

Descent Pathways editorial introduction*

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Today, more than forty years after the Club of Rome published the *Limits to Growth* (Meadows et al., 1972), a renewed groundswell of awareness appears to be building in relation to humanity's overshoot of numerous global limits. While the *Limits to Growth* thesis drew the ire of champions for the established economic order, evidence supporting its veracity continued to mount (Bardi, 2013, Turner, 2012, Turner, 2008). Growing appreciation for the collective socio-ecological challenges faced as we converge on planetary limits is accompanied by speculation that some sort of civilisational collapse could be immanent. Understandably enough, such concerns can readily appear over-stated and, as such, are commonly dismissed—if not ignored or neglected—by guardians of established socio-political and economic arrangements at every level. The evidence in support of such views is less easily dismissed and, over time, has arguably led to a systemic crisis of purpose that raises major questions about the very basis of the existing, growth addicted, social order.

The prospect of collapse not only implies an end to three centuries of technological complexification, economic growth and wealth accumulation; it also suggests that we are entering a period of widespread disruptions and conflicts, especially in relation to constrained expansion of—and even decline in—resources of energy, food and raw materials. Hence a growing cohort of practitioners and researchers has turned attention to understanding what is at stake and how this 'civilisational challenge' can be addressed. Such inquiry is typified by work including that of the Transition Town and de-growth movements. We have chosen to explore this domain via the concept of 'descent pathways' as we believe this holds out real hope for what might be called 'moderated descent'—as opposed to the kind of comprehensive 'crash' that some suggest could unravel many of humanity's prized economic, technological, social, political and institutional gains of the industrial age.

This situation clearly has major implications for all who are concerned about their children, future generations, other species, the environment and so on. It arguably has even greater significance for futures and foresight professionals as it alters—probably forever—the earlier core hope and aspiration of the field to be focused on 'exploring alternative futures.' While there are still plenty of alternatives that can be envisaged, it appears that they will fall increasingly within the kind of limitations that we are addressing. This creates in our view a strong imperative to generate deeper understanding of the issues before us and to stimulate a new or renewed commitment to effective action. It is towards these twin purposes that this special issue of *Foresight* is directed.

A descent pathways primer: three economies and the case for descent

Before introducing the contributions in more detail, we will outline the global context within which we see conversations about descent pathways as so important at this point in time. This is not intended as a definitive account by any means. We make our case here on the basis of only a tiny sub-set of the supporting knowledge bases and associated data. Our framing is unapologetically economic, as we feel that the most productive conversations about descent can be conducted when a sharp differentiation is drawn between descent in terms of quantitative production and consumption, and the nature and quality of human experience playing out within such material conditions.

We start by drawing on Greer's (2011) differentiation between primary, secondary and tertiary economies, a classification that builds on Schumacher's (1973) distinction between primary and secondary goods (see Figure 1). The primary economy corresponds with the natural or non-human world. It is the source of all material and energetic inputs for human societies, and must also cope

with their discard streams. To the extent that it is taken into account in conventional economic thinking, this is usually via instrumental concepts such as natural resource management and ecosystem services. The secondary economy encompasses what is conventionally recognised as the realm of economics—production and distribution of goods and services by and for humans. This is the physical economy. And the tertiary economy is that area of economic activity that involves the creation and trade of financial instruments, or abstract claims on real wealth. This can be conceptualised as the ‘control system’ regulating resource allocation in the secondary economy. The distinction between secondary and tertiary economies relates also to the markets in which their respective trading is conducted. Martin (2011) characterises this in terms of ‘real’ versus ‘expectations’ markets.

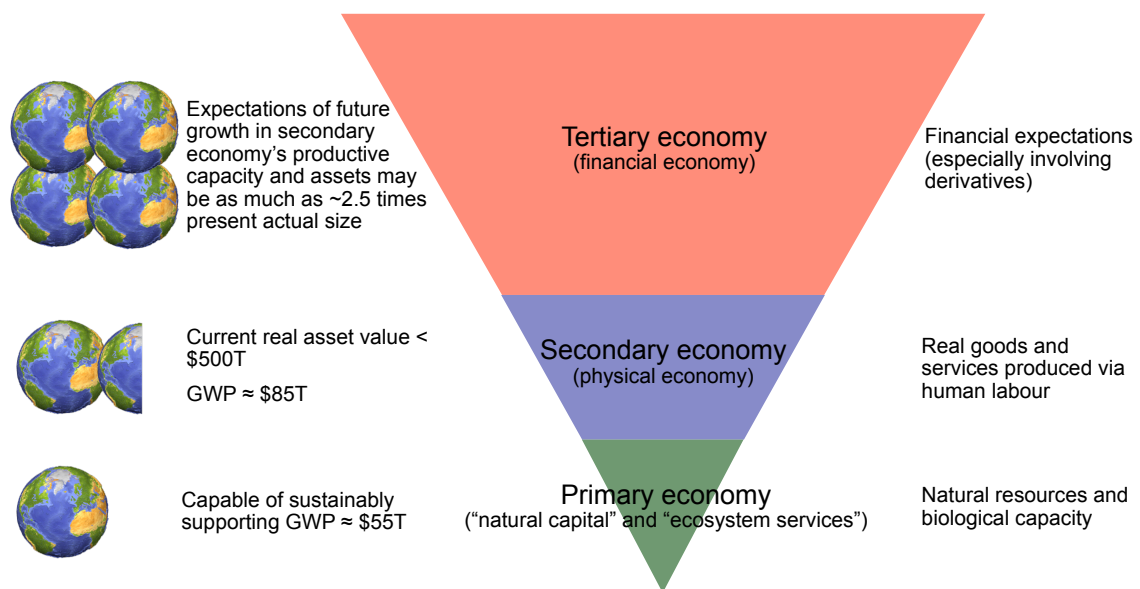


Figure 1: the three economies and a rough representation of their relative sizes

The case for making the descent pathways metaphor a principal ‘index map’ by which we navigate humanity’s longer term societal futures rests in important respects with the relative magnitudes of the three economies. The figures we use here can be considered ‘back of envelope’ indicators—our intention is not to provide the most accurate or comprehensive characterisation possible, but rather to illustrate via some headline data the strength of the headwinds faced by any expectation that the economic growth of the past 300 years can extend significantly further.

Starting with the secondary economy, annual Gross World Product (GWP) in 2012 was approximately US\$85 trillion (2012 dollars, purchasing power parity basis). Using the Ecological Footprint indicator as the basis for comparison with the *primary* economy, this corresponds with using resources and discarding waste at a rate perhaps as much as fifty percent greater than the earth’s regenerative biological capacity (Ewing et al., 2010). GWP effectively measures the aggregate *flow rate* of productive activity through the global economy. Scaling on the basis of Ecological Footprint, the primary economy can support a secondary economy in the order of US\$55 trillion in annual production activity.

It should be noted, though, that the Ecological Footprint indicator does not incorporate the full spectrum of factors that govern the relationship between primary and secondary economies. Energy supply and use is particularly important in this respect (see for instance Hall and Klitgaard's *Energy and the Wealth of Nations: Understanding the Biophysical Economy* (2011)). More than eighty percent of global final energy use depends on non-renewable fossil sources (IEA, 2012). For energy from renewable sources to make significant in-roads into replacing—rather than simply *extending*—fossil sources, a foundational requirement is the diversion of a significant proportion of the current energy supply provided by fossil sources away from present applications and towards the replacement task (Prieto and Hall, 2013).

In 2012, global investment in renewable energy sources was US\$244 billion—down from US\$279 billion in 2011 (Frankfurt School-UNEP Centre, 2013). Compare this with global fossil fuel *subsidies* in 2011 of \$533 billion (IEA, 2012); and fossil fuel investments in the pipeline just for Australia at end of 2012 (with most due for start-up by 2016) of more than AU\$220 billion (BREE, 2013). Clearly the reinvestment of energy from fossil fuelled to renewable supply infrastructure is not being addressed on a scale commensurate with the transition task (see articles by Moriarty and Honnery and Zehner in this special issue for further perspectives relevant to this). This leaves aside myriad additional factors that combine to challenge the expectation that levels of energy services similar to those currently enjoyed by industrial societies might be provided via renewable sources (see for instance Smil, 2010, Moriarty and Honnery, 2009, Moriarty and Honnery, 2012a, Moriarty and Honnery, 2012b, MacKay, 2009, Hall et al., 2009, Michaux, 2011, Floyd, 2012, Friedrichs, 2011, Zehner, 2012, Trainer, 2012, Trainer, 2013b, Trainer, 2013a, Trainer, 2014, Palmer, 2014).

To get some sense of how the *tertiary* and secondary economies compare in size, we require a suitable basis for differentiating between the scale of each in monetary terms. In the neat world of conceptual abstractions, the tertiary-secondary distinction provides a useful rhetorical tool. Concrete reality, on the other hand, defies such easy classification. The illustrative approach that we adopt here compares a rough estimate of global financial and non-financial assets with a similarly rough estimate of the global derivatives market, on the basis that the latter provides a proxy indicator for the scale of expected future growth in the former.

McKinsey Global Institute valued 2013 global financial assets—comprising equity market capitalisation, corporate and government bonds, and loans—at US\$225 trillion (Lund et al., 2013). Credit Suisse Research Institute valued 2012 global household wealth— comprising marketable value of financial assets plus non-financial assets (principally real estate), less debts—at US\$223 trillion (Keating et al., 2012). On the basis of these figures and making a very rough allowance for state and publicly owned non-financial assets, it is probably reasonable to estimate present aggregate global wealth, and our rough indicator for the size of capital assets in the secondary economy, at well under US\$500 trillion—keeping in mind also that a substantial proportion of this is likely attributable to speculative over reach (Schularick and Taylor, 2012). For present purposes though, we will assume this as the broadly indicative figure.

Global debt bears further attention in its own right, as we consider what the size of the tertiary economy implies for expectations of future growth in the secondary economy (and the degree of disconnect between the secondary and primary economies). In 2012, global household debt was 16 percent of gross assets, or around \$42 trillion (Keating et al., 2012). This is in the order of 60 percent of GWP. But the global average glosses over the far more significant issue of where this debt is accrued. In the ten largest developed economies, even with post-Global Financial Crisis deleveraging (a process that may have much further yet to run), it ranges from around 45 percent of GDP (Italy) to 105 percent (Australia) (Roxburgh et al., 2012). Household debt is just a fraction of total debt: when debts held by non-financial corporations, financial institutions and government are

added to the picture, total debt for the large mature economies ranges from around 275 percent of GDP (Canada and Australia) to over 500 percent (UK and Japan). These debts can be viewed as representing broad expectations of future economic activity.

But this tells only part of the story of spectacular over reach in the tertiary economy. A more comprehensive view must expand to take in the world of derivatives. A defining characteristic of the tertiary economy is the practice of rehypothecation whereby derivative contracts involving multiple claims against the same underlying assets are traded in the ‘expectation’ market (Singh, 2010). It is on the basis of such mechanisms that the activity in the tertiary economy derives its reputation for trading in financial *abstractions* disconnected from the primary and secondary economies’ underlying *real* wealth.

Though the overall size of derivatives trade is notoriously difficult to pin down, official data provides a sense of scale. According to the Bank for International Settlements, the value of notional amounts outstanding in global over-the-counter (OTC) or off-market derivatives trade was \$633 trillion at the end of 2012, corresponding with gross market value of all contracts of just under \$25 trillion (BIS, 2013). Given the unregulated nature of OTC trade and attendant opacity, these figures may account for only a fraction of the actual total. According to Cohan (2010), quantitative finance expert Paul Wilmott estimated the total notional amounts for all derivatives, including OTC and exchange traded, at around \$1200 trillion in 2010—more than double the BIS’s ‘official’ OTC figure, allowing for market growth over the intervening period. On this basis, gross market value may be as high at \$50 trillion, in the order of seventy percent of GWP.

The portion of the gross market value for all derivatives realised annually by contract holders amounts, in effect, to additional claims on existing productive capacity and assets. As such, it acts as an indicator for expectations of future growth in economic output and capital. Given that this figure comprises both speculative positions and more legitimate hedging, any attempt to ascertain the actual net value of payouts is likely an exercise in futility. We can, however, use the figure of \$50 trillion as a proxy for estimating a possible upper bound to the tertiary economy’s annual increase in overall claims on underlying wealth. This can be compared with the size of the secondary economy, in which GWP is currently growing at an annual rate of around three to four percent (CIA, 2013), or \$3 trillion; and global annual gross fixed capital formation which currently increases at around twenty percent of GDP annually, or roughly \$15 trillion (World Bank, 2013). That is, the secondary economy *might* be able to accommodate—via future growth in goods, services and assets, and for the sake of this very rough illustration, ignoring capital depreciation—annual additional claims very roughly in the order of \$15-\$20 trillion. In other words, the tertiary economy may reflect expectations of growth capacity in the secondary economy of up to two and a half times what the secondary economy actually makes available. Even if we attribute only a part of this to financial speculation, it represents future growth expectations well in excess of what is possible, even without taking into account the longer term consequences of the extent to which the secondary economy *already* overstretches the *primary* economy.

The relative scale of the three economies provides the narrative backdrop for appreciating why the environmental conditions facing humanity are ones in which descent shifts from being the stuff of nightmares, to a potentially adaptive response. However we wish to frame this situation, humanity faces overshoot at two levels: the secondary economy in relation to the primary economy; and on a shorter time horizon, the tertiary economy in relation to the secondary economy, as has been unfolding around the globe for the past seven years. So this is the basis for seeing humanity-scale futures as playing out over the next century or so—and perhaps even longer—in terms of an overall descent trajectory, at least in terms of the nature and scale of physical economies and the level of social complexity that they can support.

Contributions to the special issue

The contributions to this inquiry into descent pathways are drawn both from within the futures and foresight field and, importantly, beyond its notional borders. The order in which we present the six¹ articles reflects two broad sub-themes of ‘situation appraisal’ and ‘response.’ We emphasise, though, that we’ve applied this classification retrospectively and as such, it provides only a rough guide to the content, with the contributions cutting across these categories to varying degrees.

In fact the opening article from Jim Dator is important on both fronts. Our decision to lead with this in the ‘situation appraisal’ section is based on the significant re-assessment that Dator brings to a perspective that many may regard as central to his futures thinking. For close to four decades now, the Manoa School has championed the idea that its four alternative futures archetypes—‘grow’, ‘collapse’, ‘discipline’ and ‘transform’—should be treated as equally-likely possibilities. Dator now sees a set of interconnected conditions associated with ‘collapse’ and ‘discipline’ futures—the ‘Unholy Trinity, plus one’ of climate change, peak production of conventional petroleum, failure of neoliberal economics and the incapacity of any current governance systems to address these crises—as playing determinative roles in *all* possible futures, a situation he characterises as the ‘New Normal.’ We think it is especially noteworthy that a futurist of Dator’s stature and influence—see for instance the recent issue of the *Journal of Futures Studies* celebrating his life work (Jones and Schultz, 2013)—sees humanity’s situation as sufficiently clear to warrant such an adjustment to a principal legacy. It is particularly significant, though, that while Dator sees our collective situation in such apparently foreboding terms, he maintains that this simply establishes the environment within which humans will both fail *and* thrive. The worlds before us present ominous challenges and myriad opportunities for creative adaptation and response. He explores this in the context of his own home of Hawaii, a place particularly vulnerable to the ‘Unholy Trinity, plus one’, and hence an ideal setting for exploring how descent pathways can be consistent with human flourishing.

Patrick Moriarty and Damon Honnery’s article, ‘Future Earth: Declining energy use and economic output’, examines in finer detail the place of energy-related considerations in establishing the context for descent futures. The analysis these authors present commands our close attention. It reflects many years of quantitatively rigorous inquiry conducted at the ‘hard edge’ of futures-related research. They are actively engaged in assessing the technical and economic prospects for incumbent and proposed alternative energy systems, and their findings have direct implications for the more general arguments advanced in this special issue relating to the adaptive nature of descent pathways. Moriarty and Honnery open by looking at the critically important link between Gross National Income (GNI) and global primary energy supply. They demonstrate that, despite widespread hopes for a ‘decoupling’ between financial income and energy supply, the physical economy remains stubbornly reluctant to cooperate. If we are dismayed by this, it perhaps reflects the extent to which abstract economic expectations have strayed from their concrete foundations in the production and distribution of real goods and services. For Moriarty and Honnery, this interdependency means that the key question for us to consider is not whether global futures will be characterised by economic descent, but rather under the influence of which mechanisms will such a descent play out? Humanity faces fundamental constraints on supply rates for both fossil energy sources and low-carbon alternatives, along with limits on the extent to which climate impacts of fossil fuel use can be mitigated without reducing overall energy use. At the same time, a range of factors impacting on the ability—or the desire—to pursue income growth as the primary correlate of human well-being could come into play. On this basis, descent pathways could follow two broad routes: ‘falling GNI could reduce energy use (as happened in 2008), or limits on annual energy availability could constrain GNI.’

Richard Slaughter's article follows this by shining light on a key cultural aspect of the global situation, that of *denialism*. A mature conversation about the pathways open to humanity must grapple with this phenomenon, for it presents a formidable barrier to a broader social engagement with descent-related themes. There is more to this though. As Slaughter argues, the prevalence of denialism can itself be read as an acute symptom of the global conditions within which the exploration of descent pathways offers a core adaptive strategy. Humanity has grown rich through future discounting. In doing so, it has set itself on a collision course with numerous planetary limits. And yet the *habit of mind* associated with discounting the future, and the short term affluence it has enabled, work together as a positive feedback loop that actually encourages denialism and diminishes awareness of our broader socio-ecological reality. On its own, this psychic dilemma might be approached as a self-made cultural entanglement from which to extricate ourselves, a consequence of ignorance but not of malice. Slaughter sees, however, a more troubling dimension to this: denialism is not simply a situation into which we have inadvertently wandered. To a significant extent, it has been actively *manufactured* by narrow but disproportionately powerful political-economic actors. While the situation that he depicts might be read as rather hopeless, Slaughter asks us to consider it instead as a provocation to revise our own ways of interpreting 'current realities.' Here he argues that the response must expand from exterior considerations to include 'post-conventional' responses 'informed by insight into the human and social interiors.' It is in deeper engagement with and exploration of this domain that Slaughter sees the greatest potential for convergence between the imperative of descent narratives and the realisation of 'compelling visions of desirable futures.'

From here the articles shift towards a more explicit emphasis on matters related to *response*. Following Joseph Tainter's seminal study *The Collapse of Complex Societies* (1988) Samuel Alexander views descent in terms of declining socio-political complexity (a significant influence reflected also in Josh Floyd's later article). Unlike Tainter, though, Alexander sees efforts to voluntarily reduce such complexity as offering pathways toward viable human communities in the face of increasingly harsh environmental conditions and declining resource availability. By choosing such pathways, rather than having these imposed upon them from without, social groups would maintain a greater degree of influence over their circumstances. But perhaps more importantly, such agency could carry with it a greater acceptance of these circumstances, and hence the opportunity to willingly encounter conditions that might otherwise be a source of much distress. For Tainter, the short-term costs of choosing socio-political simplification make it a path very unlikely to be embraced, a view that he sees reflected in the historical records of past social collapses. Instead, he favours efforts to extend or maintain socio-political complexity, even though this may be at the cost of exacerbating the underlying problems. Alexander's critique is ultimately a sympathetic one, reaching beyond Tainter's analysis to consider issues that he has left unexamined, and that may offer means of climbing out from the dilemma with which Tainter confronts us. He is under no illusion that the pathways he illuminates are ones that will meet with widespread popularity or be easily embraced, particularly where business-as-usual still maintains a veneer of credibility, but they may provide us with options otherwise hidden from view, and with that, a different sort of hope.

For many readers, the success story of the new renewable energy technologies and their market embrace over the past decade will stand as a cognitive barrier to seriously contemplating the prospect of descent in general, and, in particular, pathways of the nature Alexander describes. The case presented here will appear strongly at odds with the story of renewably-powered economic transition. Ozzie Zehner's article sheds light on the way that media narratives based on 'energy production' have come to dominate popular consciousness on these matters, pushing to the side alternative narratives of 'energy reduction.' He illustrates this by comparing the abundance of favourable media coverage for solar photovoltaic panels (a production technology) with the far

more prosaic and modest in scale treatment of LED lighting (a reduction technology), during the petroleum price spike of 2003-2008. This is not, however, simply a story of technological winners and losers, or of thwarted ambitions for those whose functional but comparatively mundane products have failed to inspire journalistic and hence public imaginations. Rather, drawing on a range of more sober recent assessments, including field observations of real-world performance, he asks us to consider far more carefully whether renewable energy technologies can actually deliver the futures their media portrayal promises. And if, as the case he makes suggests, greater circumspection is warranted, then would we not be better off giving the descent-ready energy *reduction* alternative more prominence? In a manner similar to Alexander's voluntary simplification, this offers a set of 'no regrets' pathways, whereby accepting increasingly apparent economic limits as givens clears the way for finding ways of life that work in any future reality.

Josh Floyd's article provides a fitting conclusion to the special issue. It breaks new ground and brings challenging new thinking to bear on some of the key terms employed in this debate. He rigorously interrogates terms such as 'pathway', 'descent' and 'collapse' to reveal meanings and implications that profoundly affect not only how they are understood and received but also how they assist or constrain helpful responses. For example he notes that the concept of 'collapse' needs to be rescued 'from pathological or dystopian associations by recasting it in the more useful role of an *evolutionarily adaptive* response within environmental conditions unfavourable to a continued growth trajectory.'

Following Maturana and Varela (1987) Floyd employs the concept of 'enaction.' The latter 'evokes the image of living beings laying down historical pathways through their own dynamics and those of the environments to which they are structurally coupled' (Thompson, 2007, p. 218). One consequence is that 'the futures open to us are those that we co-construct with others.' Then, similarly, the notion of 'adaptivity... suggests a very different way of understanding human achievement, one that makes values of material accumulation or technological power subordinate to that of meaning.' The comprehension of readers could perhaps be tested somewhat had the above been presented solely in theoretical terms. But he usefully provides worked examples from Tibetan and Aboriginal cultures that serve to exemplify and consolidate many of his key points.

He notes that 'given emerging environmental conditions, today's industrial societies conserve adaptation in ways that do not bode well for ongoing viability.' Furthermore, 'the myth of progress, as industrial society's principal source of meaning, presents a particular vulnerability.' It follows that responding to the changing global outlook is not just a matter of learning new ways. It also 'implies the difficult cultural task of unlearning established habits of thought.' The challenge needs to be undertaken 'both creatively and constructively, (and) with enthusiasm.' The goal is to draw from this process 'new sources of meaning to undergird the experience of lives well lived.' One of the distinctive features of this perspective is that 'autonomy of meaning making... is central to the view of life quality.' Lewis Mumford's dictum that 'the pursuit of significance crowns every other human achievement' is provided to support that view (Mumford, 1966, p. 97). That sounded familiar so it was interesting to note that the present writer had underlined the very same line in a book that had been on his shelf for over 30 years!

Two works that are central to the themes of the Descent Pathways special issue are Urry's *Societies Beyond Oil* (Urry, 2013) and Greer's *Not the Future We Ordered* (Greer, 2013). So the editors are grateful to Katerina Psarikidou and Sandra Geitz for providing critical reviews of each. John Urry is a noted British sociologist whose recent work deals centrally with two of the most central and contentious issues of our time—climate change and peak oil. While the latter are frequently obscured by conventional thinking or side-tracked by ultimately futile searches for technical fixes, Urry carefully unwraps some of the social, political and ideological dimensions and reaches what

some may consider to be startling conclusions. One of these is that for many societies oil has actually been a curse.

Psarikidou notes how Urry challenges narrow technocentric approaches by bringing human agency and social concerns into the picture. She provides a concise overview of his account of the connections between money and oil, both of which are united in what Urry calls 'carbon capitalism.' The latter refers to 'the emergence of powerful states, corporations and individuals who not only disproportionately benefited from oil-based carbonism, but also mobilised resources against oppositional voices.' This is a theme pursued elsewhere in the special issue.

Part two of the book outlines four social futures: the 'magic-bullet future' (in which an unexpected innovation 'solves' the peak oil / climate change dilemma); 'digital lives' (dreams of a digital society become real); 'resource fights' (escalating conflicts over resources) and a 'low-carbon society' (transition to a sustainable future). Psarikidou comments on some of these. For example in relation to the latter she suggests that 'promises to fulfil the usually unreconcilable needs for energy reduction and wellbeing' could be considered 'utopian.' Still, adding a more positive option to the set does help to off-set the all-too-easy accusation that the whole exercise is mere 'gloom and doom.' In conclusion the writer finds the book to be 'inspirational and thought provoking' in that it 'awakens the readers' imagination to engage with a series of oil-descending futures that situate society in the heart of their analysis.' Further, 'by challenging conventional technocentric approaches to the description and prescription of descending futures, Urry succeeds in introducing us to a series of imaginaries that, despite their different levels of likelihood and desirability, all go beyond a fatal catastrophist vision for future lives.'

Sandra Geitz's review of John Michael Greer's *Not the Future We Ordered* provides a valuable complement to Slaughter's consideration of human interiors. As Geitz describes, the book 'concerns human beliefs and responses to challenges of beliefs' in a world shaped increasingly by the hard limit of a global peak in conventional oil production. Geitz highlights the emphasis placed by Greer on the idea of progress in understanding both how the modern world has arrived at its present juncture, and why it is that the alternative idea of descent is for so many literally unmentionable. As economic and social structures shaped by easy access to abundant petroleum encounter compounding crises associated with constraints on this fundamentally important energy source, progress, as perhaps *the* principal cultural belief structure of modernity, becomes a decreasingly useful way of interpreting the world around us (a theme also explored in some depth elsewhere in the special issue). And yet we continually recycle this as the default social narrative for charting humanity's future. The resulting double-bind creates the conditions for psychological distress on a wide scale. Geitz emphasises that for Greer, descent, then, is a matter of psychological adjustment across populations, as much as a matter of adapting infrastructure and developing appropriate institutions. But while signs of just such an adjustment are becoming more apparent, on a broader scale it is likely to be hard-won. Bringing to light the interior dynamics at play here may play a crucial role in assisting others to navigate this change process successfully.

Since beginning work on this project in early 2013 we have become increasingly aware of the fact that many other individuals and organisations are beginning to focus on the issues raised here. There is, in fact, a significant global conversation taking place of which the contributions presented here are merely fragments. Some of the most interesting and productive of these are taking place under the heading of the Great Transition Initiative and repay close attention (Cohen, 2014). A greater concern, however, is that to a large extent this conversation is taking place mainly at the margins and only appears in mainstream discourse in tokenistic and stereotypical terms. This suggests that weaning a growth-addicted culture away from its current preoccupations will continue to be difficult for some years to come. Despite the hopes of many, our situation is not one in which

new technologies, however ‘transformative’ they may appear to be, will be particularly helpful. We are collectively challenged to recognise not only the external impacts of human activity upon an increasingly imperilled world but also the interior sources of identity and behaviour from which those impacts arise. The underlying question is how far that process will go before the global system responds in ways foreshadowed by the *Limits to Growth* project (Meadows et al., 1972, Bardi, 2013) and, in so doing, places pathways of moderated descent out of contention for all time.

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Endnotes

¹ A seventh article by Oliver Markley is still under review at the time of writing, and subject to final acceptance will appear in a later issue of Foresight.

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