Climate Change and Society

John Urry

polity

8

Innovating low carbon lives

> You never change anything by fighting the existing reality. To change something, build a new model that makes the existing model obsolete (well-known oral aphorism).
>
> Buckminster Fuller

Introduction

In this chapter I examine the complex processes that could result in systems that develop and enhance low – and not high – carbon lives. Such systems would involve laying down new path-dependent patterns, breaking with high carbon systems and lives of the previous century. Lying behind this chapter is the general argument that Giddens elaborates: that 'fear' is not the best way to induce low carbon. There must be positive alternatives to high carbon lives, alternatives that become a matter of fashion and desire. Such low carbon alternatives should not be advocated through fearing the future.

Rather, my question here is: how could low carbon lives be innovated, generalized and sustained as a practical, desirable and fashionable set of alternatives? I consider examples from travel and transport where breaking with the high carbon car and truck is a huge challenge, as already noted. And this requires a thorough examination of the nature of innovation and especially of its complex and societal patterning. As in other chapters I consider the need to bring society back in, in this case with regard to how it is that innovation is realized through various intersecting social processes. Innovation involves new 'combinations' of elements that, over often lengthy periods of

time, are appropriately assembled together. They might be viewed as different islands of an archipelago dotted around the world and relatively isolated from each other. Innovations minimally presuppose the combining of these isolated islands of the archipelago into a different system. This process, according to Brian Arthur, typically takes three to four decades – time which we may well not have before very different economic, social and political consequences unfold.[1]

I especially examine how 'innovation' is actually different from the linear notions often deployed by policy-makers. Policy-makers tend to attribute the emergence of a particular innovation to the brilliance of a single entrepreneur, or to the chance 'discovery' of a new technology, or to the system of knowledge-creation put in place by farsighted policy-makers, or to the gleaming temple of interdisciplinary science established on a university campus.[2] But innovation is not like this at all. It is non-linear, systemic and often unpredictable.

Innovation typically involves some new combination of existing elements of machinery, text, technology, materials and organizations. It is the combination which is key, according to Arthur. Innovation should not be viewed as simply technological or economic or social or political but as a distinct combination of all of these.

But it involves something else as well. Innovation stems from 'synchronization' occurring between many different agents whose actions stretch across local, national and global levels.[3] The key question in explaining such innovation is how synchronization happens between what can be a large array of 'agents' involved in producing some new innovation. Synchronization is effected between many different agents that generate some idea or machine or system which then becomes faddish or fashionable. Much of the existing innovation literature and related policy-making has insufficiently examined these complex synchronization processes, including what is often an international division of 'innovative' labour. Millions of interactions generate a new order out of apparent chaos, an innovation stemming from 'sync' or synchronization. The key question then is: how does synchronization come to happen between the agents involved in performing the new 'innovation'?

And after such an innovation, the world is changed, with at pivotal points a new set of products and services fitted into it. Innovation can take the world by storm and no-one can imagine how life was possible before the innovation was general and taken-for-granted, almost no longer noticed. One example of this was the innovation of the motor car in the early years of the last century.[4] As Virginia Woolf noted after buying her new car in 1927: 'Yes, the motor car is turning out to be the joy of our lives, an additional life, free and mobile and

airy ... Soon we shall look back at our pre-motor days as we do now at our days in the caves'.[5]

This captures how innovation ushers in a different world that makes the previous world impossible to remember or even to imagine. Innovation transforms through a kind of recombination the very entities that form life, whether it is massive steam engines or smelly cars, computer screens or miniature, smart mobile objects. These successful innovations become present within and central to people's lives and quickly taken-for-granted and part of the *new* background of life in some sphere, such as the home, the city, the laboratory, the workplace, the countryside and so on.

In the next section I develop some general points about innovation before applying these to the particular possibilities of developing low carbon innovation, especially within systems of personal travel.

Synchronized system change

First, new or existing 'technologies' should not be thought of as bounded and specific to certain sectors or domains. Thus, although we can talk of 'transport technologies', they do not develop in and of themselves. They operate within an environment, and components of that environment can be drawn into and become part of a network of innovation consisting of very many agents. The term *agent* is used here to refer to specific people, or social groups or categories, or organizations and institutions.

Various innovations within 'transport's' environment have become components of mobility systems. During the nineteenth century the postal system, the packaged tour and the telephone transformed the environment within which the railway system developed, and then became components *of that system*. Recently, the internet with billions of users; mobile telephony with over 3 billion users worldwide; internet-based social networking; telephone (VOIP), video and web-based forms of 'conferencing'; and the 'smart' nature of physical environments – all are parts of contemporary mobility systems and are not just *in* the external environment. There are many other examples of how apparently non-transport components become part of travel systems, such as credit cards, newspapers and magazines, fast food, out-of-town supermarkets, freezers and so on.[6] Thus when we examine the possibilities of innovation we need to think in whole-system terms and not in terms of incentives offered to potential individual innovators. What is key is the combination.

So, system innovation involves various features: co-evolution of numerous interrelated elements; changes in both demand *and* supply sides; a large range of agents; long-term processes that stretch over decades; and the impossibility of innovation being generated by a single 'policy' or 'object' as such. Tuomi shows how these characteristics make it hard to say exactly when an innovation process can be said to begin, when in a sense some infinitesimal 'sync' begins to take place, when the butterfly's wings start to flap in a way that later can be seen to start a wave of what becomes an orchestrated process of change.[7]

Geels elaborates why this is so. System innovations 'are not merely about changes in technical products, but also about policy, user practices, infrastructure, industry structures and symbolic meaning etc.'.[8] The social is core to innovation, something shown in the innovation of the internet. Thus, all 'innovation is social innovation. Innovation does not happen 'out there' in the world of objects, but in society and in minds.'[9] Innovations thus presuppose a societal as well as a business model for their successful emergence. Only if a potential innovation comes to be successfully inserted within societal processes will it take off, become so part of life that it is a successful innovation. This is another aspect of how 'society' has to be brought into the analysis of low carbon system change. This approach contrasts with linear and individualistic notions derived from orthodox economics which will produce or perform a vision of innovation that is unlikely to generate sustainable energy.[10]

Certain systems can be seen as hovering in a state of precarious stability, a critical state – neither fully secure nor fully insecure, but what physicists call metastable.[11] In conditions of such self-organized criticality, what can matter is not the average behaviour of people or institutions but what happens at the extreme. Key is the extreme behaviour of certain components and not the average. I noted above the importance of so-called black swans, rare events, unexpected, highly improbable and yet having huge impacts upon physical and/or social systems. These are statistical outliers and not averages, responsible for much economic, social and political change, for making history jump and not crawl.[12]

The spreading of a possible innovation is thus not a smooth *diffusion* but involves non-linear points of bifurcation when systems tip from one path to another. Change may not be gradual but abrupt, in a rush. If a system passes a particular threshold, phase transitions or tipping points occur through positive feedback and dynamic change. This happened in the case of fax machines in the early 1990s when almost overnight no 'office' could be without their own fax machine

and their use sky-rocketed. Each machine became so much more valuable if every other office also had a fax machine that enabled new networked connections to form and extend themselves. Fax machines became utterly part of office life.[13] The benefits of each extra fax machine were non-linear. The system turned over, as also with the internet growing dramatically in the late 1990s, with millions and then billions of people and organizations adapting and co-evolving with it so that life for much of the world's population became impossible without it.

Such innovation processes often involve powerful connectors (individuals or organizations) playing a pivotal role in how innovations spread. Such connectors possess a disproportionate number of social ties. As a result of connector concentration, systems suddenly tip through social contagion. Gladwell notes the importance of 'word of mouth' communications, of social interactions, in how systems tip from one state to another. Contrary to notions of a purely virtual world he argues: 'we are about to enter the age of the word of mouth ... to rely more and more on very primitive kinds of social contacts'.[14] The non-linear outcomes resulting from 'tipping points' involve three notions: that events and phenomena are contagious, that little causes can have big effects, and that changes can happen abruptly at a moment when the system switches. These notions are all relevant to imaging what low carbon innovations could come to be like.

In such innovations, wealth derives not from scarcity as in conventional economics, but from abundance. Extraordinary benefits flow throughout the network as a consequence of what economists term 'increasing returns'.[15] This is different from what economists have understood by the notion of 'increasing economies of scale'. The latter are those that result from and are found within a *single* plant or organization, such as Ford. These economies within single firms increase output, and reduce over a long time the average costs of production. But no further gains are possible after a point is reached and costs begin to rise again.

By contrast, 'increasing returns' involves exponential increases in output (and rewards or wealth) that spread throughout a network of relationships between many different enterprises. It is the 'externalities' *across* the networked relationships that can produce spectacular non-linear increases in output and income (as with the innovation of the fax). The 'network economy' changes how economies and their rewards operate, on occasions spreading massive, non-linear gains and benefits. There are increasing returns that result from improved coordination between entities and from the processes of organizational learning across the network(s) in question.[16]

Increasing returns are a leading example of the idea of positive feedback mechanisms. Such positive feedback in the form of increasing returns can result in astonishing escalations of economic wealth. The internet, for example, emerged out of 'small' local changes, including the invention of HTML language in 1990 and the first Web browser released in 1993.[17] Dynamic and irreversible change thus occurs over time, change that takes a system further from equilibrium. Such increasing returns are connected with how patterns of socio-technical development are 'path-dependent'. The notions of path dependence emphasizes the importance over time of the ordering of events or processes. As opposed to linear models, the temporal patterning in which events or processes occur significantly influences the way that systems eventually turn out. Causation can flow from contingent minor events to powerful general processes that, through increasing returns, then get locked-in over lengthy periods of time. Thus we can say that 'history matters' in path-dependent development.

Such tipping points onto a new path do not derive from linear changes within existing firms, industries, practices and economies. The internet and mobile telephony unpredictably emerged from 'nowhere', involving new and unexpected combinations. And this is because most companies do not innovate time and time again.[18] Rather, it is markets that bring forth innovation. The economy is driven more by the entry and exit of firms, by their emergent effects, than by individual companies being able to innovate many times over (except perhaps for Apple, as the exception that proves the rule?). Innovation normally stems from the entry of new 'kids on the block', and those kids can be corporations, entrepreneurs, governments, NGOs and so on. Indeed, various authors maintain that it will be newer, smaller companies and organizations that are able to take advantage of niches in the system. It is such niches that can provide sites for the 'incubation for radical innovations able to develop in relative isolation'.[19]

But this argument needs further clarification since it is not just markets that produce innovation. First, many of the entities implicated within innovation processes are non-market, such as users or households, consumers, states, NGOs and international organizations. Those central to innovation are often 'disrupters' who can be opposed to the prevailing 'spirit of capitalism'.[20] These entities are likely to be especially important in developing low carbon innovations in challenging high carbon energy-systems.

But more significant is that a tipping point involves something more substantial than the market. After all, mostly, markets are

there working away to ensure that supply and demand are roughly in alignment, that there are prices arrived at which mean that markets 'clear' or at least are moving in the direction of clearing. This is business as normal and it is presumed that markets tend to equilibrium. We might call this state 'normal markets', and conventional economics deals adequately with these. Such normal markets are somewhat analogous to what Thomas Kuhn famously calls 'normal science'.[21]

But innovations such as automobility or the internet or some low carbon systems are not like this at all. These are revolutions analogous to the scientific revolutions Kuhn examined; they make the world different, as we saw in Virginia Woolf's observations about the car in the inter-war period. They are really the opposite of markets and their normal enduring patterns. 'Markets' do not explain the development of such paradigm shifts or their world-making significance.

Because of this role of chance events and lock-ins, the resulting outcomes are not necessarily optimal, either economically or certainly from the viewpoint of human or environmental value. Many commentators consider that the petrol-based car was the least desirable of the three alternative fuel systems available to power 'horseless carriages' at the end of the nineteenth century, and yet it was the one that swept away all others during what Gilroy terms the 'century of the car'.[22] This new system was organized around the newly discovered resource of oil that combined with other components and had such fateful consequences for developing the high carbon twentieth century.

It is sometimes said that this last point shows that markets are not always efficient. But markets are not so much to blame here since innovation is not a purely market mechanism, although of course markets are involved. Many commentators presume that the choice in generating innovation is between centralized state solutions and the private market-place. Especially since the development of neo-liberalism, the world has seemingly been polarized between these stark alternatives. However, the period of neo-liberalism coincides with another periodization favoured by more sociological formulations, namely networks, as in Castells' *The Network Society*.[23] And although networks are varied, what is generally significant about them is how they exhibit self-organization. Physicist Steve Strogatz describes how 'millions of interactions occur simultaneously – where everyone changes the state of everyone else'.[24] He goes on to describe the nature of such complex networks: 'Enormous numbers of components keep changing their state from moment to moment, looping back on one another in ways that can't be studied by examining any one part in isolation ... These phenomena ... are fundamentally *nonlinear*.'[25]

'Synchronization' is key in the performances of agents implicated within a division of labour resulting in significant 'innovation'. A set of changes happens so that the actions of many agents, both producers and consumers, come over time and space to be 'marching to the same drum'. And this is so although, typically, those agents, who may have many different beliefs and practices, do not know in advance what is the likely outcome, scale or impact of what turns out to be such an 'innovation'.

However, in many cases there is no synchronization and no – or limited – innovation takes place. A good example of this is the 'failed' 1980s Aramis rapid transit system that Latour examines.[26] In this case there was no development of the suitable 'digitization' that could be combined with the electronically and mechanically engineered rapid transit units to produce an appropriate viable combination. During the 1980s, this new system could not be brought into operation in that pre-digital period. But with digitization a somewhat similar rapid transit system is now about to be realized, if only in very specific locations such as airports.[27]

Synchronization, and hence the combination of otherwise disparate elements, may occur between many very different kinds of agents and entities located at different positions within what is understood in retrospect to be a 'division of innovative labour'. Marginson describes the nature of what he calls 'global synchrony', how 'electronically mediated networking positively *encourages* creative people to join with kindred spirits, and to synchronize with them in real time or close to real time ... Electronically mediated synchrony provides for their needs.'[28]

The actions of these multiple agents thus come to march to the same drum, in a kind of synchronized dance. This in turn relates to how various commentators such as von Hippel now emphasize the 'democratization of innovation'. He describes how so-called 'users' of goods and/or services come to engage in, and be constitutive of, product modification and development.[29] Likewise Thrift describes consumer communities gathering around particular obsessions, sometimes 'as mere interest groups, sometimes fickle fans, sometimes hobbyists, and sometimes cults'.[30] 'Sustainable innovation' will require 'consumer communities' highlighting, advocating, developing, making fashionable and synchronizing actions and objects across diverse geographical scales and socio-economic practices. Crucial thus to innovation is fashion, also very much a feature of twentieth-century

capitalism. As Gronow notes, the 'consumer is as much the heroic innovator as the entrepreneur'.[31]

Such user innovation was particularly important in the early development of what emerged as the fashionable car system. Car drivers were often innovators. Such innovation occurred through many complex connections and relations with producers and other users across north America and Europe. The outcome of 'global automobility', as realized at the end of the twentieth century, was never envisaged by these early innovators. These early drivers and car developers were enthusiastic experimenters, making tiny modifications which then delivered unpredicted and yet more systemic outcomes that contingently began to 'fit' together. The car became a consumer good owned and driven by private individuals (not experts). Especially important in synchronization were these enthusiasts who, in 'tinkering' with these new machines, improved the fit between their desires and the mass-produced machines.[32]

Knowing how to tinker rapidly became an important form of expertise that many middle-class women were drawn to, challenging notions of the 'passive consumer' and promoting the tinkering fashion. Bertha Benz is often credited with playing a seminal role in turning the machine of the 'car' into a fashionable machine for living. In 1885 she took her husband's 'car' out of his workshop and went for a drive to her parents who lived some 100 kilometres away. This is said to be the first *social* use of the car, although she apparently had to do plenty of tinkering with the car en route. It required this very striking disruptive innovation, bringing out women's role in initiating new sociabilities – albeit a woman with a particular set of 'connections' that made fashionable the social use of the car. At that time Karl Benz had been concentrating upon what he thought was his main business, which was engineering *stationary* engines!

The 'uses' of what turn out to be crucial innovations are often unpredictable, unplanned and undesigned. This was the case with SMS texting or the widespread availability of credit cards. More generally it is 'situated actions' rather than 'plans' which are key to how technologies in the end have their 'effects' through synchronization.[33] Moreover, many 'old' technologies do not simply disappear but live on through path-dependence, and can then be combined with the 'new' in some reconfigured and unpredicted cluster. One good example of this is the enduring importance of paper and its significant role in 'high-tech' offices. Edgerton provocatively describes this as involving *The Shock of the Old* rather than the new.[34]

I now 'apply' some of these arguments to examine how in the early twenty-first century various experimenters are seeking new ways of

powering, organizing, governing and experiencing personal vehicles. This experimentation does not have a clear end-state. It is not that the agents are working towards some definitive outcome, some precise technological objective or 'climate technic'. What may turn out to be an innovation is taking place in many contexts with very different agents, but where synchronization may happen, with each drum coming to beat to the same rhythm and hence a tipping point occurring, within the next few decades. There is no conductor of the orchestra, but in retrospect we may come to understand how over time this process of synchronization is orchestrated behind the backs of the musicians. Indeed, what may turn out to be an innovation may not have direct consequence but may transform the broader architecture or system of related technologies and economic and social practices with which it is, or may come to be, interconnected during the lengthy and uncertain innovation process. This is roughly similar to what Stark refers to as 'heterarchies', as opposed to markets or hierarchies.[35]

Overall, innovation always depends upon both viable 'business' and 'societal' models for the emergence of the innovation in question. This is now explored in the context of possible low carbon developments in travel and transport.

Low carbon innovation

In *After the Car*, Dennis and I examine the 'division of innovative labour' with regard to a post-car personal vehicle system.[36] It is presumed that the steel-and-petroleum car that came into existence at the end of the nineteenth century will not still be around at the end of this twenty-first century (except in museums, if there are still 'museums' housing physical objects). This potentially huge innovation of a post-car system stems from a dramatically changing environment examined in previous chapters: global climate change, the peaking of oil and gas supplies, the potential offered through new digital control systems, and the growth of mega-cities, especially in many developing countries including China, now the world's largest car market.

Some powerful forces are undermining this current car system, this 'car-centric monoculture' and will usher in a new system sometime during this century.[37] The car system is based upon nineteenth-century technologies, of heavy steel bodies and very inefficient and polluting internal combustion engines, showing how old technologies endure. It is very likely that this mass system of individualized,

flexible mobility will be 're-designed' and 're-engineered' well before the end of this century. A new system is coming into being. It is a bit like the period around 1900 when the current car system was being formed. It was emerging although no one at the time could imagine exactly what was going to emerge, even what its source of power would be or what it would be used for, let alone how central it would be to the American and western way of life.[38]

This is not a question of considering the gap between values (wanting to slow down climate change) and behaviour (continuing to drive). That gap will always exist, partly because of the peculiarities of fighting climate change. What are crucial are not only minor modifications of individual behaviour but the potential of 'system' change. Are there new systems that could develop here? How could such a different world emerge and what might provoke appropriate synchronization?

We can imagine that a post-car system would provide flexible, comfortable and secure personal mobility but not based upon the high energy of the existing car system. It is necessary to develop a system that is 'after the car' but which does not displace certain of the car's advantages or its affordances, which have so far 'locked-out' serious competitors. Sheller writes that 'Car consumption is never simply about rational economic choices, but is as much about aesthetic, emotional and sensory responses to driving, as well as patterns of kinship, sociability, habitation and work.'[39] The post-car innovation has to become an object of consumer fashion and cannot simply involve 'loss' and nostalgia for the previous regime that was ideologically based upon the 'freedom of the road'. It has to be a system that is fashionable and faddish, that wins hearts and minds, that is better and more fun. Or as Michael Beard, the anti-hero climate scientist, says in Ian McEwan's climate change novel *Solar*: 'Virtue is too passive, too narrow . . . For humanity en masse, greed trumps virtue. So we have to welcome into our solutions the ordinary compulsions of self-interest, and also celebrate novelty, the thrill of invention, the pleasures of ingenuity and cooperation, the satisfaction of profit.'[40] Major innovations must also avoid the 'rebound' problem: that if energy savings are made in one sphere, people then increase energy consumption in that or other spheres.[41]

Some small change(s) would mean that the car system, that currently seems so locked-in and stable and able to 'drive' out all competitors, may wash away. Strogatz maintains how a 'network appears highly stable and resistant to outside disturbances. Then another seed comes along, seemingly indistinguishable from the others before it, yet this one triggers a massive cascade. In other words, near this

second tipping point, fads are rare but gigantic when they do occur.'[42] They take the world by storm.

A set of potentially interlocking changes is emerging that could innovate a new system comparable in scale and significance to the development of automobility. There are at least eight different components of this division of innovative labour, all of which have to 'advance' and develop appropriate synchronization. These components are: new low carbon fuel systems; much lighter body materials; making vehicles smart; digitizing urban environments; de-privatizing vehicles; sustainable transport policies; new living and working practices; and disruptive innovation from below.[43] There will be a complex international division of innovative labour, with different components needing to interlink in order that such an innovation system is set in motion and can have transformative effects by, say, the middle of this current century. For various reasons such a system would have to be well set in place by then and lead to the wholesale collapse of the present car system.

The current car system is neither secure nor insecure. It may get transformed, but only because some changes at the extreme tip it into an alternative. It is, we might say, 'ripe' for tipping into a phase transition, but that does not mean that it will be tipped. It will tip if the system has reached a 'chaos point' in which the die is less cast and change is just possible through unpredicted developments at the extreme. It *may* be that dramatic increases in oil prices (which seem to have contributed to the Great Crash of October 2008), or an intense series of climate change events within the US or Europe, exploding crises in countless global cities with unbearable congestion, or new philosophies of slow travel, are amongst the extreme events that could so tip the system (as examined in the next chapter).

There are many potential innovators, including here not only large motor vehicle manufacturers, but other large and small corporations, NGOs, cooperatives, universities, software designers, science institutes, local councils, community-owned enterprises and 'consumers'. And uncertain outcomes result from high levels of experimentation and enthusiasm amongst these many users and producers currently scattered across the globe. They could come to develop a kind of synchronized 'cosmopolitan' innovation. Around the world there appear to be a 'new wave of environmental pioneers' developing various low carbon niches within different contexts: 'In short, we need disruptive forms of innovation – cheaper, easier-to-use alternatives to existing products or services often produced by non-traditional players.' This is a question not only of 'new technologies', but of 'wider forms of innovation, such as innovation in organizational

forms and business models' and of these coming to occur within certain globally connected hubs.[44] There is some significant evidence for the importance of such disrupters in China – itself a kind of cosmopolitan disruptive innovation.[45]

So what might a post-car look like? Such a shift to low carbon is complex because a new low carbon system needs to substitute for high carbon and not merely sit alongside it. The complexity of this issue can be seen from the possible significant development of electric vehicles (EVs).[46] There are four ways in which EVs might develop and fit into and/or contest the dominant high carbon car system.

First, there is modest development of EVs but within the general context of a *decline* in all kinds of personal vehicles because of large and persistent oil and other energy shortages. In this future there are no magic bullets to deal with the effects of climate change, the peaking of oil and gas and continued population growth. There are still personal vehicles about but they are mainly repaired and recycled versions of old vehicles.[47]

Second, there is *competition*. Here there is development of EVs by large car companies and they are sold and mostly used just like petrol vehicles. They are expected to cover long distances and so these are large with heavy batteries. Because of the intermittently rising cost of oil, EVs make a significant dent in the market through developing as family cars. They are something of a luxury because of their quietness and apparent 'greenness' (depending on the dominant forms of electricity generation in that society).

Third, there is *complementarity*. The growth of EVs occurs side-by-side with continued use of petrol-based vehicles. There are two systems at least in the rich North. Prosperous households own both vehicles. 'Garages' develop charging as well as petrol distribution functions, and EVs may enable personal vehicles to be used even at times when oil supplies run down or get turned off.

Finally, there is *system substitution*. EVs develop alongside – synchronizing with – many developments including de-privatization systems, smart cards, virtual communications, non-metal bodies, some driverless vehicles, road and neighbourhood redesign, smaller vehicles, smooth interchanges with mass transit and so on.[48] These come to morph into a fully fledged EV system, one that is smarter, quicker, reliable and more fun and fashionable. As this develops, so it replaces petrol-driven cars that now appear as 'so twentieth-century', with low social status. Petrol vehicles are seen as noisy, smelly, dangerous and unreliable, especially if oil supplies are intermittent. A tipping point occurs and many new uses – new apps – for these de-privatized, smart, small vehicles develop. Major companies emerge as leasers of huge

numbers of such vehicles, developing technologies similar to those deployed in El Bicing in Barcelona/Paris. Petrol garages convert into battery replacement centres (this all presupposes low carbon forms of electricity generation).

This substitution may happen first in relatively small, maybe island, societies which are prosperous, with strong 'states' and environmentally oriented 'civil societies' which initiate and experiment with emerging components of these systems (such as Singapore, Hong Kong, Copenhagen). Some developments take place through disruptive innovations occurring in local areas. To develop the post-car EV system, many innovations happen in multiple sites and contexts. This involves not only new fuel systems, new materials and lower carbon ways of generating electricity. It also necessitates new entities developing ways of thinking and designing futures, new kinds of local policies, new digital innovations – some of which seem to have little to do with transport – new systems of de-privatizing movement, new ways of organizing social life 'at-a-distance', and clear unambiguous commitments by governments to prevent this 'digital nexus' developing into a digital state by providing democratic control over surveillance. States can only really develop this if they are or become 'high trust' states.

More generally, there would be multiple, dense forms of movement of small, ultra-light, smart, probably battery-based, de-privatized 'vehicles'. Flexibilized travelling would involve accessing such small, light mobile pods when required. Electronic regulators embedded in lamp posts and in vehicles would regulate access, organize price and control vehicle speed. Some such vehicles would be driverless. The movement of vehicles would be electronically and physically integrated with other forms of mobility. There would be a mixed flow of these slow-moving micro-cars, as well as bikes, hybrid vehicles, pedestrians and mass transport. There would be electronic coordination between motorized and non-motorized transport and between those 'on the move' in many different ways. Smart 'cards' would control access and pay for people's uses of the many forms of mobility. And software systems would 'intelligently' work out the best means of doing tasks, meeting up or getting to some place or event, as already is happening with mobile phone apps.

This model would not involve returning to the *dominance* of publicly owned, managed and timetabled buses, trains, coaches and ships. This system involves the integration – through information, payment systems and physical access – of personal vehicles with various forms of collective or public transport. At the same time neighbourhoods would be redesigned so as to foster 'access by proximity' through

denser living patterns and integrated land use. People would live in denser, much more integrated urban areas that maximize co-presence. Such redesign would 'force' people to bump into each other since their networks overlap, and there will be many 'meeting places' for different groups of people.

This model would involve some notion of carbon allowances as the currency to be allocated, monitored and individually measured, so dramatically constraining much physical mobility. Physical movement would be subject to rationing through price, or need, or some kind of quota. Air travel would be the most heavily rationed form of transport. Much of the time physical travel would be replaced by virtual access. These forms of virtual access would need to have been much more developed so that they effectively *simulate* many of the features that physical co-presence with others currently affords.

The development of this model is unpredictable. The tipping point cannot be read off from linear changes in existing firms, industries, practices and economies. Just as the internet and the mobile phone came from 'nowhere', so if there is a tipping point here it will unpredictably emerge, probably from a set of technologies or firms or governments that are not currently at the centre of the world travel and transport industry. Indeed, I have so far talked of this 'innovation' without referring to its likely geographical location, although it has been implicitly presumed that the origins of the post-car system will lie in the 'rich North'. This is because its infrastructure would be very costly to implement, although much of the 'hard technology' will develop over the next few years.

This future relies upon various technologies becoming combined together so as to produce a post-car system. These components include: CCTV cameras; data mining software; biometric security; integrated digital databases; the embedding of digital processing within the environment and moving vehicles; Radio Frequency Identity (RFID) implants to track objects and people; automated software systems for allocating road space; smart code space to determine the route, price, access and speed of vehicles; sensors and processors to enable vehicles to self-navigate; and the likely tracking and tracing of each person's carbon allowances and carbon expenditures. The costs may make it globally impractical to implement on an extensive scale even if some prototype cities were able to develop it (such as city states like Singapore or Hong Kong). It would require vast sums to develop such a system in the emerging mega-cities of the 'poor South'. Huge investment by private companies and large amounts of 'aid' from the rich North to the poor South would be necessary for its development as a globally influential innovation,

analogous to mobile telephony or the internet. And because petrol-based cars are everywhere, so this has to be a *global* post-car alternative to what Sperling and Gordon dramatically refer to as the potential of *Two Billion Cars* on earth.[49]

Further, the digital developments necessitated by such a post-car innovation will be intrusive and threaten civil liberties. Already many states are seeking to integrate different databases that contain 'private' information on each person. This further extension would link that information with data on each person's movement by personal vehicle, and in due course by that involving public transport (as happens now for air travel). This would limit the 'freedom' to walk, drive or move without record and without connections being made with other information held about each person. It is likely that such 'smart solutions' would be contested in the name of 'freedom', especially within 'democratic' societies and where there is little 'trust' in the state. Janette Webb suggests that few people in Scotland, which has a better 'trust' record than the UK as a whole, do in fact trust government websites, scientists or publications. This is by comparison with the relatively high trust people have in TV and radio news, documentaries and, interestingly, independent scientists.[50]

Such contestation, at a time of many other conflicts around security and population management, will make such a system bitterly fought over, a new politics of mobility in which the threat of climate change and the peaking of oil may engender new systems of global governance with certain developing societies in the lead. Such societies do not have anything like the same investment in the current car system. Innovations could enable societies to leapfrog: the 'first shall be last and the last shall be first'. A version of this can be seen in how mobile phones have in a way become more influential in some poorer countries because there was less economic and social investment in land-line technologies.[51]

So it is just possible that the post-car system could in fact develop outside the rich North, in places where the car system is less omnipotent and there are already some elements of a new system. China could just about still be that place but this would need to develop incredibly rapidly given the increasing power of the car system, especially in more 'advanced' parts of emerging China. Ominously, according to Arthur, system innovations have not in the past developed rapidly and will not in the future. He argues: 'A revolution does not arrive until we reorganize our activities ... around its technologies, and until those technologies adapt themselves to us. For this to happen, the new domain must gather adherents and prestige. It must find purposes and uses ... This time is likely to be decades, not years.

And during this time the old technology lives on', driving out or locking-out the new, such as low carbon vehicle systems.[52]

Conclusion

This chapter has thus set out some of the preconditions for the development of one particular low carbon system. Obviously it would be necessary to develop similar analyses of other such systems and also to imagine how they might interconnect, transforming in a positive way the environment within which each would operate. In investigating such a system I examined the likely complex division of innovative labour, and hence the need for synchronization to occur across very different 'agents' located within a range of societies. It was suggested that a 'disruptive cosmopolitan innovation' might be the right way to imagine such a system coming to be developed and being implemented worldwide.

But we need further to ask whether it is really possible that such an innovation system will be established, so that future avant-garde novelists (if the 'novel' has persisted as a relevant genre!) cannot imagine life without driverless vehicles, smart cards, zero emissions and virtual meetings that have all become the real thing (a Virginia Woolf for the post-car digital age). And could this different system develop fast enough and across sufficient societies to ensure huge reductions in travel-related carbon emissions within two to three decades?

If this and a cluster of other related low carbon systems do not get initiated very soon, then some other bleaker scenarios are likely by the middle of this century. Such future scenarios are examined in the next chapter, including further aspects of what a low carbon personal travel system might be like if it were ever to materialize and displace the car and its extraordinarily powerful friends.

9

Alternative future societies

Introducing futures

In this book I have provided a social science interpretation of the nature, form and patterning of potential climate change. I tried to place the social at the heart of the analysis of such potentially changing climates. In this chapter I consider some of the possible futures that lie in store for different societies over the next few decades. Stoekl, in examining Georges Bataille's analysis of energy, maintains that we will all be forced to become futurologists, whether we like it or not.[1] It is now clear just how energy is crucial to this new century: without sufficient energy and harnessed in the right long-term way, many societies and many lives will reverse from their apparently inevitable high carbon trajectories. We all need to be thinking futures even if doing so is immensely difficult. Keynes importantly wrote: 'human decisions affecting the future, whether personal or political or economic, cannot depend upon strict mathematical expectation ... it is our urge to activity which makes the wheels go round'.[2]

There are different ways of developing models of future societies. I term these the normative, the extrapolation and the building of scenarios. The first involves developing notions of what a future society should or could be like. Often such a future society derives from the critique and rejection of all or certain features of many existing societies. Such utopian thinking has not been well regarded in social science – although, used in certain ways, it can bring out important connections between elements which might comprise such a future society. It can also hold up a mirror to existing societies and demonstrate their limitations in many different ways. Moreover, such a Utopia may also be brought into being, in part by inspiring social

movements to organize so as to bring the Utopia at least partly to fruition.[3] The Utopia can thus become something of a self-fulfilling prophecy. In relation to contemporary environmentalism, there are many such futures – often organized around the Utopia of the 'sustainable society' – predicting how life should be organized.[4] The obvious deficiency of such normative notions of the future is that they often do not specify how to get from existing societies to such a future, and especially what would be the constellation of social forces that might bring about such a transition. So, in much utopian thinking, 'society' can also be largely absent, especially in terms of the processes that might or could realize the Utopia in question.

Second, there is the widely used technique of extrapolating from existing societies. This is particularly common and is the main form taken by much social forecasting. Here, often, time series data are examined and linear extrapolations are then drawn from the recent past into the near or distant future. What is problematic about this is that over time there are almost certainly crucial changes in the relations between the different elements or components of a society, and these will not be reflected in such linear extrapolations. Extrapolations may well underemphasize possibly dramatic non-linear changes, especially those brought about by unpredicted extreme events.[5] These extreme – rather than average – events can provoke reversals or sharp breaks of the sort emphasized in the potentially catastrophic processes that we have been considering in changing climates or the peaking of oil.

Such extreme events can be taken into account in scenario building, which is the third futures technique.[6] This involves first setting out various scenarios for a future year in the light of known trends, the drivers of change and, most importantly, what we know of the character and nature of economic and social life and processes. Then there is establishing those events and processes that would have to happen and when, in order that each scenario would be realized by that particular time. This involves imagining the interdependent effects of economic, social and resource events and processes upon each other in the future, and hence upon likely future outcomes. This is, of course, beset with uncertainty because of the role in history played by extreme events which mean that 'we do not know what we will know'.[7] If those events are likely to happen, then that makes plausible the scenario in question and certain policy lessons can be drawn so as to help bring about that particular future if it demonstrates desirable characteristics. As a result it can be determined which of the different futures seem most likely to happen, or at least those least unlikely to occur. It is also important to distinguish

between three kinds of future: possible, probable and preferable. And the last of these, preferable futures, are often neither probable nor even possible. Moreover, even preferable futures are likely to involve winners and losers. So achieving one set of goals almost certainly means not achieving other goals. Scenario building, as described here, makes it clear that there is no single best future.

In considering various future scenarios below, one 'new' system also needs to be briefly examined. This is the emergence since around 1990 of the system of 'digital worlds' which is central to the analysis in this book. Digital systems both are significant consumers of energy and resources and also have great potential for reducing some kinds of energy use if they are widespread and able to displace, or be combined with, other systems and their energy requirements.

Digital worlds

Since around 1990 there has been a significant change in the context of human life. Until then, two distinct kinds of things provided the background to everyday lives. First, there was the 'natural world' of rivers, hills, lakes, soil, storms, crops, snow, earth and so on. This physical world provided the taken-for-granted background during almost all human history. Second, there was the background made up of the 'artificial' objects of the Industrial Revolution from the eighteenth century onwards, such as trains, pipes, steam, screws, watches, lights, paper, radio, cars and so on. This background gradually spread around the world, especially during the twentieth century as higher carbon lives became common and pervasive.

But from 1990 onwards, a third background emerges.[8] This background is the world of 'virtual' or 'digital' objects. These include computer and mobile screens, cables, computer mice, signals, satellites, ringtones, texts, sensors, software and so on. In the background of twenty-first century life are these many material and virtual objects, hovering and often taken-for-granted. Some such backgrounds are themselves 'smart', sensing, adapting to and transforming lives more interactively. Many such virtual objects are only noticed or remarked upon when they break down, which they intermittently do.

Such digital objects are developed by private-sector corporations as well as by disruptive innovators. They are dependent upon software that makes it certain that actions are normally unexceptional and unproblematic. The software means that the product can be purchased, the meeting will happen, the hire car is ready and waiting, the

components will arrive at the factory, the plane can be boarded, the message will get through, the money will arrive, the friends can be met, and so on.

According to Castells, the growth of such micro-electronics-based communications technologies transforms the nature of life.[9] It leads from more hierarchical to more horizontal ways of organizing economic and social life. Especially important was the 1990 'invention' of the World Wide Web and the resultant networking of computers around the world via cables, masts and satellites. This system enables the (mostly) seamless jumps from link to link without regard to some of the conventional borders of country, language, subject or discipline. Such a novel language, architecture and network initiated an astonishing array of digital projects, services and sociabilities. With information becoming 'digital', it is less tied to place. Information is everywhere. The futures discussed in this chapter all presuppose some significant role for the digital worlds and communication power initiated in the most fateful of decades at the end of the high carbon twentieth century. Castells summarizes how: 'What is specific to our world is the extension and augmentation of the body and mind of human subjects in networks of interaction powered by micro-electronics-based, software-operated, communication technologies. These technologies are increasingly diffused throughout the entire realm of human activity by growing miniaturization [and portability].'[10] Central thus to much human experience are flickering 'screens' increasingly carried close to, or often now on, the body, and in the future likely to be in some way merged into a 'sixth sense' through gesture and projected data screened onto people's clothing and surroundings.[11]

The rest of this chapter involves the examination of a number of possible future societies for the middle of this century. All such futures presuppose a significant positioning for digital worlds. However, one danger of scenario building is to over-emphasize the power and significance of new technologies. Many visions of the future have not at all unfolded as technology optimists predicted. There is a strong danger of technology-hubris since there are many 'failed technology futures'. This is another reason to establish and assess *alternative* scenarios, especially noting that few, if any, 'technologies' emerge and impact upon society in anything like the ways in which technology developers, corporations and policymakers ever imagine and predict.[12]

Matters unfold in ways less 'planned' and more socially 'situated'.[13] As Molotch brings out, 'stuff' comes from diverse roots and routes. Developing new stuff is not inevitable. How and why a whole system of production and consumption is established are relatively contingent and a matter of fashion, desire and place. He concludes from studying the assorted 'innovations' of toasters, toilets, cars and computers, that 'production success comes from the cultural currents that make up social life in general and from all over the world'.[14] This must be strongly recognized in the case of low carbon innovations. They too will not turn out as intended. What we should consider in analyses of different futures is, paraphrasing Molotch, 'where does low carbon stuff come from?'. We can be sure that it will not be coming from where we had thought!

There are three further important points about such digital futures. First, fears over security and safety reached high levels in the opening decade of the twenty-first century. These are times of emerging risks, uncertain 'enemies' – what some refer to as a post-millennium state of 'insecurity'. A terror suspect can no longer be easily identified as 'the enemy', and so all civilians can be categorized as 'potential terrorists'.[15] Digital worlds have initiated a 'battle zone' where security issues of surveillance, tracking and identification are played out through new ways of tracing populations. This battle zone is especially found at transport hubs where meetings proliferate and travellers are rendered temporarily static.[16] Future transportation will build digital security into the infrastructure, and this will monitor and regulate 'mobile individuals' and assess the potential threat of attack. Transport security and monitoring are emerging markets for new kinds of 'security' corporations.[17] Virtual objects are part of the background experience of many sites where people are or might be on the move. New virtual objects will be built both into 'vehicles' and into street furniture, roads, lampposts and meeting places in major cities where much of the world's population currently lives and seeks to move around.

Second, whatever digital worlds there are, so far 'lives on the screen' seem less satisfying than co-present meetings. Meetingness is a crucial human property and value, the stuff of social life. Co-present talk is embodied and may involve food, drink, music and a shared physical place, places that are temporarily full of life. Thus what needs development is a virtual meetingness that effectively substitutes all, or at least most of, these affective pleasures of being present with others face-to-face, emotion-to-emotion, sometimes body-to-body. So far there is no digital technology that achieves this but some such development would be necessary in order to bring about effective substitution of movement with a 'digital co-presence'.

Third, digital worlds are much more carbon energy-intensive than previously realized. Even humble Google searches use Google servers located in at least thirty to forty vast data centres that are spread

around the world. Such energy costs will be especially high in the future if very large bandwidth is developed so that a life of the screen does come to involve the effective simulation of the affective qualities of meetingness in the way I have just proposed.[18]

A number of future scenarios for the middle of this century are now elaborated.[19] To varying degrees, they each interrelate with such digital worlds in the construction of the future vision. Unlike most scenarios, these attempt 'whole society' futures and do not consider just one or two elements, such as future transportation or future energy. The first scenario is that of hypermobility and hyper-consumption.

Perpetual consumerism

The patterns of mobile lives based on new communication and transportation practices develop on an extreme scale. Resource shortages and the effects of climate change turn out to be much less significant, at least for those living in the rich North. Their patterns of movement and consuming food, objects and services become more extensive, frequent and utterly part of most people's very 'persona'. There does indeed turn out to be a technological fix, with energy becoming relatively cheap and its emissions of limited global impact. Probably the most likely source of energy use and storage is a hydrogen-based economy of the sort advocated by Rifkin.[20] This is not business as usual but the development of a new source of more or less limitless and emissions-free energy.

This is a 'hyper' world, with people 'always on', with messages and individual media continuously streamed to miniature intelligent devices, especially when 'on the move', which people would be much of the day and night. Devices connect consumers directly with global wireless networks. The lifestyle and retail advantages of an 'always on' connection mean that devices manage personal finances, using 'agent-based' technologies to switch funds automatically between different assets and purchases. They also make arrangements and even friendships and appointments with others chosen smartly for their presumed compatibility. More generally, people are forced into a life of 'distant connections' through others being on the move – hence the even more extensive development of miniaturized communication devices, some implanted and constituting the basis of smart connections, friendships, consumer purchases and practical arrangements.

There is also extensive telepresencing, involving both videoconferencing and virtual reality to create three-dimensional, high-speed,

fluid interactions across different geographical locations. The software automatically stitches together feeds from several cameras by integrating the visual data with each camera's location and the direction in which it is pointing.

Average citizens travel four to five hours a day, so overcoming the notion of a constant travel time. Personalized air travel, São Paulo writ large, would be common through hydrogen fuel cells. Cars would be unfashionably stuck on the ground as a Corbusier-inspired future beckons many into the skies, including regular flights into space with Virgin Galactica. There would be regular trips into at least inner space.[21] The final frontier would indeed be overcome, with space travel fully privatized and the long decline of the idea of space travel reversed with the neo-liberalization of multiple 'rocket dreams'.[22] Almost all would be able to be 'Up in the Air'.[23]

In this scenario most people study elsewhere, they migrate frequently, they regularly meet and remeet with family, they often see long-lost friends, they go shopping on the other side of the world, they go on a holiday to the Moon with others, and so on. And because people seek to do these things with other people who are geographically distant and constantly moving, so they travel and communicate frequently and over long distances. Living a 'networked life' with most members of one's network being far-flung is worldwide and generates an enormous burden of very fast travel, constant communications and smart purchasing in order to keep up.

Underlying this scenario is the notion that social status is derived from high levels of smart consumer goods and especially long-distance machine-based movement. It is presumed that fast travel is a powerful 'positional good'.[24] Consumption here is conspicuous, so that the fast car or access to a personal plane is meant to be seen, commented upon and generative of status. Travelling long distances and having far-flung connections with those in other societies are major bases of social status, except of course for those who are forced to be migrants or exiles.

Electronic communications do not *substitute* for physical travel but enhance it and provide further ways in which consumption is made conspicuous and enhancing of status. This is global so it is difficult somehow to stop those living in one society from engaging in such perpetual motion with significant others, and such reductions would anyway reduce economic and social wellbeing. So much life is lived 'on the screen', but this is still not as attractive and position-enhancing as travelling to be with others in one's networks from time to time, even if that network is smartly organized in terms of digital connections.

In this highly connected world, social life and work are intense, and the boundaries between them increasingly blurred. Some thrive on the buzz of activity that results, but early burn-out is common and stress is a way of life for most. Even low-paid service workers are so used to being 'always available' that holidays are no longer a break. Stress is undoubtedly the major new health issue costing a significant proportion of any society's national income.

This scenario is less preferable to certain others because societies based on such high levels of movement will be highly unequal, with access to network capital being a major source of social inequality by class and gender. This scenario is certainly not probable. However, it could just be that an unexpected 'technological fix' does occur that dramatically changes energy costs and availability, which somehow makes mass movement – especially above the ground – and multiple communications more or less cost-free. This has been described elsewhere as the *Star Trek* vision of the future.[25]

Local sustainability

The second scenario is what many environmentalists argue for, namely a worldwide reconfiguration of economy and society around practices of 'local sustainability'. This Schumacher model would involve a network of self-reliant (and probably physically semi-isolated) communities in which people would live, work and mostly socialize. Its emergence would roughly follow the 'transition timeline'.[26] This scenario would involve a dramatic global shift towards lifestyles and energy requirements that are more local and smaller in scale (and in some ways 'less efficient' because of reduced economies of scale). The carbon cost of everything would be measured and circulated; this would be the common currency to be used as the basis of economic value and social priority. We would know and deploy the 'carbon footprint of everything'.[27] Almost certainly there would be a reduced level of environmental injustice – that is, the inequitable treatment and involvement of people, especially minorities and those on low incomes – with respect to developing, implementing and enforcing environmental laws, regulations and policies.[28]

Friends would have to be chosen from neighbouring streets, families would not move away at times of new household composition, work would be found nearby, education would be sought only in local schools and colleges, the seasons would determine which and when foodstuffs were produced and consumed, and most goods and services would be simpler and produced nearby. There would be a less pronounced international division of labour and a refocusing of economics upon resources and local energy.

It would be unfashionable to live and bring up children in anything apart from 'compact cities' (as suburban living, by contrast, became so fashionable in the middle years of the twentieth century). Status attributions would be relocalized and long-distance mobility would not be a positional good. This scenario depends upon new kinds of 'friendship', on choosing to know mostly those who live close by and who can be accessed nearby. This would also require people to be unperturbed by a lack of long-distance travel and connection. Long-distance travel based on 'choice' would be uncommon and a source of low status. Indeed, the value of choice would need to be relocalized.

There would have to be extensive building of such new local 'communes' to facilitate such localism. Planners, politicians and citizens would collaborate in the redesign of urban and rural centres, with neighbourhoods and mobility/communication systems focused upon local access and high-level facilities.[29] There would need to be some distinct new materials and techniques to enable the building of such compact cities. Indeed, the development of such compact places requires new kinds of private–public–community partnerships simultaneously able to develop new urban forms, related transport and decentralized self-supporting small local communication nodes.[30]

Such a 'contraction' in human affairs would open up opportunities for more revitalized and cooperative community-based social relations. Kunstler predicts that 'the twenty-first century will be much more about staying put than about going to other places'.[31] In an extreme post-peak oil scenario, cars would be a luxury creating resentment amongst those unable to access them. This could lead to vehicles being vandalized or drivers subject to abuse. Kunstler maintains that the future will involve comprehensive downscaling, downsizing, relocalizing and the radical reorganization of lifestyles. He states that: 'Anyway one might imagine it, the transportation picture in the mid-twenty-first century will be very different from the fiesta of mobility we have enjoyed for the past fifty years. It will be characterized by austerity and a return to smaller scales of operation in virtually every respect of travel and transport. It will compel us to make the most of our immediate environments.'[32] Many forms of life will be locally centred and concentrated. Because much movement will be local, so feet, the bike and many new low carbon forms of transport will be found alongside recycled cars and trucks.[33]

This scenario could develop in response to dramatically decreased availability of cheap energy and increased global contestation. The

intense economic meltdown triggered by the decline of the US economy could generate a global push to local sustainability, as discussed in Kim Humphrey's critique of many forms of *Excess*.[34] Alternatively, this shift could result from climate change/environmental disruptions and resulting social conflict, especially over resources such as oil, water and food. If these disruptions are critical, then this could produce increasing disenchantment against consumerist and especially mobile lifestyles. Values of community and eco-responsibility could in a global crisis come to be viewed as more worthwhile than those of consumerism, competition and unrestrained mobility. Especially significant would have to be the reversal of many of the financial innovations of the neo-liberal period which so detached resources from finance. This scenario implies that localized resource capitalism somehow can emerge separate from and uninfluenced by the development of the vast scale and potentially catastrophic impacts of trading in financial derivatives.[35]

However, this scenario of local sustainability and a move along the 'transition timeline' is possible but not probable. It requires the reversal of almost all the systems of the twentieth century, as well as a much smaller global population. The commitment of the BRICs (Brazil, Russia, India, China) to developing western-style consumerism and movement makes this particular future hard to realize, unless it were to arise through a profound global crisis. There would have to be a restructuring of economic activities and the de-globalization of economy, finance and social life. There would need to be the large-scale reduction in the conventionally measured 'standard of living'. It is hard to see all the events occurring that seem necessary for the emergence of this scenario across the globe. If climate change and peak oil effects are overwhelmingly significant, creating a new 'global disaster', then the next scenario is more probable than that of local sustainability, but less preferable.

Regional warlordism

In another report, a possible future of 'Barbarization' is imagined. Here the 'socio-ecological system veers toward worlds of sharply declining physical amenities and erosion of the social and moral underpinnings of civilization'.[36] In this 'barbaric' future, oil, gas and water shortages and intermittent wars lead to the substantial breakdown of many of the production, mobility, energy and communication connections, especially through many climate change threats to

various critical infrastructures.[37] In this de-civilizing energy-starved future, there would be a plummeting standard of living, a relocalization of mobility patterns, an increasing emphasis upon local 'warlords', and relatively weak national or global forms of governance. There would be no monopoly of physical coercion in the hands of legitimate national states. Tribal and other wars within countries would be increasingly common.[38]

Given the huge shortages of energy, it is likely that many infrastructural systems would begin to collapse and there would be increasing separation of production and consumption between different regions. These warlords would control recycled forms of mobility and weaponry, with increasingly localized recycling of bikes, cars, trucks and phone systems. Much of the time they would not be working. Cars and trucks would rust away in the deserts or would be washed away in floods. Certain consequences of climate change may partially rectify themselves as oil and other resource use declines, and overall world population would plummet, although what is crucial about GHG emissions is their overall total and not their annual rate.[39]

Systems of secure long-range mobility would disappear, except for the super-rich. As in the mediaeval epoch long-distance travel would be risky and probably not undertaken unless people were armed. The rich would mainly travel in the air in armed helicopters or light aircraft. Each warlord-dominated region would potentially be at war with its neighbours, especially for control of water, oil and gas. With extensive flooding especially of the seaside places of twentieth-century excess (beginning with Dubai?), extreme weather events and the break-up of long-distance oil and gas pipelines, these resources would be fought over and defended by armed gangs.[40] Those able to live in gated and armed encampments would do so, with the further neo-liberal privatizing of many collective functions.

Some cars and trucks will remain but they would mainly be rusting versions from previous decades. Enormous efforts and skill would be deployed to keep these wrecks moving and to stop them being commandeered. The use and re-use of cars in some developing societies indicates the kind of improvisational, tinkering cultures that would be likely to develop.[41]

The movie *Mad Max 2* depicts this future through a bleak, dystopian, impoverished society facing a breakdown of civil order resulting from extensive oil shortages, and where power rests with those able to improvise new mobilities, including short-term flight.[42] Oil is indeed black gold in *Mad Max 2* scenarios.

This scenario could be described as 'Fortress World'. Richer warlords would break away from the poorer into fortified enclaves.

Beyond these enclaves there would be terrorists, refugees or slaves. In Fortress World:

> the elite retreat to protected enclaves, mostly in historically rich nations, but in favoured enclaves in poor nations, as well . . . Technology is maintained in the fortresses . . . Local pollution within the fortress is reduced through increased efficiency and recycling. Pollution is also exported outside the enclaves, contributing to the extreme environmental deterioration induced by the unsustainable practices of the desperately poor and by the extraction of resources for the wealthy.[43]

This scenario involves 'walled cities' similar in some ways to those in the mediaeval period, providing protection against raiders, invaders and diseases; hence this could be said to be a 'neo-Mediaevalist' vision of the future. As noted above, emerging global relationships have already been termed 'climatic genocide' with millions forced to migrate away from global climate change risks, risks so far mainly experienced in the poor South.[44] Life under this scenario, as already prefigured in parts of the poor South in the contemporary world, would be nasty, brutish and 'shorter'.

Low carbon, digital networks

There is a fourth future, more preferable than the last but still full of risks and dangers. I noted how adherents to the neo-liberal shock doctrine hold that crises can be productive in generating vast, clean canvases ready and waiting for rounds of new investment.[45] Thus, economic and social forces across the world could find that the combination of energy starvation and climate change provides opportunities for developing what Perez terms a new 'technological paradigm' – in this case, a low carbon 'economy-and-society' paradigm.[46] Such a crisis could provide just that clean slate to force through a low carbon, digital networks paradigm, based on the creative destruction of many existing technologies and their frenzied replacement by huge investments in this new paradigm and in deploying new financial instruments. It is similar to what Sperling and Gordon call 'Futurama III'.[47]

First then, this paradigm would involve large investments in 'local e-communes', involving networks of self-reliant communes in which people live, work and mostly 'recreate'. This would involve shifting towards 'social practices' more local and smaller in scale. Status would be relocalized with long-distance travel being uncommon.

'Success' would be measured by developing and practising low carbon lives. There would have to be extensive building (hence high carbon costs) of such new local 'communes' to facilitate this localism. Each town would have to have some special characteristic in order to attract *and* to keep residents there and dissuade them from travelling elsewhere. Software would 'intelligently' work out the best means of doing tasks, whether this involves getting to some place or event or more desirably staying put.

There would be redesign of neighbourhoods so that access would be generated through more dense patterns of living. This redesign would 'force' people to bump into each other since their networks will overlap, and there will be many 'meeting places' for different groups of citizens.

As noted, when there is travel, this would be likely to involve small, ultra-light, smart, probably battery-based 'vehicles' that would be hired, like bike hire currently in Paris or Barcelona. Streets would be full of often speed-controlled micro-cars, demand-responsive mini-buses, bikes, hybrid vehicles and pedestrians, seamlessly integrated together with larger-scale public transport. Smart 'cards' would control access to forms of movement and ensure appropriate payment. Some vehicles would be driverless. There may be a tipping point when personal vehicles come to be combined with a 'smart' infrastructure so as to develop an integrated network rather than separate 'iron cages'.

There would be electronic coordination between motorized and non-motorized transport and between those 'on the move' in many different ways. There would be the integration – through information, payment systems and physical access – of personal vehicles and collective forms of transport.

This society would necessitate the use of carbon allowances as the currency that would be allocated, monitored and individually measured, so dramatically constraining much physical movement and other consumption forms. Where movement does occur, then this would be subject to rationing through price or need or some kind of quota, so that new low carbon mobilities were not more extensively used as they became cheaper.

Much physical travel would be replaced by virtual travel. Forms of virtual access would effectively *simulate* many features of physical co-presence with other people. An early version of this is the Halo system of videoconferencing that simulates a boardroom. As the website promises: 'Halo gives the sense of being in the same room together. And best of all, it's right down the hall.'[48] Tele-immersion environments may simulate the pleasures and especially

the complexities of face-to-face interactions. It will enable users in different locations to collaborate in a shared, simulated environment as if they are in the same physical room. Computers will recognize the presence and movements of individuals and objects, track those images, and then permit them to be projected in realistic, multiple, geographically distributed immersive environments where people feel that they are 'interacting' with each other, with all the complexity that entails.[49]

If we backcast from 2050, then this would indicate that this future would be likely to follow dramatically decreased availability of cheap energy and increased global contestation through the peaking of oil, or economic/financial meltdown, or climate change/environmental disruptions and resulting social conflict. Components of this system are in place and this is a distinctly possible future scenario, as set out in chapter 7. However, there are some major complexities.

First, such an infrastructure would be very costly to bring about and would require huge new levels of financing. Some of the 'hard technology' will be found in cities in the rich North over the next few years. But at a time of increasing resource constraints because of climate change and financial crises, the costs mean that it is unlikely to be developed on a global scale. It would require vast sums to develop such schemes in the mega-cities in the poorer part of the world. Huge investment by private companies and large amounts of 'aid' from the rich North to the poor South would be necessary. But even then there is the Jevons paradox: the more efficient we make the cars that are developed – such as low carbon cars – then the more they will get used, and hence the less energy that will be saved. To offset this Jevons paradox, it is almost certain that significant rationing will be needed.

But rationing is a problem. Many of these digital developments threaten various rights.[50] They transform the nature of the individual person. Already many states are seeking to integrate different databases that contain 'private' information on each person. This further extension would link that information with data on each person's movement by personal vehicle and public transport (as now with London's Oyster card when registered). People and their movement become recorded and classified.

These 'smart solutions' will be especially contested, particularly at a time of many other conflicts worldwide. In this scenario, the future of *human* life may depend upon moving across a tipping point to the 'digitization' of each self and the integration of multiple databases (what China calls the 'Golden Shield'). Such a system of tracking and tracing will involve noticeable changes to the very fabric of social life,

freedom of movement and lifestyle practices. This bargain could involve a digital 'Orwellian-ization' of self and society, with more or less no activity or movement without digital tracing and tracking. Achieving that would require exceptional political leadership worldwide to ensure that personal rights are significantly protected. With large private-sector corporations devising many new 'security products', there are good reasons why an illiberal securitized future is a likely outcome in this scenario.

Thus, to summarize, this new low carbon technological paradigm is a possibility. In order that it could take root in a significant number of societies, it would necessitate all the following preconditions being implemented so that it might prosper and relegate existing high carbon systems to history:

- *re-designing* by public sector, corporations, thinktanks and NGOs of places, computers, personal communication devices, so as to tip societies towards a 'post-oil' pattern
- developing *low carbon financial investments* and new financial instruments on a vast scale, focused upon investing in this new paradigm
- *innovating*, through multiple 'users' of consumer communities engaging in product modification, making fashionable various alternatives and developing through 'we-think' new forms of collective innovation
- *encouraging 'access by proximity'* through redesigning neighbourhoods and patterns of living and so developing post-suburban 'social practices'
- *developing democratic participation* and effective political leadership so that with new mobilities personal rights are developed rather than the generation of a 'surveillance state'
- *simulating* physical co-presence through virtual travel and hence reducing the frequency of physical travel; developing virtual environments to simulate the pleasures and complexities of F2F interactions
- *innovating software* systems that 'intelligently' work out the best means of doing tasks, whether this involves meeting up or going to some place or event, or not
- *developing multiple, dense* forms of movement made up of small, ultra-light, smart, probably battery-based, de-privatized 'vehicles', with smart 'cards' controlling access to and paying for people's use of the various mobility forms; *regulating access*, organizing price and controlling vehicle speed, with some vehicles driverless, through embedding electronic regulators in street furniture and

vehicles; personal vehicles to become electronically *integrated* – through information, payment systems and physical access – with collective forms of transport
- *reengineering 'success'* within societies so that personal and financial gain comes to be measured by social practices and innovations that are low carbon.

This is a formidable set of requirements for a lower carbon economy-and-society. If it does not come to develop, then one or other future scenarios is more likely.

Multiple futures

I have suggested that there are four scenarios for the middle years of the twenty-first century. These can be described as the Corbusier, Schumacher, Hobbesian and Digital scenarios. None of these are without costs for human lives, democracy and social life. They all entail new kinds of vulnerabilities.[51]

And none of them is simply preferable, although the last has significant advantages in substantially reducing, in the long run, carbon emissions and dependence upon oil. None is obviously the most likely to develop. So whether and to what degree high energy lives continue is debatable. The reason for this constrained set of alternatives is the twentieth century, with its unprecedented energy production and consumption that paid little attention to future generations. The message with regard to mobility was 'drive and fly now' using the almost free energy of oil, and the future was seen as looking after itself. We now know that the future will not look after itself and, indeed, that the frequent consumers, drivers and flyers may soon be grounded for good if certain scenarios for the middle of this century are realized.

10

A manifesto for bringing society into climate change

> We have deployed more energy since 1900 than all of human history before 1900.[1]
>
> John McNeill

There is such a thing as society

In this book I have developed an analysis in which 'society' in many different aspects is systematically brought into thinking through the nature of climate change and its complex ramifications within the contemporary world. I have tried to show that 'society' is both the problem and mostly the solution.

Overall, climates have been thought of as fixed and unchanging. So, while weather changes, climate does not. But over the past two or three decades, various climate sciences have shown that climates do in fact change and that very recent human behaviour may be contributing to some 'strange' changing climates.[2] The notion that climates are not necessarily fixed has become widely accepted by policy-makers and commentators and is becoming well established amongst a significant proportion of the world's population.

Central to climate futures is, it seems, 'human behaviour'. This is reasonably well understood but the discipline that has so far captured, represented and modelled such behaviour is economics, as in the *Stern Review*.[3] But to the extent that economics is dominant in investigating changing climates, the less likely policy-makers will be to be able to engender the social-and-physical preconditions for a low carbon economy-and-society. We have recently come to

understand that economics is partly performative, especially of markets, including the development of even a market for emissions.[4] In this it performs a model of human behaviour that is individualistic and utility-maximizing; and in so doing it turns individuals into utility-maximizers.

In this book I try to show that it is not individuals who have to change but social-and-physical systems. Hence the social sciences need to displace individualistic economics from its dominant role. And this needs to happen fast so that new systems can generate positive feedbacks upon each other, taking them away from the existing patterns being performed by utility-maximizing individuals or firms as powerfully modelled by conventional economics.

Such systems are not just economic or technological but also presuppose patterns of social life which come to be embedded and relatively unchanging for long periods, such as the 'steel-and-petroleum' automobility system or suburban living.[5] Such high carbon systems have got into social life. And that is why I refer to the 'economy-*and*-society'. Systems both form and presuppose habits. These habits are the stuff of social life and are not easily changeable, certainly not by states when they seek to instruct people to change their behaviour. Such instructions are often rightly seen as utterly hypocritical, especially where many people have low trust in their state and in other major institutions. The rich and powerful with their many houses, 'servants' and first-class or private travel have a carbon footprint many times greater that most and are hence the least appropriate to be instructing others as to their carbon excess! Hypocrisy is a major issue in questions of climate change mitigation leadership.

I showed how during the last few centuries, and especially in the twentieth century, various high carbon systems were established within societies of the 'west'. This seems to be so significant that some geologists refer to this period as a new geomorphological era, the 'anthropocene'.[6] Societal changes have brought about high carbon forms of life, as well as vast population growth and growing GHG emissions qualitatively different from previous eras. The main conclusion then of this book is that sociology shows the importance of systems and systems do not often change. They are locked-in.

Especially important within these twentieth-century path-dependent patterns are interlocking carbon interests, the 'carbon military–industrial complex' operating in most societies and, above all, globally. This complex seeks to develop and extend major carbon-based systems, the carbon economy-and-society. This is a kind of class politics centred around interdependent systems, including electric power

and national grids, the steel-and-petroleum car system, suburban housing filled with household consumption goods, technologies for networking at-a-distance, distant specialized leisure sites visited from afar, and aeromobility with its multiple airspaces. Central to most of these systems is oil which, as much as money, makes the world go round. And these, in their interdependence, form complex interests which directly and indirectly undermine or misrepresent or minimize the still being formed sciences of climate change.

In order to overcome these carbon interests and this high carbon world, there would have to be a speedy shift onto a new set of path dependencies, an interlocking set of low carbon systems. This would be a bit like the inter-war period in the US when the current set of high carbon systems were set on their fateful journey.

And yet such a widespread system shift will almost certainly take decades, judging by historical evidence from previous paradigmatic system shifts. Partly this shift involves establishing and examining the characteristics of a sustainable low carbon 'economy-and-society'. It is urgently necessary to develop not post-modern but post-carbon thinking and practice, in order to delineate how such alternative paths might be formed and sustained. This is especially so given how more and more energy sources, many of which are not expanding in scale, are being used both to produce energy and to offset the boundless energy of the sun.[7]

Having established what a low carbon 'economy-and-society' might be like, the crucial need is for social science analysis of how to move from here to there, to societies comprised of interlocking low carbon systems. Such systems will on the face of it provide lower levels of measured income, economic wellbeing and population, at least for those in the rich North. And moving from here to there is a matter not only of policy prescription or of transformed economic incentives, but of transforming patterns of social life within most domains, as well as effectively countering the power and embedded interests of the carbon military–industrial complex. The scale of changes needed here is dramatically summarized by the US National Intelligence Council: 'an energy transition, for example, is inevitable . . . An energy transition from one type of fuel (fossil fuels) to another (alternative) is an event that historically has only happened once a century at most with momentous consequences.'[8]

If we examine a single 'society', then it seems that shifting to a low carbon path is more likely to be possible, the more equal and 'deeply' democratic the society in question, the greater the scale of local social experimentation, the more that decisions can be taken locally – or at least nationally and not globally – and the greater the finance, human

capital and social capital that can be moved into a range of post-carbon programmes, initiatives and experimentation at many levels, on many scales and by many types of agent. The more economies are globalized, the more difficult it may be to develop many kinds of low carbon systems, especially where these depend upon innovations and investments taking place and 'owned' elsewhere. Some degree of 'de-globalization' might be productive in enabling prototype low carbon economies-and-societies to get established and provide models to be copied by other societies. In economics there has been a strong argument that 'infant industries' should be constructed behind tariff barriers. That does not seem quite right here, but certainly it should not be assumed that the more globalized a society the better it will be. The trouble is that the globalized economy is carbon-dependent and those carbon interests are not going to go away. What needs development then is cosmopolitanism and especially cosmopolitan innovation across borders, reflecting what I termed the international division of innovative labour. But at the same time some insulation from the exceptional economic, social and organizational power of carbon would be desirable. It would seem that the odds of this set of system shifts occurring are low, but not zero.

The following sets out the seven *preconditions* for such a shift of multiple systems to a low carbon future:

- a massive sustained global recession clearly seen as being at least in part brought about by oil and gas shortages
- unambiguous evidence of changing climates in the rich North as shown by record high temperatures, widespread deaths through droughts and flooding, and severe reductions in food supply
- the clear sense engendered by these events that there is a global common interest in forging new alliances and cooperations across borders; for example, seventy-three countries already have renewable energy targets[9]
- many events and processes occurring that weaken the power of carbon interests and especially their capacity to undermine climate science and the thesis of peak oil
- the widespread commitment of vast sums of finance ($30 trillion),[10] not into speculative property development, but into low carbon initiatives around the world, even though only a small proportion will provide the killer applications that in combination with others, could result in major new systems
- an array of organizational and technological disruptive innovations worldwide that are clearly seen as the basis for a new low carbon paradigm

- exceptional political leadership worldwide that at least temporarily effectively links together these issues, especially across the major blocs of the US, Europe, China and the BRICs.

It is significant that some of these preconditions are present during 2010 as this book is being completed: probable double-dip recession and some evidence of oil shortages; clear climate change evidence, with record temperature in seventeen countries including Russia, as well as unprecedented flooding in Pakistan and China; the record oil spill in the Gulf of Mexico which makes further deepwater drilling less likely and has made BP perhaps the most reviled of companies; and many examples worldwide of low carbon innovations. But the other preconditions are nowhere near being found in 2010, especially with huge reductions in national budgets and hence little capacity or will to develop the context for low carbon initiatives, especially following the failure of the 2009 Copenhagen summit and the ongoing disputes about climate science.

Moreover, if there is no substantial shift within high carbon countries and cities to a much lower carbon economy-and-society, then many negative system effects will become widespread. This is especially the case because what is crucial here are cumulative anthropogenic emissions and not those per year or decade. It is calculated that such total emissions must not exceed a total of a trillion tons of carbon if warming is to be limited to 2°C; and at least half of this 'budget' has already been used up.[11] There is, moreover, no gain from delay since carbon dioxide emissions stay in the atmosphere for at least 1,000 years. The sooner the tipping point to a low carbon future, the greater the chance of limiting temperature increases to 2°C. But the conditions for this seem totally unlikely to happen. So we can anticipate changing climates as well as relative or absolute decline in oil and gas supply, with many dire consequences for income, food and water. These system effects, as examined in the previous chapter on scenarios, include greater degrees of ungovernability of many countries exhibiting characteristics similar to many 'poor' oil-producing states now; major losses of income and also of population, especially in poorer countries, because of changing temperatures and rainfall; and large increases in personal and system surveillance through a kind of 'green Orwellism'. So, in the absence here of the beginnings of a low carbon system shift starting very soon (by 2020?), then some bleak futures seem probable. Or, as Mike Davis graphically expresses the stark choices for at least rich societies, 'the mitigation targets presume that windfall profits ... over the next generation will be efficiently recycled into renewable energy technology

and not wasted on mile-high skyscrapers, asset bubbles and mega-payouts to shareholders'.[12]

Moving to a low carbon economy-and-society is unlikely but not impossible. It involves 'reversing' most of the interlocking systems set in motion during the course of the twentieth century. It also has to counter systemic and hugely powerful carbon interests; the long-term path dependencies of existing systems, including the routinized nature of the practices of everyday life; the need to change multiple systems simultaneously; and the sheer difficulty of orchestrating and generalizing a global polity to reset agendas when there are so many other powerful productivist, consumerist and carbon agendas. Given these limits there is insufficient time to effect a seismic shift, since new systems take decades to be realized. What has been called 'the next world war', to deal with profound 'ecological decline', may well be already lost, partly because of the effects of cumulative emissions. Many scientists now expect at least a minimum of a 4 °C increase by the middle of this century.[13]

The difficulties here are also revealed through rethinking what is involved in 'innovation' and low carbon.

Innovating

The history of innovation reveals that a new socio-technical system – photography, the car, the internet, fax machines, mobile telephony – is not known or predicted in advance. The new system emerges haphazardly, unpredictably and from left-field. So planning to innovate a specific and predictable set of low carbon systems is likely to be impossible. Some thus argue that innovations should all be left to the market and that markets know 'best'. But this does not solve the issue. Markets have many failures. These include the generation of climate change itself which has been described as the greatest of all market failures, as well as the increasing exhaustion of energy and specifically the 'energy descent' of oil. There is also no way yet of ensuring that markets will find profitable low carbon alternatives on a sufficient scale, even if states take on some of the start-up costs, as with wind power. And markets consist in part of large corporations whose interests are often to stifle, to steal or to subvert innovation. This is shown in the film analysing the complex of interests responsible for 'killing off' General Motors' apparently successful prototype electric car.[14]

Since therefore it is not known in advance what will work, states have to enable 100 flowers to bloom. There should not be a 'mass broadcasting' view of low carbon innovation, with the state or large corporations dominant and broadcasting to the world what innovations should be developed.[15] Rather, in the new century – a post-mass new century – there should be more of a distributed, viral model of innovation. Is it possible that states, companies and NGOs could initiate the equivalent of iPhone apps with thousands of user innovations springing up around the world? Ideas need generating and many will fail. What we should not have are risk-averse systems, or systems that are overly focused upon rich-North innovations.

So the key thing is to ensure that 'ideas' enter and circulate the virtual, viral world, and it is not known where they will end up. While much of the contemporary world is hugely problematic because of wars and terrorism, climate change, population growth and energy security concerns, the one great system advantage in the new century are viral-like digital worlds. This is true both in terms of new kinds of virtual communications – some of which may substitute for physical movement in ways we do not have much sense of yet – *and* because this viral world may generate new non-mass forms of engendering 'innovation', as discussed in chapter 8.

I noted above how Buckminster Fuller claimed that one does not change anything by fighting the existing reality but change comes from a new model that makes the existing model obsolete. But whether this can happen sufficiently fast and furiously is uncertain. The growth of the internet, mobile telephony and iPhone applications show that, once there is a system tipping point, remarkable changes can spread like wildfire, even if governments and corporations are often unable to imagine what such changes would need to be. Fashion and fad are crucial to the development of the 'synchronized' innovation, which rapidly takes over and means that people are often unable to remember what the world was like before it got remade or reworlded through some new system or systems.

Overall, I have suggested the desirability of resource capitalism. Versions of this notion are being articulated by various leading commentators. Stern's *The Economics of Climate Change* attempts to bring about a new post-neo-liberal consensus. It concludes with the rallying cry that 'reducing the risk of climate change requires collective action ... It requires a partnership between public and private sectors, working with civil society and with individuals'.[16] Giddens, one of the west's leading public social scientists, recently called for a positive model of a low carbon future that will involve states thinking ahead, making interventions, countering businesses which block climate change initiatives, developing appropriate fiscal stimuli and planning overall for low carbon futures.[17] Likewise, Stiglitz' *Making*

Globalization Work presents a post-neo-liberal line of argument, with chapters on making trade fair, lifting the resource curse, saving the planet and democratizing globalization. The book is based around the claim that 'another world is possible'.[18] A further Nobel Prize-winner, Krugman, critiques *The Return of Depression Economics* and argues the need to develop a different economic model, especially from that of endlessly bursting financial bubbles.[19] Many of the catastrophist texts mentioned in chapter 2 likewise argue for the extreme urgency of shifting to such a resource or natural capitalism.[20]

Shock doctrine

So far I have examined a bottom-up and decentralized low carbon economy-and-society. It has been suggested that there is only a limited chance that this will develop in time and on a sufficient scale. But there is here another route into low carbon systems and that is to impose change from the 'top' via international states, powerful carbon emitter states and large corporations. This would happen through a 'shock doctrine' and a 'global war' that short-circuits normal procedures and protocols.[21] The global war on terror after September 11 involved such a short-circuiting of normal procedures and protocols.

A massive collapse of oil supply or oil price increase or dramatic flooding or drought in a global city could constitute the event that provokes such a dramatic 'climate change shock treatment'. This 'treatment' would short-circuit procedures and plans and lead to the widespread top-down imposition of a low carbon future. This would also necessitate global science, politics and media all being successfully able to frame this 'crisis' as being bound up with and part of 'changing climates' and as having to be 'dealt with' quickly, globally and without normal procedures. As with the war on terror, such a shock doctrine normally involves both the loss of rights, representation and democracy and the support and encouragement of regimes that much less deeply protect rights, representation and democracy. Shock doctrines and many related 'wars' are generally bad for enduring democratic practices.

Thus, developing a low carbon 'economy-and-society' might result through a shock, a bit like the way neo-liberalism was imposed more or less worldwide during the 1980s. This would be a corporatist, top-down surveillance-based low carbonism, a future with many social and political costs. The alternative of a more localist, decentralized

self-organizing low carbonism would not be imposed top-down. And both scenarios seem to have a limited probability of being realized.

A further issue here is that it is not known just how powerful climate change scepticism is likely to be over the next few decades. By early 2010 we have seen the failure of the Copenhagen summit and the unwillingness of the US or China to commit to major emissions reductions; the embarrassing apology by the IPCC which revealed how the 2007 Report had used non-peer-reviewed material for its false scandalous claims about melting Himalayan glaciers; and the apparent loss or theft of damaging emails from the Climatic Research Unit at the University of East Anglia (UEA) which seem to reveal some efforts to fix data to theory.[22] Such scepticism is almost back in the ascendancy, especially in the US in the early years of this decade, and this makes a low carbon shift across multiple systems much less likely within the next decade or so.

It is of course utterly clear that there are huge levels of uncertainty (both the known and the unknown unknowns) with regard to the economic, political, social and physical processes that will develop, especially in medium- to long-term futures. And we should be especially wary of scientists, corporations or policy-makers who suggest that there is a magic bullet, a particular climate technic, that could and must provide the 'technological fix' to deal with what appear to be undesirable changing climates in the current century. Almost certainly there is no such single fix.[23] However, that climate change scientists are confronted here by huge uncertainties does not mean that everything is simply uncertain.

Indeed, changing climates, rising population (from 6+ to 9+ billion), and declining oil *will* transform the resources underlying societal formation and reproduction even in the rich North. This will change future societies and it is possible that this will enforce a low carbon future through default, through declines in each society's resource-base and resulting reductions in consumer goods and services and, more generally, in those consuming lives often experienced on the move.

Sociology has spent much time examining the nature of modern societies, of modernity, but has mostly failed to analyse the carbon resource-base of such societies. It was carbon-blind. In particular it did not examine how the forms of movement within that society – as analysed, say, by Simmel or Berman – were based upon oil.[24] Oil, we have seen, provides almost all transportation energy. If oil is no longer in such cheap and plentiful supply or comes to be priced or rationed so as to minimize use because of its climate change emissions, then the world may slow down, as it has between 2008 and 2010.

This enforced slowness would be true of people, as well as objects, food, water and indeed science itself. Preparing or even planning for a less mobile future is a further challenge for a post-carbon sociology. We can also anticipate variations in the significance of climate between different societies, in the degree of acceptability of different kinds of climate change, and in the ability of states to regulate and govern such very uncertain futures.[25]

Moreover, we saw how the climate sciences deal with incredible levels of 'uncertainty' as opposed to mere risk. These sciences have various characteristics. Most of the science involves both known and unknown unknowns. There are different 'sciences' involved in determining the possibly changing climates, and they pursue different theories, methods and types of result. Most of the predictions of future temperature increases through General Circulation Models are unable to factor in multiple physical and social feedback mechanisms, which render these models more gradualist than catastrophist in their globally agreed predictions (IPCC) although some powerful catastrophist arguments and evidence have recently developed.

But, most problematically, these diverse competing sciences are expected to deliver predictions and policies for powerful policy-makers, such as what forms of energy generation in the next few decades would keep future temperature rises to below 2 °C. But the 'science' is still being formed and in many ways it is not mature enough to provide such robust predictions. It is not an immutable mobile. It is mostly not a laboratory set of sciences. It involves investigating incredibly open systems upon a global scale, with the need to provide estimates of possible temperature rises that might happen over the coming century, although this depends upon events that are currently 'unknown' and still a long way off. Hence there is huge vulnerability to error, misjudgment and defensiveness. Climate change science is rather like the social sciences of global society over the next few decades: absolutely essential but irreducibly uncertain.

Such uncertainties are compounded by what social futures might develop and their very varied GHG emissions. This is why the topic of this book is so significant, and why the social sciences need to be developing robust analyses of climate change futures, of the character and consequences of a high carbon – and of the possibilities of a low carbon – 'economy-and-society'. These social models need to be inserted into the climate models as soon as possible in order to determine which of the sceptical, gradualist or catastrophist positions is most plausible, and hence to help to determine 'what is to be done'. So far the chances of the widespread implementation of a low carbon set of systems seem unlikely, except through a shock treatment or

through a massive enforced reversal through 'resource collapse' and a move to local sustainability or regional warlordism.

Finally, there is another possible response to climate change and resource collapse. This is that there is no really effective pursuit of a post-carbon future. Powerful societies and their corporations defend their position in the world through simply maximizing access to scarce resources using military, diplomatic and political might. This serves to protect their 'global' or 'regional' warlord position.[26] In this future such powerful states knowingly deploy green policies as calculated 'greenwash', concealing their ruthless pursuit of oil, uranium, water, food and territory. 'Greenness' is, in this future, an ideological smokescreen. There are already regional and global warlords. The consequences of climate change and energy shortages hit home, so this makes powerful societies focus upon short-term national security and renders longer-term global agreements unlikely. And given how much of the world's economy is based around war, crime and financial 'products', there are plenty of incentives for public-expenditure-pressed states to find low carbon innovations too troublesome and unprofitable.[27] Each major power bloc may well put up the drawbridge and protect their fortress world, especially given that this is exactly how both the world's two largest emitters have behaved over the past decade or so. Regional warlordism, here we come!

Limits to growth

In conclusion, I reflect upon the 1972 *The Limits to Growth* report produced by the environmental thinktank the Club of Rome. At the time this was a hugely influential report selling over 12 million copies and was the first major study of a global environmental issue. The limits to growth were said to be the result of global resource constraints and pollution. This report was also one of the first attempts to model the future using computer simulations involving exponential – rather than linear – increases in the processes being examined.

In recent years this report has been largely forgotten, partly because it was thought to have been 'disproved', especially by energy experts and economists. But in fact most of the report's attempts to predict the future were based upon what sort of world there might be around 2070 – that is, we have not got there yet! And their prognoses seem remarkably prescient. In 1972 they wrote that if the present growth in world population, industrialization, pollution, food production and resource depletion were to continue: 'the limits to growth will be

reached sometime in the next hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.'[28] So, judging by this report, imagining the future of society is indeed possible and do-able – something I too have tried to develop in this book. And, even back in 1972, a catastrophist future seemed the most likely development. There is little likelihood of avoiding a 'limits to growth' future. The twentieth century, as the Club of Rome realized, bestowed a poor legacy upon the next century. Podesta and Ogden starkly conclude that 'there is no foreseeable political and technological solution that will enable us to avert many of the climatic impacts projected'.[29]

So my final claim is that there is a strong probability that nothing can be done except to *prepare* for various catastrophes. Unless some remarkable and unlikely system reversals take place in the extremely near future, sociology's role will lie more in the field of disaster studies. These reversals of carbon worlds were argued for in the 1970s but never materialized because of neo-liberalization and the power of the carbon military–industrial complex. Issues, then, of resilience and vulnerability, and disasters, will be the topics for the coming century and its social science, as the world moves beyond the carbon century and its era of carbon-hubris. Giddens maintains that societies do significantly vary in their degrees of resilience. The cases of Haiti and the Dominican Republic in 2004, or in the recent earthquake of 2009, show important variations in the degrees of societal resilience.[30] Societies are differentially vulnerable and the sociology of vulnerability and resilience will be a future crucial domain of inquiry.

There are some awesomely powerful limits to growth. We could say that none of the policy futures discussed in this book – to develop economically regardless of consequence, to develop a green new deal especially of new energy, to decentralize to local communities, to digitize energy and movement, to internationalize through agreement, or to limit populations – will be at such a level that they will effectively reverse the climate, energy and population juggernaut analysed here. The twentieth-century patterns of life organized around oil and coal are still with us and spreading around the world. They will haunt this coming century, both through their emissions and, in the case of oil, through its rising price and reduced availability. There is no evidence that huge 'voluntary' reductions in use of these carbon-intensive energy forms will occur. There is a carbon 'lock-in' which seems impossible to break from for many reasons examined in this book. Indeed, what we might be witnessing is a more generalized 'peaking', at least in the global North, of oil, gas and water – which various analysts have examined. But there may be a peaking

too of American power and imperial reach, of the welfare states of the European model, and more generally of 'states' that seek to deliver reduced inequalities to all their citizens. So rather than thinking of peak oil as a specific issue of a particular energy source, the notion of peak may be a more general characteristic of the early twenty-first century. Much may well be peaking.

The industry which best symbolizes the twentieth century can help interpret this more general sense of peaking – namely, the American car industry. Lovins et al. write how the 'trillion-dollar global auto industry is the largest and most complex undertaking in the history of the world'.[31] And yet various commentators describe the 'perfect storm' that afflicted US and then Japanese car makers over the past few years. This may be a first step in an enforced 'de-mobilizing' and 'de-energizing' of American and western life more generally, as we move past peak.

In that perfect storm, Detroit symbolizes this 'demobilization'. It was the frontier city in the American motorized dream, the place where mobile modernity was established and generalized, that made the American twentieth century into a high energy, consuming and mobile century based upon cheap plentiful oil.

Film-maker Julien Temple now presents Detroit's 'Last days'.[32] There are rusting hulks of abandoned car plants, empty ghost freeways, blackened corpses of hundreds of burnt-out houses with one in five empty, full-grown trees spouting from the tops of deserted skyscrapers, half the children living below the poverty line, and almost half the adults functionally illiterate. And, most striking of all, is that over a quarter of the inner city has been reappropriated by 'nature', with even many gardening projects reclaiming the land for a kind of collective primitive agriculture where anyone can harvest the 'crops' and there is no use of money, only some simple exchanges.

This vision of Detroit is rather like, Temple says, the lost cities of the Mayan civilization that play a significant role in visions of the future presented in the 'collapse of civilization' literature examined in chapter 2. What happens in Detroit with nature's reclaiming of the carbon world may provide important lessons as to what could turn out to be a dark century indeed. Multiple intersecting system failures may generate many more 'last days' in many kinds of place around the world, and not just Detroit.

There are indeed huge limits to developing low carbon systems and little sense that Plan B can develop in time. The low carbon cluster of interdependent systems needs to be put in place now in order to slow down the scale of changing climates and energy descent. This book has attempted to elaborate the array of social science resources

that are relevant to deciphering the scale, organization and costs of such a cluster of systems and of the very difficult preconditions that would have to be met for a Plan B to be realized. Mike Davis concludes that, given that Plan B is unlikely to have been realized by 2030, 'the convergent effects of climate change, peak oil, peak water, and an additional 1.5 billion people on the planet will produce negative synergies probably beyond our imagination', beyond the dark futures examined in this book as we move into a post-peak world.[33]

Notes

1 Society matters

1 *The Observer*, 29 November 2009, www.guardian.co.uk/environment/2009/nov/29/rajendra-pachauri-climate-warning-copenhagen (accessed 18 December 2009).
2 *BBC News*, 10 p.m., 24 August 2009. The UK Government Chief Scientist, John Beddington, was the source of this material.
3 IPCC, www.ipcc.ch/ (2007) (accessed 2 June 2008).
4 See Fred Pearce, *With Speed and Violence: Why Scientists Fear Tipping Points in Climate Change* (Boston: Beacon Press, 2007).
5 Nicholas Stern, *The Economics of Climate Chang: The Stern Review* (Cambridge: Cambridge University Press, 2007).
6 Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge: Cambridge University Press, 2007), p. xiii.
7 George Monbiot, *Heat* (London: Allen Lane, 2006).
8 Mark Lynas, *Six Degrees: Our Future on a Hotter Planet* (London: Fourth Estate, 2007).
9 See Ben Fine, *The World of Consumption* (London: Routledge, 2002), p. xi.
10 See David Strahan, *The Last Oil Shock* (London: John Murray, 2007), ch. 5; Richard Heinberg, *The Party's Over: Oil, War and the Fate of Industrial Society* (New York: Clearview Books, 2005), pp. 3–5.
11 David Strahan, *The Last Oil Shock* (London: John Murray, 2007), p. 123.
12 Jeremy Leggett, *Half Gone: Oil, Gas, Hot Air and Global Energy Crisis* (London: Portobello Books, 2005), p. 11.
13 IPCC, www.ipcc.ch/ (2007) (accessed 2 June 2008); Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge: Cambridge University Press, 2007). See Eugene Linden, *Winds of*