**Energy Descent Futures**

Samuel Alexander and Josh Floyd

**Introduction**

It is not necessary to resort to energy determinism or crude reductionism to insist on the fundamental role energy has played, and continues to play, in shaping the rise (and demise) of human civilisations. Energy is not just another resource or commodity: it is the key that unlocks access to all other resources and commodities, thereby giving shape to the physical boundaries within which human societies must take form. In other words, a society’s energetic foundations delimit the socio-economic forms that it may take. This is simply to concede that a particular form of society cannot emerge without sufficient energy supplies, in the appropriate forms, to support it. And further, that a society must be able to meet its *ongoing* energy demands if its specific socio-economic form is to persist. If it cannot, the society will transform or be transformed, voluntarily or otherwise.[[1]](#endnote-1)

Today we live in a world fundamentally shaped and enabled by access to the energy-dense fossil fuels: coal, oil, and gas. We could call this mode of life carbon civilisation – defined further below – and in its globalised form it is historically unrivalled in its degree of societal complexity. Never have human societies had such advanced technologies, such diversity in social roles, or so many administrative and bureaucratic institutions governing the flow of information, money, and commodities – all of which depend to varying degrees on the energy surpluses provided by fossil fuels.[[2]](#endnote-2)

One of the central questions of our age, then, is what might become of carbon civilisation as these finite fossil fuels deplete or as we voluntarily give them up in response to climate change. What would a post-carbon civilisation look like? The dominant energy narrative tends to acknowledge the need to transition away from fossil fuels but assumes that alternative energy sources, such as renewables or nuclear power, will be able to replace the energy foundations of carbon civilisation without fundamentally reshaping the form of life we have become accustomed to in the most developed regions of the world. More specifically, it is assumed that post-carbon energy sources are consistent with a complex, globalised economy that is structurally designed or required to grow without limits. In short, it is widely assumed that energy will be even more abundant in the future than it is today.

In contrast, the alternative energy narrative we outline in this chapter maintains that we should be preparing for futures not of energy abundance, but rather of reduced energy availability, futures in which viable ways of life are characterised by energy sufficiency.[[3]](#endnote-3) With respect to the most energy intensive societies, this means planning for what permaculture theorist and practitioner David Holmgren calls ‘energy descent.’ While acknowledging a range of uncertainties about how humanity’s energy futures will unfold, we argue that the plausibility and even the likelihood of energy descent futures implies that planning and preparing for such futures is the most prudent course of action.

The implications of this alternative narrative are profound, yet rarely addressed in the dominant discourses around energy. Our goal presently is to broaden the discourse on energy futures. Although we cannot provide comprehensive answers in the space available, we hope at least to provoke thought about new questions, with the aim of unsettling some assumptions about energy futures that we feel are widely held with undue confidence. Such an act of unsettling can prepare the way for developing perspectives on energy futures that better equip humanity to find viable pathways amongst the landscape of emerging global challenges.

**What is carbon civilisation?**

Just as the bird’s nest, the badger’s lodge and the bees’ hive require investments of energy for their construction and maintenance, so too with human settlements. Taken to the extremes of scale and intricacy, settlements in the form of cities constitute humanity’s most energy-intensive creations. In fact, cities might be viewed as meta-creations that enable the emergence and development of other expressions of human creativity, and this creativity, as with all life, depends on energy, in requisite forms and quantities, for its sustenance and development.

A hunger for energy is woven particularly deeply into the nature and condition of modern humanity. We fell the forests and mine the landscapes to construct our dwellings and build our roads. In much of the world, heating of houses and water relies on combustion of wood, gas, oil or coal. Electricity, like a god, gives us light and it powers our abundance of convenient appliances and machines. Oil takes us where we desire to be and back again without effort. The expansion of energy harvesting and use that allows large-scale societies to grow inevitably generates new problems that these societies must then deal with. In turn, responses to such problems typically drive further energy demand. The processes by which large-scale societies take form and evolve are both enabled and constrained by their energetic foundations.

Consider the image of a metropolis at night, as seen from an aeroplane window, to highlight the practical implications of the energy surpluses provided by fossil fuels. The aircraft itself is entirely dependent on the unique power density of oil, not simply to provide the fuel, but also to make viable the range of complex background activities on which modern aircraft depend: the mining of materials and the production of plastics; the laying of roads and runways; the development and production of computers and communications technologies that coordinate the tens of thousands of daily flights; to say nothing of the broader investment in education required to train the engineers, computer scientists, pilots, and so forth.

In this web of dependencies it is not long before one arrives at the combine harvester that plays a key role in feeding much of the population. These machines, also powered by oil, take the Neolithic innovation of freeing up human labour for ‘non-food specialisation’ and amplify its effects through the industrialisation of agriculture. If in the past essentially all members of hunter-gatherer societies were required to be ‘food specialists’, in some industrially advanced societies today the proportion of the population required to be farmers has dropped to as low as 2 percent. During this demographic transition people were displaced from the land by machines and into the factories and offices of the built environment. It is this image of mass migration that perhaps most vividly illustrates the tight interrelationship between intensification of socio-political complexity and the urbanisation of modern life in the industrialised world.

Beneath the aircraft lie the sprawling, glowing suburbs – the defining manifestation of carbon civilisation on the ground. No previous form of human settlement has ever been more energy intensive to produce or to maintain. Again, think through the long and diverse chains of extraction and production on which suburbia depends, not only for its creation but also to support the high-consumption ways of life widely practised there: the underlying energy infrastructure like oil and gas pipelines and the electricity grid; the mining and transport activities that siphon resources from the global periphery to the urban and suburban landscapes; and the final consumer commodities shipped and trucked to the shopping malls, via a vast and complex network of global trade routes and practices; the manufacture of vehicles to transport people to and from work, leisure, and tourist activities; the production of houses, kitchen gadgets, plastics, computers, pharmaceuticals, appliances, and clothing; refrigeration of food; water heating, and space heating and cooling; and, thanks to hydrocarbon-derived fertilisers, the abundant provision of food from all around the world, no matter the season, free from blemishes due to the liberal use of hydrocarbon- derived pesticides and herbicides.

The list really has no end, because in our increasingly globalised and interconnected world-spanning economy everything seems dependent on everything else. Nothing, though, is more fundamental than the fossil fuels that make other physical transformation possible. Just look around the space in which you are reading: it may not always be obvious, but essentially every artefact you see will have a history saturated with fossil energy, especially oil.

This is carbon civilisation.[[4]](#endnote-4)

**Assumptions of ongoing energy abundance**

Throughout history the *over-*use of energy has not been a prevailing problem – more often, the existential challenges that humans have faced can be viewed in terms of energy *scarcity*. Had ready access to new energy sources been available, many past societies may have overcome (or at least delayed) crises that precipitated their demise.

Even so, the provision and use of energy in previous eras caused problems too. Deforestation is not a purely modern phenomenon. The harm caused by airborne particulates from burning wood and coal has a long history. As horses became a dominant mode of urban transport, their manure in the streets became a hazard. That human exploitation of energy resources should drive environmental change is not new. This is as old as the mastery of fire, and our energy use always has and always will have consequences beyond the benefits it brings.

Nevertheless, it seems that we have now entered an age in which problems that can be characterised in terms of the *under*-use of energy are being eclipsed by dilemmas in which *over*-use is central. Granted, humans enjoy vastly disparate access to energy, with billions still living in conditions of energy poverty. Collectively though, we now face dual energy crises that are distinct but intimately connected: first, fossil energy depletion, and secondly, the major contribution that combustion of these same energy sources makes to climate change. Both arise from the vastly increased scale of humanity’s energy use during the industrial age. As humanity’s demand for energy expands, the problems attending satisfaction of this demand intensify. To the extent that conventional responses to this situation themselves stand to further increase energy demand – including the default reliance on ‘technological fixes’ – the dual crises perpetuate themselves. This is the energy paradox that is coming to define our age: we expect to solve the dual energy crises with approaches that themselves demand more overall energy use.

Energy forecasting conducted within the auspices of conventional institutions typically reinforces the orthodox assumption that humanity (or the portion living in the rich world, at least) will always be able to satisfy ongoing energy demand in a timely and affordable fashion. This is not necessarily a conscious assumption. Rather, it is a consequence of the ways in which large-scale societies are constituted that the association between institutional responses to collective problems and increased demand for energy is rarely apparent. As citizens of societies organised by industrial economies and market capitalism, we have simply become accustomed to overcoming (or at least displacing) any immediate problem that arises and, simultaneously, to satisfying the aggregate growth in energy demand. In mainstream energy discourse the fact that fossil fuels are finite and being depleted at pace is generally dismissed as a distant concern that will be solved before it arrives. Even if such a view is by no means universal, media narratives both reflect and propagate the widespread and popular assumption that renewable energy or nuclear power will be able to replace current fossil fuel use without significant social or economic disruption, as well as match growing global energy demand into the distant future.

In support of this energy optimism, analysts point to promising advances in technology. Sure, they say, new energy demands will arise, but a clever and resourceful humanity will be able to meet them. Markets and price signals will provide the right incentives. According to this narrative, industrial capitalism will soon be global – a transition almost complete – and efficiency gains and new energy sources and conversion technologies will mean we can avoid the worst oil depletion and climate change scenarios. Just look to history and you will see that in recent periods, humans have always managed to satisfy growing energy demand. The future will be the same, won’t it?

**Peak oil, climate change, and the limits of alternative energy sources**

We seek to challenge that dominant energy narrative from a range of angles and offer an alternative perspective on humanity’s energy futures. First, we remind the reader that fossil fuels – currently comprising about 85 percent of global primary energy use – are finite, and therefore carbon civilisation, one way or another, has a time limit. Our one-off fossil energy inheritance is but a brief anomaly in the evolution of the human story, a momentary energy spike from the perspective of deep time.

Although the timing and trajectory of fossil energy depletion is subject to many uncertainties and controversies, the fact that fossil fuels are finite and subject to depletion is an undeniable geological reality. This is a matter of particular significance in relation to oil, given its role in enabling industrial agriculture, and global transport systems and supply chains. With each passing day, as the low-hanging fruit is picked, it becomes harder to increase or even maintain current net energy supply. In recent years, the large growth in United States oil production due to shale oil developments using hydraulic fracturing (‘fracking’) techniques has encouraged some commentators to proclaim ‘the death of peak oil’.

Our assessment of the evidence suggests that such pronouncements are greatly exaggerated.[[5]](#endnote-5) Eventually – perhaps sooner than most think – the rate of oil production will enter a phase of net energy decline, with new discoveries unable to offset the flagging fortunes of existing assets. And while oil has commanded the vast majority of attention to date in public discourse about fossil energy resource depletion, the timelines for gas and coal may not be anywhere near as protracted as is typically assumed. Alongside this, exponential growth trends (both energetic and economic) that have defined dominant conceptions of human development since the industrial revolution can be expected to end, and even reverse. This raises questions not only about what a post-carbon civilisation will look like, but, perhaps more pressingly, how we should best manage the inevitable and foreseeable contraction of fossil energy source production in coming years and decades.[[6]](#endnote-6)

Secondly, and perhaps most prominently, there is the climate crisis, no longer of the future but the present.[[7]](#endnote-7) What was only a few years ago thought to be a sufficiently distant concern to be deferred or ignored, is now upon us. Compounding the challenge of maintaining energy supply in the face of fossil energy depletion, climate science overwhelmingly concludes that the burning of fossil fuels is a leading cause of anthropogenic climate change. Any adequate response to this potentially existential threat is going to require, among other things, a swift and committed transition beyond fossil energy sources.

The best available science tells us that to keep the impacts of climate change within the range of human adaptation, we need to limit the consumption of fossil fuels even before limits are geologically enforced – that we must leave them before they leave us. The question is whether we are able to muster the wisdom to do this, and what the resultant societies might look like if we succeed. If we fail, then it seems that we will burn – and already things are heating up. According to NASA, seventeen of the eighteen hottest years in recorded history have occurred since 2001, to say nothing of the increasing regularity and severity of extreme weather events. And yet we wait.

In light of the urgent imperative to reduce carbon-based fuel combustion to mitigate climate change, it may be tempting to see the prospect of fossil energy depletion as a red herring. If fossil fuel use is incompatible with maintaining a habitable climate anyway, then why be concerned about geophysical supply constraints? Surely these must, if they come into play in time, only help with the climate imperative for decarbonising economies.

While that perspective makes sense if current fossil energy reliance is viewed in very abstract terms, it oversimplifies the complex relationship between climate change and energy resource depletion. The arrival of peak oil, if planned for, will unfold very differently than if it arrives without any or much preparation. So an assumption that peak oil will necessarily be good for climate change mitigation is by no means self-evident. Furthermore, in our more pessimistic moods, the sluggish political and cultural responses to climate change to date make it plausible that peak oil transforms (or disrupts) the global economy before any serious climate response does. Accordingly, it is not enough to say we *need* to decarbonise the global economy to mitigate climate change. That may be true, but if, in fact, the world fails to mobilise adequately in that regard – which, again, strikes us as a plausible scenario – then peak oil may be the energy challenge the world is *forced* to deal with.

The cursory review of humanity’s situation through the overlapping contextual lenses of fossil energy resource depletion and climate disruption sets the scene for a third context of inquiry. This concerns the extent to which alternative energy sources – specifically renewable and/or nuclear energy – will be able to replace the fossil energy sources of carbon civilisation.[[8]](#endnote-8) Can this be achieved without significant disruption or fundamental change to its industrial, energy-intensive, extractivist and expansionary nature? We acknowledge a range of promising technological and economic advances in the energy domain, and categorically support the planned transition to a post- carbon society. At the same time, critical questions must be raised about whether alternative sources can seamlessly substitute for incumbent energy systems, without transformation of the wider social and cultural contexts within which they are deployed.

Unfortunately, this is an area of scholarly debate in which competing schools of thought – ‘renewable advocates’ vs. ‘nuclear advocates’ – hold what often seem to be commitments of an almost religious nature to their particular energy solution.[[9]](#endnote-9) While we cannot review the intricacies of this debate here, we approach the issues with more circumspection, knowing that the current knowledge basis for energy transitions is uncertain – that reasonable people can disagree. But we maintain that this very uncertainty about the viability of fully replacing fossil fuels with alternative sources, and the knowledge humility this uncertainty demands,[[10]](#endnote-10) ends up supporting the case for energy descent preparation and planning. That is, if we are not sure renewable energy or nuclear power will be up to the task of fully replacing the energy supply from fossil fuels, then we should not assume existing energy supply – and the societal complexity it enables – will be able to be maintained in a post-carbon world. In short, it would be prudent to prepare for an energy descent future, whether one is motivated by peak oil, climate change, or uncertainty about the prospects of alternative energy sources replacing fossil fuels (or all those reasons).

Adding further to the scope of the decarbonisation challenge is the perennial question of ‘who benefits?’ We must ask distributive questions about how the energy humanity manages to harness should be shared amongst the growing global human population, currently at 7.7 billion and, according to the United Nations, trending toward 11 billion or more by the end of the century. This is the ethical dimension that energy transition inquiries too often marginalise or simply ignore altogether, in favour of technological and market-driven solutions.

Elsewhere we have provided the evidential foundations for energy descent in much more detail.[[11]](#endnote-11) For present purposes, however, our contention is that there are various reasons to think that the future may be shaped by energy descent not energy abundance. Fossil fuels are finite and being depleted at pace; climate change mitigation cannot be solved merely by ‘greening’ energy supply but also requires choosing radical energy demand reductions; nuclear and renewables cannot fully or directly replace the nature and magnitude of fossil energy surpluses; and finally, distributive concerns suggest that energy-intensive societies should be reducing their energy use in order to share global energy access more broadly. Any one of these energy challenges justifies taking energy descent futures seriously. Considered together, we contend that an energy descent future is more likely than not.

**Navigation notes for energy descent futures**

So far we have not attempted to describe the range of preparatory or adaptive strategies that are available for dealing with energy descent; nor have we discussed in any detail what a post-carbon civilisation might look like. Our goal has been diagnostic rather than prescriptive. That said, we believe the diagnosis supports the case for, and adaptive potential of, engaging intentionally with energy descent processes.

Drawing attention to this perspective is important because until the plausibility of such energy futures is understood and taken seriously, individuals, communities and political processes will not be mobilised to prepare for their eventuality. A range of looming energy shocks may well arrive and societies will be unprepared for them, which is likely to bring unnecessary suffering, harm and instability. At the extreme, it potentially precipitates civilisational collapse.[[12]](#endnote-12) In light of this, we will now say a few words on the cultural and socio-economic implications of energy descent, and the variety of responses available. The brief overview we present can only anticipate the much more extensive discussion that the subject both requires and deserves.[[13]](#endnote-13)

In earlier sections we discussed the ways in which energy surpluses are used by societies to solve the problems they encounter, and typically also to feed growing and evolving material desires. We showed that as societies acquire and invest energy to solve problems and feed desires, they become more socio-politically complex (in the social scientific sense, of increasing social role differentiation and specialisation, with attendant expansion of the means for coordinating these roles; this tends also to be accompanied by expanded suites of technologies and related institutions). This in turn drives the need for further complexification, and hence increased energy use. Because existential problems are in fact being solved, it is widely inferred that such a trajectory of change represents a general progressive improvement in life conditions within a complexifying society – for the time being at least.[[14]](#endnote-14)

As an aside, we stress here that we do not subscribe to the view that increasing socio-political complexification constitutes a trajectory of *general* progress or improvement. We distinguish this idea of general progress from the ongoing possibility – which we *do* subscribe to – of localised performance improvement in specific contexts, as measured by appropriately defined and context-specific criteria. Human history is not in our interpretation characterised by a unidirectional, largely deterministic and hence predictable pattern of change from less to more socially desirable states. We just point out that this is an interpretation that is widely held and that is a highly influential cultural characteristic of modernity.[[15]](#endnote-15)

Economic growth is one prominent area of performance from which a general trajectory of progress is often inferred. Money and other financial assets – the instruments that mediate economic activity – can be viewed as claims on the product of surplus energy. Societies allocate money to initiatives intended to solve their problems, and the expansion of physical economic activity that this stimulates and incentivises entails increased rates of energy use. This energy-economy relationship is evidenced historically by the close correlation between economic activity measured in terms of GDP and total primary energy use.[[16]](#endnote-16) Provided energy surpluses continue to grow, economies have been able to grow in scale and socio-political complexity. On the surface, then, it is quite understandable why more money and energy are overriding goals of most, if not all, contemporary economies: these are apparently required for maintaining the conditions that are interpreted as ‘progress’, and that, as such, are widely attributed the status of being of ultimate value.

But what happens (or might happen in future) when a society finds itself with less energy to invest in economic growth, and the socio-political complexification growth both brings and requires? There are two broad pathways it may follow: either it tries to maintain the existing, growth-oriented socio-economic form but solve fewer problems due to the declining energy budget (a phenomenon typically characterisable as societal decay, recession or collapse, depending on the speed and extent of decline); or the society rethinks the range and nature of the problems it is willing to solve, and then reprioritises its investment of available energy in order to create new, less energy intensive socio-political and economic forms.

It seems clear enough that rich nations (our focus herein) are in the process of choosing the former strategy – evidenced by their unremitting hunger for more energy, more (and more diverse) technological solutions and more economic growth. This dominant strategy is selected on the assumption that more energy will be available in the future to fund the attendant increase in socio-political complexity. This is the message relentlessly pushed by mainstream energy analysts and institutions. However, the central implication of our analysis is that it would be prudent to embrace the radical alternative strategies of voluntary simplification (of the socio-political structures for organising human activity) and economic deintensification, given the likelihood of forthcoming energy descent. What, then, might such voluntary simplification look like? We sketch a view here in the broadest possible terms, and we expect to raise as many new questions as we answer.[[17]](#endnote-17)

Given that sufficient rates of energy supply in appropriate forms are required for production activity within a given socio-political- economic complex, it follows that in an energy descent context voluntary simplification would involve less overall production activity in physical terms, which would also mean less material- and energy-intensive consumption. From an engineering perspective, this decline in production activity is a simple consequence of less overall work and heat transfer being carried out by a society’s physical plant, equipment and infrastructure.

Today the outcome of this process of organised economic contraction widely goes by the name ‘degrowth’ (which for present purposes can be considered a consequence of success in the positive development of voluntarily simplified societies and deintensified economies).[[18]](#endnote-18) But degrowth does not merely mean less of the same type of economic activity within the same system; it also means less and different, within a new system. Depending on local context: not simply fewer SUVs, but more bikes (or less desire for transit in the first place); not just less deforestation but more reforestation; not fewer meals in the day, but different diets; and so forth, across all domains of life. In other words, not the same narratives of human identity, success and wellbeing, but new narratives of what it means to be human.

Within such new narratives, if the social justice imperative of meeting the basic wants of all people were to be realised, the reduced material output of economic activity in a degrowth transition would need to be distributed more fairly than it is in most societies today. In other words, the degrowth economies would not be structured to maximise economic growth and hope that wealth ‘trickles down’; instead the economies we envisage here should ensure material sufficiency for all more directly, through the creation of new distributive ground rules that do not rely on growth. Here the same social ‘problem’ is solved, only in alternative, less energy and resource intensive ways, which is a key feature of what we mean by voluntary simplification.

This process of shrinking or abandoning many present economic arrangements in organised ways should not be assumed to automatically imply social hardship or deprivation, provided communities negotiate the transition mindfully. And although significant deindustrialisation would ensue, obviously some economic sectors would expand in order to meet real and ongoing human desires in regenerative and equitable ways (notably renewable energy infrastructure). Granted, consumer affluence as we know it today may not be viable for any or many – clearly requiring a fundamental shift in cultures of consumption and conceptions of the ‘good life’. But once basic material wants were met and appropriate technologies developed, degrowth societies would have the freedom to turn away from limitless material advancement and instead seek happiness and meaning in life through less consumptive avenues – where, as it happens, pretty much every wisdom and spiritual tradition advises that lasting fulfilment lies.

Members of post-consumerist cultures enabled by voluntary simplification would thus have increased scope to choose the realm of the spirit, not the shopping mall, to satisfy their hunger for contentment. Paradoxically, the shift to less consumptive pursuits might imply not an outright *rejection* of material culture but a ‘new materialism’, in which post-materialist cultures actually pay more attention to and exercise greater care for the material realm (e.g. building things to last and taking care of them). This might be motivated by highly utilitarian concerns, such as minimising environmental impacts or resource extraction and discarding of waste. But it can also be consistent with what might be termed spiritual motivations, a move to healing or transcending the supposed enmities between ‘culture and nature’ and ‘body and mind’.

The degrowth in production and consumption required by energy descent is one thing. But it is not just the *magnitude* of energy availability that shapes a society. It is also the *nature* of the energy sources, especially their power density. Assuming that a degrowth society is fully or primarily powered by renewable energy, with little or no use of fossil energy and a limited role for nuclear electricity, it follows that such a society would have to adapt to the fundamentally different nature of energy supply, as well as reduced overall availability.[[19]](#endnote-19)

In order to avoid an economically crippling reliance on expensive energy storage, a degrowth society may need to adjust by storing *work*, using energy as far as possible when the sun is shining or the wind is blowing, rather than assuming that energy is always available on demand and without interruption. While modest biofuel volumes could be produced for tasks deemed socially essential (such as limited use of heavy machinery and aviation), a defining feature of a post-carbon society would be the electrification of essential energy-demanding tools and technologies and even a return to human-labour power for more tasks (including farming). Overall, of course, energy demand would have to be significantly reduced compared to rich nations today. Precise levels, though, are subject to the myriad social, political, economic, technological and cultural characteristics of as-yet-unknown viable human futures.

In short, degrowth processes of voluntary simplification, as we envisage them, would seek to meet genuine human wants and essential needs in sustainable ways through socio-economic practices that are far less energy and resource intensive than in industrially advanced societies today. As well as a range of institutional and structural changes (which we won’t attempt to review here),[[20]](#endnote-20) such degrowth societies would have to be shaped by values of material sufficiency, moderation and frugality – simply because there would be insufficient surplus energy to meet the energy (or broader environmental) costs of consumer lifestyles.[[21]](#endnote-21)

Central to the changes we see as plausibly enabling this is a decrease in hours spent working in the formal economy. This would free up increased time for participation in the informal economy at the household and community levels. In such a world, repair, recycling and reuse would be radically embraced and practised, incentivised by the increased value of materials. Clothes might be second-hand, mended or produced within the household and neighbourhood economies. Cultures based on rapid fashion cycles would very likely wither away and new aesthetics of sufficiency and timeless classic design might emerge. Home energy use would have to be a fraction of typical usage in rich societies but homes would be retrofitted for energy efficiency and essential functions could be met. Permaculture gardens and food forests would reshape the urban and suburban landscapes. Car culture would enter its terminal phase as oil becomes ever-scarcer, and bicycles and electrified public transport would become primary modes of transit. Regular air travel would become unaffordable, as would consumer lifestyles more generally. Infrastructure that is currently replicated across all households would increasingly be shared at the neighbourhood scale. Food and other commodities would generally be grown, produced and traded far more locally than at present. Markets local to living places could be expected to proliferate to facilitate this trade.

This rough and incomplete thumbnail sketch seeks simply to highlight how a degrowth process of voluntary simplification points towards non-affluent but sufficient material living standards. By avoiding the energy inputs currently invested in the vast mediating economic structures necessary to support large-scale societies oriented towards continuous and unchecked growth, degrowth societies would thereby still have sufficient energy available to meet wants consistent with human flourishing.

Approached judiciously and with appropriate care, we see it as entirely conceivable that sufficient surplus energy would also be available to allow continued collective problem-solving on a significant scale.[[22]](#endnote-22) But problems would be solved in ways different to those that have become habitual during the industrial age. Different value-systems would even produce different conceptions of the problems faced and, with this, new ways of thinking about the nature of adequate solutions. This is not to deny the necessary role of technology and engineering in navigating viable energy descent pathways, it is only to emphasise that a techno-fix alone will be insufficient if not set within a suitable framework of reappraised values. Technologies are tools the use of which is inevitably shaped by the cultural contexts in which they are deployed.

How voluntary simplification unfolds in practice could take an essentially infinite number of forms. It defies precise forecasting. Indeed, the shape of a flourishing degrowth society in an energy descent context is limited only by its members’ shared imagination. Scarcity begets creativity. Voluntary simplification is based on an essentially *polycultural* vision, as distinct from modernity’s *monocultural* vision. This is a vision where the trajectory of change will involve many of infinite possible social forms being enacted simultaneously, in response to local conditions. This diversity will be amplified by the interactions between groups pursuing viable trajectories free of the constraints of uniformity imposed by massive bureaucracies and centralised institutions. In important respects, as David Fleming has pointed out, this ‘simplification’ in fact entails a drift to greater complexity.[[23]](#endnote-23) Again, this is simplification only in the limited sense of reduction in the formal socio-political complexity – that is, institutionalised social role differentiation and diversification, and attendant means of coordination – that characterises large-scale societies.

Obviously, such ‘simplification’ of past socio-political complexity will be experienced very differently if it is chaotically imposed upon a society as a consequence of collapse, instead of being creatively and caringly navigated into existence through deliberate intention. Degrowth by way of voluntary simplification and economic deintensification provides not just an alternative to collapse, but also the potential for prosperous descent.

Nevertheless, no matter how well justified degrowth may be as a coherent response to global crises, we acknowledge that it seems unlikely to be widely embraced by governments or civil societies. But this does not undermine the case for degrowth. If, in the face of the evidence, nations continue to pursue economic growth without end, and thereby continue to collide with ecological limits, then we argue that degrowth values and practices remain justified as a means of building resilience to forthcoming shocks. In other words, we should aim for regenerative forms of social organisation that build rather than deplete the foundations on which they rely.

**Conclusion**

We set out to show through this critical exploration that much mainstream energy discourse is based on a series of highly optimistic assumptions about future energy supply. The improbability of conditions aligning such that all necessary assumptions are born out implies that the energy futures ahead will diverge strongly from those envisaged within this established discourse. This has potentially profound implications. The availability of energy in the right forms at sufficient rates is the lifeblood of any particular form of civilisation. Energy-related factors are fundamental to how we shape our societies and pursue our goals – yet it seems most individuals and societies are making plans based on highly implausible expectations. We’ve encouraged readers to treat the prospect that these expectations will *not* be realised as, at the very least, a matter of plausibility.

In the event that mainstream expectations are thwarted, the consequences could range from the disruptive to the catastrophic. This is not a case *against* optimism, but rather of channelling it in directions that lie within humanity’s scope of influence. Even within the difficult circumstances that our assessment implies, there is still much good that can be achieved. Ample room remains for adjusting expectations to better reflect underlying energy and environmental realities, and to reconstitute societies – and the economies that support them – accordingly.

Our critique focussed on three key issues: (1) the likelihood (or unlikelihood) of meeting growing energy demand as fossil fuels continue to deplete; (2) the size of the available carbon budget for a safe climate and the economic implications of keeping within such a budget; and (3) the degree to which alternative energy sources (renewables and/or nuclear) will be able to replace the fossil energy foundations of carbon civilisation, without significant disruption to today’s large-scale societies and the dominant political-economic paradigm of global market capitalism.

On our reading of the evidence the peak oil phenomenon is not dead but at most in short term remission. Ongoing fossil energy depletion is likely to cause supply disruptions in coming years and decades and thereby undermine the energy supply needed to maintain economic growth. In any case, the carbon budget for a safe climate is so tight (and in fact is arguably non-existent) that decarbonising at the rate needed is inconsistent with ongoing economic growth. This means we should be choosing to leave fossil fuels even before they leave us. But as we argued, that requires the unthinkable: transcending the growth imperative that is common to all large-scale societies but which is greatly amplified within competitive economies operating under market capitalism.

Finally, we looked beneath the gloss of promising advancements in energy sources and conversion technologies, reminding readers that alternative energy sources differ dramatically in nature from incumbent sources (intermittency, storage issues, low energy density, system cost, etc.). Considered systemically, these differences imply that the alternatives will not directly replace the fossil energy foundations of carbon civilisation. In short, we have explored the possibility that a post-carbon civilisation is most likely to be one with less energy available, not more, and hence with reduced energy *services* in the form of work, heat, lighting and data manipulation than is currently available in rich nations. The situation is compounded if distributive questions are taken seriously. Ultimately, this means it would be prudent to be planning for energy descent futures.

In closing, we appreciate the psychological drivers for denying these conclusions and trusting instead in a cornucopian or techno-optimistic worldview. It is less confronting to human identities and ways of life to believe that technology and markets can solve social and environmental problems without needing to rethink the underpinning structures that give rise to those problems. We posit that this means of coping with psychological dissonance, perhaps adaptive in other circumstances, is influential in the apparent ‘self- censoring’ (consciously or unconsciously) by mainstream energy and economic analysts, resulting in the publication only of perspectives consistent with dominant economic and political paradigms. But critical, evidence-based thinking demands that we should not believe something merely because we wish it to be so. In our view, it is preferable to believe and act upon what is most likely to be true following an honest and frank weighing of the evidence. We have argued that this means accepting more modest visions of future access to energy services and creatively preparing for the socio-economic implications of energy descent.

The age of energy abundance is arguably drawing to an end. The human species has created a form of civilisation the energy demands of which cannot be sustainably or fairly maintained. Certainly, this high-consumption, energy-intensive way of life cannot be globalised to the entire, growing population approaching eight billion. As Joseph Tainter maintains: ‘a society or other institution can be destroyed by the cost of sustaining itself.’[[24]](#endnote-24) Our message, therefore, is to accept the implied energy descent futures before their consequences overwhelm us. This is likely to be an extremely challenging and uncertain journey. But it also has the potential to offer people renewed prospects for lives of meaning and purpose, provided we learn to collectively see these overlapping crises as opportunities for deep civilisational transformation.

The human opportunity, as always, is to constitute the future rather than be constituted by it. Today that requires seeing through the dubious and even dangerous optimism of energy cornucopianism and developing an appreciation of, and even *desire for*, futures of the kind that energy descent entails. We acknowledge that this prospect will be interpreted by many as carrying associations of deprivation and defeat, and thus seem undesirable. Consider a metaphor though. For a pilot nearing the range limit of their aircraft’s fuel supply, making a controlled descent in order to land safely is so natural and expected that the plane passing overhead is barely registered. It is only in the rare instance in which a pilot, in error or incapacitated, acts contrary to their passengers’ and their own interests, crashing to the ground with great violence, that such an everyday occurrence as the end of an aircraft’s flight suddenly galvanises collective attention. Dystopian interpretations of descent are not inherent in the concept itself. Rather, they are an entailment of cultural priorities formed around the present civilisation’s dominant story of progress.

Given that the energy prospects of the old story are beginning to fade, we find ourselves in a sort of limbo, in between stories. What is required today more than anything else is a new story. Or rather, an assemblage of new stories, which together help us break through the thick crust of conventional thinking and being, thus allowing us to think and be otherwise, as pioneering citizens of a post-carbon civilisation, in a world not yet made.

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