of humans and the rest of nature as the basis for the creation of a sustainable and desirable future (Costanza 2009). Responsible innovation evokes a collective duty of care, and acknowledges the power of enterprise-led innovation to shape our collective future. It also challenges us to ask what kind of future do we want to create as part of the design process.

The circular economy strives to address sustainability challenges by redesigning systems to eradicate waste while still maintaining access to goods and services that we have come to rely on. By narrowing, slowing, and closing resource loops, circular business models endeavour to transition towards a more sustainable way of producing, accessing, using, and re-using goods. Responsible innovation and the circular economy thus offer businesses further opportunities to realise greater value from resources, materials, and products, while delivering environmental and economic benefits, and more sustainable and equitable solutions. In their own right, the concepts of responsible innovation and the circular economy, help dissolve the barriers between the traditional disciplines, such as management studies and sustainable production and consumption, and ecological economics.

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Conclusion – Whither ecological economics?

Haydn Washington

This book is the third I have edited about ecological economics (EE) (the other two are Washington and Twomey 2016; Washington 2017). I would note that I am an environmental scientist looking in at economics, and trying to *make sense of it*. There is no doubt that our current economic system is designed 'optimally badly'. This is why society is currently 'bankrupting nature' (Wijkman and Rockstrom 2012). Hence the need for EE. This book was designed to have a focus on using EE to help solve the unsustainable environmental crisis. We collectively should ask what things in particular constitute solutions for EE? Well, I would argue that in particular the vision is that EE becomes the blueprint for an *ecologically-sustainable* economy that operates within the Earth's ecological limits (Daly and Farley 2004). EE would then help to solve the environmental crisis (Washington 2015, 2020) and help society move from an endless growth economy to one in balance with the world that sustains human society.

Is this hope 'pie in the sky' - as one academic has suggested to me? There are I believe two key questions to raise – what is *practical* and what is *ethical*? On a finite planet, is an endless growth economy 'practical' (especially in the long-term)? As was noted in the Introduction, both environmental scientists (e.g. Ripple et al 2017) and ecological economists (e.g. Daly 2014) argue that it is not practical to proceed in the way we have been doing over the last hundred years. Humanity is at the crossroads - society can either transform itself … or collapse (Washington 2020). The supposed 'wisdom' of neoclassical economics (NCE) insists our economy *must* always grow, and that this growth should arise from increasing population and consumption of resources (Daly 1991, 2014). However, the strongest elements of EE argue this is not possible, indeed fundamentally unsustainable, as endless growth is in fact responsible for the crises we face (Daly 2014; Washington and Kopnina 2018). Surely it is time to rethink society's 'given truths' and question their unsustainable assumptions (Washington 2020)? After all, Braungart and McDonough (2008: 117) note that 'insanity' is defined as doing the same thing over and over - and expecting a different outcome. An endless growth economy that is bankrupting the nature that supports society cannot be seen as 'sane' (Washington and Kopnina 2018). Similarly, it is time to stop pretending economics doesn't (or shouldn't) involve *ethics*. It should, and if we are to find solutions that will work, I believe it must now do so. I believe it is time to look outside the solution box of NCE. Hence the chapters in this book explore solutions based on EE, some of them outside the box of usual solutions.

Four current and relevant topics

Before I discuss the solutions specifically covered in the chapters, there are some topics this book touches on that I believe deserve *special discussion* in a conclusion about EE and solutions. These are:

1) The governance of the United Nations (especially the Sustainable Development Goals);
2) The much discussed 'Green New Deal';
3) The relationship of renewable energy to EE and a steady state economy;
4) The taboo of population.

It was noted in the introduction that the world is not travelling well in terms of solutions, as all our problems (environmental and social) are worsening, some of them rapidly. Where does that failure lie? Well, our top governance body internationally is the United Nations, so one can validly ask whether it has been a 'leader' regarding solutions that will turn around our worsening predicament? Let us consider the key strategies the UN has embarked on. It was the key leader on the World Commission on Environment and Development (WCED 1987), which embedded the idea of 'sustainable development' in the lexicon of world governance. Yet despite this report pointing out many of the key environmental problems that society faces, its main solution was to *grow* our way out of the problems with an ongoing GDP growth rate of 5%. If 'development' has taken on the meaning of growth (as is largely the case now, Washington 2015) then 'sustainable development' then becomes 'sustainable growth' - an oxymoron on a finite planet. Similarly, the UN Environment Programme (UNEP 2011) developed the 'Green Economy' which described itself as a 'new engine of growth' (p. 10). It argued that growth could continue without increasing environmental impact - via the highly questionable 'absolute decoupling' that was discussed in the Introduction.

Finally, the UN oversaw the development of the Sustainable Development Goals (SDGs) discussed in detail in the chapter by Kerryn Higgs. The SDGs in Goal 8 state: 'Promote sustained, inclusive and sustainable economic growth'. However, despite the UN being heavily involved in studies that acknowledge that society has exceeded ecological limits (e.g. MEA 2005: Kumar 2010), Goal 8 of the SDGs continues to argue for a *sustained* growth that is portrayed (apparently magically) to be 'sustainable'. It is also planned to be 'inclusive', though presumably (ethically) this is just for humanity, as the nonhuman world is in the process of collapse (Wijkman and Rockstrom 2012; Ripple et al 2017) due to the accelerating environmental crisis caused by society's endless growth mantra (Daly 1991, 2014). Notably, the SDGs fail to discuss the key problem of overpopulation, and argue quite glibly for 'no poverty' (Goal 1) and 'Zero hunger' (Goal 2). However, *how* are these to be achieved when an increasing population and consumption of resources is degrading the nature that society is fundamentally reliant on (Washington 2013; Crist et al 2017)? There are thus good grounds for questioning whether the SDGs are in fact sustainable, as Kopnina (2020) concludes, and is analysed in the chapter by Higgs.

So is the UN in fact leading society towards a sustainable future? Many of the SDGs are of course praiseworthy, but are they in fact *practical* solutions when they ignore overpopulation and support a continually growing economy? Similarly, the SDGs argue for 'Reduced inequalities' (Goal 10) when in fact the current neoclassical growth economy is worsening inequalities (Wilkinson and Pickett 2010; Piketty 2013). This brings us to a key problem that I have written substantially about – the problem of *denial*. Humanity has a key failing, it tends to deny any problems it does not want to think about. This is not just a problem of business or government, it is common in the public also (Washington and Cook 2011; Norgaard 2011). I suggest that denial is also arguably operating in the UN, as almost all its work seems to be based on the idea that the economy can (in fact must) keep growing. Despite the documentation of the accelerating environmental crisis over many decades (MEA 2005; Kumar 2010; Ripple et al 2017) the UN remains wedded to support for growing our way out of our problems. However, as eminent ecological economist Herman Daly (1991) has noted, further growth will not solve a problem *caused by growth*. In this regard, a key solution that EE could provide is a long overdue discussion of the fixed idea in global society that growth is 'always good'. I suggest it is not always good, nor is it now sustainable (Daly 2014; Washington and Kopnina 2018). It is time to plan for a future that looks beyond growth (Daly 1996; Washington and Twomey 2016). I suggest it is time for the UN to step up and now drive this discussion, and lead the way to an economy that does operate within ecological limits.

The *second* important topic is the Green New Deal (GND), about which there has been much discussion (e.g. GNDG 2008; Pettifor 2019; Klein 2019). This is discussed in detail in the chapter by Frank Stilwell. As Wikipedia notes, the GND has been defined as the: 'proposed United States economic stimulus package that aims to address climate change and economic inequality'. The UK GND differs somewhat from the US GND, and Pettifor (2019) argues that economic change is wholly possible, based on the understanding that finance, the economy and the ecosystem are all tightly bound together. Proponents of a GND tend to demand total decarbonization and a commitment to an economy based on fairness and social justice. However, it is clear from Stilwell's chapter that the definition of a GND is not set in stone, and could evolve to a stronger form. There are two key points I would raise about the GND:

> 1) Is it truly 'green'? Let us consider the Wikipedia definition of GND, being an 'economic stimulus package'. This is well and truly entrenched in the idea that we will grow our way out of this problem by stimulating the economy to grow by renewable energy, green jobs and greater equality. Now of course I accept that part of the idea of this is to get strong support for renewables and sustainability. In this case however it is by using our civilisation's addiction to endless growth to try and support renewables - because they will grow the economy. However, given that many environmental scholars argue that climate change is in fact a symptom of society's commitment to an endlessly growing population, consumerism and economy (e.g. Rees 2008; Washington 2020), maybe it is actually time to realise that the solution to get us out of this mess is to abandon this endless growth idea in regard to all three (Ibid)? After all, the IPCC 'Climate Change 2014' Synthesis report (p. 5) states:
>
>> Globally, economic and population growth continued to be the most important drivers of increases in CO_2 emissions from fossil fuel combustion.

Similarly, the Second World Scientists Warning to Humanity (Ripple et al 2017: 1026) has also stated:

> We are jeopardizing our future by not reining in our intense but geographically uneven material consumption and by not perceiving continued rapid population growth as a primary driver behind many ecological and even societal threats.

Similarly, the IPBES (2019: 3) extinction report detailed media release notes that: ‘Key indirect drivers include increased population and per capita consumption’. It goes on to say (Ibid):

> … a key element of more sustainable future policies is the evolution of global financial and economic systems to build a global sustainable economy, steering away from the current limited paradigm of economic growth.

If the IPCC, Scientists Warning to Humanity, and the IPBES extinction report can question the rationality and sustainability of endless growth, why cannot the Green New Deal do so also? Continuing to support endless economic growth, but just trying to swing it towards renewables and green jobs, is still leaving the fundamental unsustainability of society untouched – and this is *growthmania* (Daly 1991).

2) Is it truly ‘new’? If justice is raised at all in regard to the GND, it is just social justice, with essentially no mention of ecological justice (Washington et al 2018) as part of the supposedly ‘new’ deal? This is very much part of the deeply anthropocentric worldview of Western modernism, and is not ecocentric at all (Curry 2011). It continues to accept the obsession of Western society over the last two centuries that the only thing that matters is ‘humanity’, that *only humans have moral standing* (Rolston 2012; Vetlesen 2015). It likewise assumes that nature has no intrinsic value or right to justice. This is not a new ecological ethics (Washington and Maloney 2020) but a blinkered anthropocentric focus that remains mired in human supremacy (Crist 2012).

Now I do understand that some will say that 'The end justifies the means' - so that if the GND helps to reduce the climate emergency, we can worry later about its other problems. This is actually not a trivial question, nor do I suggest it is an easy one to solve. Ignoring the problems of endless growth is indeed part of the denial regarding the human predicament (Washington 2020). However, there is an *absolute urgency* to solving the climate crisis (e.g. Lawn 2016; Klein 2019; Ripple et al 2020). Given the societal obstacles to confronting and abandoning growthism, is the GND not the best immediate compromise we can come up with to support climate action? As Stilwell notes in his chapter the GND can be: '… a means of getting started on an overdue journey'.

I am conflicted as to this debate. Failing to change the endless growth mantra in society remains a long-term recipe for disaster (and the GND largely doesn't do this). I believe that the steady state economy is the most sustainable approach to finding an ecologically sustainable future (Washington 2014). However, all 'steady-staters' are well aware of the barriers to moving quickly to a steady state economy (SSE) (after all, Herman Daly has been arguing for the SSE since the 1970s). Might a good (i.e. better defined) GND be a worthy interim solution that speeds up solutions to the climate crisis? This is truly what can be called a 'wicked problem', as I suggest both views are valid. However, a lot of people will accept and support the GND - while not accepting a SSE. The GND is likely to be only a temporary 'partial solution', but perhaps one that can assist rapid action on climate change and inequality. I can only point to and acknowledge the difficulty of this conundrum, without offering a clear resolution. However, I do suggest that perhaps we need a Green*er* New*er* Deal that goes beyond the original limited idea of the GND being primarily an economic stimulus.

The *third* key area I feel I should raise is the debate about renewable energy, its practicality and its relation to the SSE as a goal. As Editor I need to declare I have taken part in this debate (as an advocate of *both* renewable energy and the SSE). This debate was catalyzed recently by the release of the documentary 'Planet of the Humans' by Jeff Gibbs and Michael Moore. This was a strong attack on renewable energy using data that was a decade or more old. It had factual errors and a complete lack of balance as it failed to interview any renewable energy expert. As climate scientist Michael Mann

(2020) concluded, it turned: 'heroes into villains and villains into heroes'. This documentary did mention in passing the population problem and the problem of the growth economy. This prompted the Executive Director of the Centre for the Advancement of a Steady State Economy (CASSE), Brian Czech (2020) to write a blog praising the film. Comments that sought to defend renewable energy were made to this blog by the Editor and chapter author Mark Diesendorf (a researcher in renewable energy for forty years). However, Czech refused to publish a blog written by Diesendorf in answer to his blog. Diesendorf's comments on the documentary were published elsewhere (Diesendorf 2020a), and his blog responding to Czech's blog has been published by CASSE NSW, the body that the Editor is Co-Director of (Diesendorf 2020b). Daly (2020) also published a blog arguing we should move to a SSE *before* we move to renewable energy. Rees (2020) also wrote a blog arguing that renewables cannot replace our current society energy use. This claim is refuted by the chapter by Diesendorf in this book, and by Diesendorf and Elliston (2018) and Diesendorf and Wiedmann (2020).

Now why is all this so important? Because we face a climate crisis of great urgency if we are to avoid runaway climate change (IPCC 2018). In fact, society tends to underestimate the seriousness of climate change (Spratt and Dunlop 2018). This means we must stop the use of fossil fuels *very quickly*. Given that nuclear power has its own very serious problems (Washington 2015), the only feasible solution is renewable energy (Diesendorf 2014; Diesendorf and Elliston 2018; Diesendorf and Wiedmann 2020), as this is both cheaper and faster to install than fossil fuels or nuclear power (Ibid). Documentaries distorting the facts about renewable energy thus aid the denial about renewables as a solution and assist business-as-usual (= continued fossil fuel dominance), as do blogs supporting such documentaries by advocates of a steady state economy (Czech 2020) or a sustainable future (Rees 2020).

We need to move to: 1) 100% renewable energy; 2) A steady state economy with a much lower energy and material use (and with an ecologically sustainable population). And we need to do both ***simultaneously.*** Renewable energy is a key solution for an ecologically sustainable future, as the chapter by Diesendorf shows. Similarly, acting to create a SSE, acting on overpopulation, overconsumption and consumerism are key solutions within EE. Currently, we stand in the worrying situation of a 'circular firing squad' (Farley and Washington 2018), where proponents of some of the above do their best to shoot down others advocating other points. As Editor, I believe *all* these solutions are needed and must be carried out together. I can only hope this debate within EE and environmental science calms down - so that the infighting ceases - and *all* parties support *all* of these solutions. I believe renewable energy needs a SSE - and the SSE needs renewable energy. Both are key solutions that must be carried out together.

The fourth topic is *population*. In the Introduction it was noted:

> However, those claiming to be 'ecological economists' – that is, those whom agree that our economic systems are subject to the limits imposed by the biosphere's ecosystems – would (we believe) struggle to ignore or deny that the Earth is currently overpopulated, and that the Earth is *finite.*

However, few topics are as polarized (or taboo) as talking about overpopulation (Kopnina and Washington 2016; Washington et al 2020). I am well aware of this as I have been trying to get dialogue on this since 1991 (Washington 1991). I raise it here because it is too important to ignore. Chapter authors had quite different views on it. Some steered well away from talking about it (and in discussion seemed worried if the topic was mentioned). Others placed it front and centre as something EE *has* to consider, such as Lowe, Farley, Higgs and Maloney. Stilwell in his chapter states:

> GND advocates tend to take the view that, whatever is the rate of global population growth (which is **difficult to reverse other than by authoritarian interventions**), public policies embodying a GND would tend to reduce the environmental stresses resulting from that growth. (my emphasis)

I wish to question this statement that population is difficult to reverse 'other than by authoritarian interventions'. Robert Engelman (2012, 2016) argues for nine *non-coercive* strategies to slow then halt population growth:

1. Assure universal access to a range of safe and effective contraceptive options and family planning services for both sexes.
2. Guarantee education through secondary school for all, with a particular focus on girls.

3. Eradicate gender bias from law, economic opportunity, health, and culture.
4. Offer age-appropriate sexuality education for all students.
5. End all policies that reward parents financially if they are based on the number of their children.
6. Integrate teaching about population, environment, and development relationships into school curricula at multiple levels.
7. Put prices on environmental costs and impacts.
8. Adjust to population aging rather than trying to delay it through governmental incentives or programs aimed at boosting childbearing.
9. Convince leaders to commit to ending population growth through the exercise of human rights and human development.

Iran was able to halve its population growth rate using similar policies (Brown 2011), while Tunisia was able to reduce its birthrate from 7 children per women down to the replacement level of 2 (Derer 2019). Kopnina et al (2020) looked at what governments had done regarding the Engelman (2016) strategies in three countries: Italy, Cambodia and Tanzania. They concluded that for Italy it was the *first three* strategies above that were most important to reach a stabilized population – good family planning; education for young girls; and eradicating gender bias. Two of the greatest problems in Cambodia and Tanzania to stabilizing population are child bride marriages and opposition to population stabilization by government (Ibid). My point here is simply to note that there clearly ***are*** non-coercive ways of stabilizing population that work - and are not authoritarian.

Higgs in her chapter has noted:

> It is vital to remember that, on average, people in the developing world consume relatively little in per capita terms and **it is population growth in wealthy countries such as Australia that contributes most to impacts** on land, oceans and climate. (my emphasis)

Higgs provides some references in support of this view, stating in some developing nations half of the extinction occurring may be due to projects carried out for the developed world, and that overall 30% of biodiversity loss in developing nations was caused by projects for the developed world. However, I would like to question this oft-quoted statement in academia (especially common among social justice advocates), which may have been true twenty years ago but I believe is now no longer true. I raise the following points:

- This tends to ignore that *local* population increase in the developing world is encouraging massive land clearing to grow more food (Laurance 2014; Crist et al 2017). Hence not all clearing is for food crops for the 'developed' world, as local population pressure equals or exceeds this. Higgs's cites a reference (Lenzen et al. 2012) that 30% of species extinction in developing nations is said to be due to projects by the developed nations. However, that means that 70% (the *majority*) is not, and is due to pressures caused by local population growth (Laurance 2014). Cafaro and Crist (2012) point to Madagascar's population growth that has triggered massive deforestation and rapid species extinction.
- Population increase causes ever larger pressures for road building, and this is a key cause of deforestation and extinction (Laurance 2014, 2019).
- Population increase causes ever increasing demand for bushmeat, timber, charcoal and bush medicines, leading to 'empty forest syndrome', greater clearing and higher extinction (Wilkie et al 2011).
- One needs to remember the massive (and rapid) increase in the middle classes in the developing world, which of course vastly increases environmental impact. Hence China now has the world's biggest carbon footprint (UCS 2018). Higgs acknowledges the validity of this point. The old mantra that the problem is just 'in the North' or developed world ignores the fact that the developing world is rapidly increasing its consumption (Washington 2015).

Hence I would suggest that it is too easy to blame all impacts in the developing world on the developed world. Rapid population increases in countries such as Cambodia, Tanzania, and Madagascar (Cafaro and Crist 2012; Kopnina et al 2020) clearly are causing major environmental impact, as is greater farming to feed local population growth elsewhere in the developing world (Laurance 2014). My point here is to suggest that population growth in any country (developed *or* developing) causes increasing environmental impact in an already over-stressed world. Dietz and O'Neill (2013) point out: 'we need smaller footprints, but we also need fewer feet'. Hence population needs to be stabilized (and then reduced by non-coercive strategies) *everywhere*. In terms of solutions for the future, my final observation on population is that while it is a highly polarized issue (that makes many people uncomfortable), we cannot afford to ignore or deny its centrality (Kopnina and Washington 2016). We are way past an ecologically sustainable population for planet Earth (Washington 2020), and we need to adopt non-coercive strategies to return us to a world population that is ecologically sustainable in the long term.

Solutions within ecological economics

There are many solutions that broadly are part of EE, from the simple and straightforward to the complex and involved. The chapters in this book cover this spectrum of worthy solutions, but of course no book can cover everything.

In Section 1: Essay assessing options for the next 30 years, Joshua Farley discusses the future of EE. Farley urges us to understand that economics is an *evolutionary science*. He argues that the insights from evolutionary science: 'can help ecological economists to achieve our goals'. He goes on to point out that: 'Achieving ecological sustainability and social justice both require cooperation at unprecedented scales …'. Solutions, and the EE solutions discussed in this book, demand that humanity *cooperates* at a greater level, rather than just competing against each other. Farley notes that such cooperation needs to extend beyond just the 'human', so that humanity must now consider: 'how humans can benefit nature in the future'. He concludes we must 'forge the Ecozoic', a mutually enhancing relationship between humans and the rest of the Earth community (Swimme and Berry 1994). Given how academics love to invent theories that supposedly explain things (such as 'the economy') he concludes that 'Our system is too complex to fully understand …' and we must learn from evolution by trying new ideas and policies. Farley concludes that: 'economics is too important to be left to ideology'. He argues: 'Our most serious challenges require cooperation. It is pointless to seek solutions based on competitive markets'. Thus ecological economists should seek to work together for change, and 'embrace evolutionary theory'.

Section II considers 'big picture' solutions. Given that most of the world's population now lives in cities, Ian Lowe considers what 'sustainable cities' might (or should) be. The key aspect here is one discussed above – the impact of population, a topic in large part ignored by much of academia, and several models of EE (see Introduction). Lowe uses a thought experiment to: 'illustrate the yawning abyss between the stated goal of sustainable development and current practice'. He concludes that the most fundamental step towards sustainable cities would be: 'accepting that there are physical, biological and social limits on their expansion'. Lowe concludes that denial is the: 'fundamental obstacle to shaping a future that could, at least in principle, be sustainable'. He calls on EE to seriously take on a project of 'Truly Sustainable Cities'. The next chapter is Mark Diesendorf's chapter on renewable energy, and has already been discussed above.

Peter Daniels then considers what can be called the 4th Industrial Revolution or '4IR'. He notes 'Many of the 4IR effects on environmental and social wellbeing will be positive', and 'the ecological economic perspective can be applied to promote technology change, innovation and practice that reduces society's throughput or metabolism'. Daniels also says: 'To effect these deeper mindset changes the analytic and communication power of the 4IR can provide a very powerful vehicle for change'. This could be by becoming: 'a framework for promulgating a society-wide understanding and appreciation of inter-connectedness as the basis for evaluating and guiding techno-economic change'. Daniels thus puts quite a positive spin on the 4IR, though he does note the possible: 'loss of warm immersive relations with both people and nature'. I should note here that my perspective on this comes from writing the book 'A Sense of Wonder Towards Nature' (Washington 2019). The loss of connection and warm relations towards nature has been called 'Nature Deficit Disorder' (Louv 2005), and this is a *major* problem in a world where the majority of people live in cities. Increasing Nature Deficit Disorder is a major block towards reaching a meaningful sustainability based on an ecological ethics that upholds the intrinsic value of nature and the need for respect and reciprocity towards the rest of life (see Washington chapter). I thus see a possible future increased loss of warm relations towards nature as a much more serious problem than Daniels concludes. At the very least I point to the conclusion of Louv (2011) that the more one uses virtual technology, the more one needs to *get out into real nature* to counteract this.

The Kerryn Higgs chapter on the SDGs has already been discussed above under the United Nations discussion. Czech and Mastini discuss the nexus between degrowth and the SSE, something that was touched on in the Introduction. It is of interest that the SSE was proposed in the 1970s (Daly 1977) while degrowth has come to the fore much later, in the 1990s. Yet while 'steady-staters' support the need to degrow *to* an ecologically sustainable economy (i.e. a SSE), many degrowth advocates do not support (or sometimes even mention) the SSE. This seems to be primarily for two reasons. First, the SSE foregrounds population as a key function of its definition, while many degrowthers feel uncomfortable about talking about population, or deny the need to even consider this (e.g. Kallis 2018). Secondly, Daly (e.g. 1991, 2014) talks about 'markets' (while clearly stating they must be *regulated* for the common good). Many degrowthers (especially from a NeoMarxist stance, e.g. Vettese 2020) consider any mention of markets to be neoliberal. Czech and Mastini argue it is time for the two EE models that oppose endless economic growth to unite and work together. We do need to degrow the size of our economy, but that cannot continue forever - as endless degrowth is not socially sustainable, just as endless growth is not. At the first Degrowth Conference, its Final Declaration concluded (FICED 2008): 'once rightsizing has been achieved through the process of degrowth, the aim should be to maintain a "steady state economy" with a relatively stable, mildly fluctuating level of consumption'. Given the introduction noted that the SSE and degrowth are centrally committed to stopping the endless growth economy (unlike some other EE models) it makes sense now for the two to now work in harness together.

Another topic much discussed in EE currently is Modern Monetary Theory (MMT), discussed in the chapter by Williams and Alexander. I agree that this theory could be useful via its argument that a government can spend what is needed to solve problems *without* being worried about budget deficits. Finding the money for a GND (Pettifor 2019) is one issue where the MMT may assist. Adoption of MMT could thus have merit in terms of aiding the funding of many strategies towards a sustainable future. MMT could thus be an important solution for EE, even if the Editor has reservations about the zealotry often evident in academia towards any 'new theory'.

As Editor of this book I support 'thinking outside the box' in terms of solutions. The chapter on 'Neighbourhoods that work and the Walden wage' is one such chapter. It seeks to focus on ways to provide greater access to housing for people, tied in with a 'Walden wage' for people who do useful work towards sustainability. I consider this a notable idea and an innovative solution. It is certainly not the only thing we need to do, but it does seem to me that it is worth doing. Indeed, in a post-Corona virus world, this may be one solution that has some chance of adoption?

The Introduction noted the centrality of ethics in regard to EE, and this is explored further in the chapter by Washington. Ethics considers what is 'right or wrong'. The destruction of the living world by an endlessly growing economy is clearly *so very wrong*. Given the most common idea of what ecological limits is – is that it means the economy operates within ecological limits – the growthism and anthropocentric focus of neoclassical economics is clearly highly unethical. Endless growth is the root cause of both the extinction and climate crises (Washington 2020). Yet EE has been quite slow (apart from Daly and Lawn) to champion the centrality of ecological ethics, and I believe this now has to be brought into the big picture. The final chapter in the big picture section is by Frank Stilwell on equity and the Green New Deal. This has been discussed already as one of the four key topics. Clearly, inequality has been rising in most nations for many years (Wilkinson and Pickett 2010) and this is a lose/lose situation for everyone, and quite unsustainable (even in the medium term). Given our discussion on ethics however, I would point out that 'equity' and 'justice' in EE should also be applied to the *nonhuman* world.

Section III is 'Other specific solutions'. Blackwell and Gemmill consider a critical topic for the world's driest inhabited continent of Australia – water. Does it make sense, and can we afford, to tip huge amounts of fresh water out to sea via ocean outfalls? At the same time we dump a great deal of nutrients out to sea in this water, when Australia is the most nutrient poor continent on Earth. This process of pumping out to sea fresh water and nutrients is neither ecologically-wise nor sustainable. EE should thus, I believe, support any moves to reverse or minimize this. The interesting aspect here is that this chapter shows it is economic to do this - even using a neoclassical Cost/Benefit Analysis. Applying an EE framework to this thus makes it even more obviously 'economic' in the sense of true sustainability.

Just as EE must consider water sustainability, so must it consider the use of energy in our societies, and how this is sourced. It is an obvious reality now that we must move from fossil fuels to renewable energy very quickly if we are to halt (and then hopefully reverse) rapid climate change. The chapter by Crosthwaite considers the need to move from natural (= fossil) gas to a renewable alternative, in a way that is a 'just transition' (in regard primarily to the jobs of workers). Solutions to move to an ecologically-sustainable economy are clearly going to have to involve the community, as the community is more likely to create change than most governments (Washington 2020). The centrality of community action is shown by the chapters by Anne Jennings and Judith Buckrich. Jennings looks at community change projects that assist overall sustainability in the Australian bush in northwest Australia, and Buckrich looks at the history of the Yarra River in Victoria, and how the community there has assisted environmentally-responsible change.

Another aspect of any transformation based on EE is *education*. This is made difficult when virtually all education systems promote ongoing growth in the economy. As David Hay notes in his chapter, we need to have EE discussed in schools, hence it must be in the curricula and syllabi. If things are going to change towards an ecologically sustainable economy, we must have dialogue and discussion in society about EE. That means the dialogue must start in schools and continue on to universities and community education programs. If such strategies were adopted, the future of EE would be brighter - because students at school would actually get to consider key issues of ecological limits in regard to the economy. Similarly, bringing EE into governance is going to be important, and the chapter by Michelle Maloney brings this to the fore. Maloney explains a strategy of 'Greenprints' governance built on the foundations of respecting, understanding and working within the regenerative capacity of the living world. She concludes it: 'offers a way for local community members to understand (and articulate to others) how to shift from human to Earth-centred governance, how we can live within our ecological limits, and how the legal and economic system can be transformed …'. Given this book is about solutions arising from EE, this is an interesting approach as to how to *operationalize* EE into society via governance. Given the SSE has been advocated since Daly (1977), the question has always been: 'Okay, what are the steps to move there?' (Washington 2017). Maloney argues convincingly that one key step is a change in governance towards Earth-centredness. The Greenprints governance strategy could be a significant solution. It will be interesting to see the finished 'Greenprints Handbook' and to see how the pilot project on the Sunshine Coast progresses.

The final chapter is on 'sustainable innovation' and the circular economy, and how this could play a part as a solution. While the circular economy is clearly an important solution, I believe it remains a *partial* solution as it does not consider population, nor focus on the ideology of consumerism itself as something that needs to change (Twomey and Washington 2016).

Final thoughts …

I cannot finish this conclusion without mentioning the Covid 19 pandemic, and how this might affect solutions within EE. Will this pandemic change society and its economy in the long term? Will it make it easier for the solutions discussed in this book (and elsewhere in EE) to be accepted? Alternatively, will society just return to growing as fast as possible to reboot the growth economy? Or will the pandemic teach society something about limits and sustainability? Or will it lead to a push for a GND to drastically reduce the climate crisis? The short answer is that it is too early to tell, but there are some indications, and some of them are positive. The Corona pandemic has promoted positive things such as working from home, video conferencing, working shorter weeks or staggering office hours to reduce traffic, and China has reduced its carbon footprint by a quarter (Magnus Johnston 2020). The head of the International Monetary Fund, Kristalina Georgieva, argues for a green recovery that tackles the climate crisis (Morton 2020). Germany and Britain want an accelerated uptake of green technologies (as do other countries). The World Bank, and even energy giants BP and Shell, seem in support (Ibid).

This could assist in the rapid roll out of renewable energy and a rapid transition away from fossil fuels. Of course, much of the media reporting may also be a public relations exercise, in the hope that society will soon return to 'business-as-usual'. Many in society clearly argue the need for rapid growth to resurrect the economy, and the pandemic doesn't seem to have seriously challenged growthism, even if it may assist a necessary growth in renewables. So the long term impact of the pandemic in regard to EE solutions remains in flux. That means it is something that our *collective activism* can influence.

Finally, I think it worth pointing out the obvious (as it is often forgotten) - the future is not 'set in stone'. The solutions we advocate as part of EE should, and I believe must, *bring change*. We need to transform society – and its economy – so that it is ecologically sustainable. That means we must *all* be part of the solution – being activists for change – as we are all (to greater or lesser extents) part of the problem. As the Editor of this book, I hope it has contributed (in a modest way) to the dialogue about such change.

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