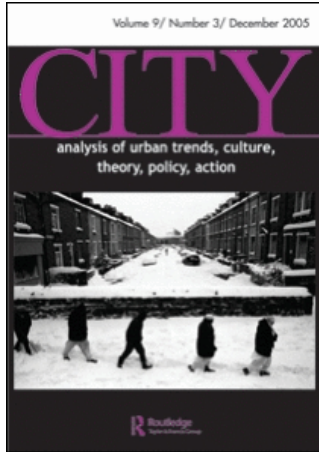


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Cities after oil—1

'Sustainable development' and energy futures

Adrian Atkinson

One facet of City over the years has been a rather dark foreboding that the trajectory of urbanisation around the world is accumulating problems that refuse to be solved and that in the foreseeable future we will see some kind of apocalyptic collapse. In New Orleans we saw one version of this, in other cities there may be others yet to reveal themselves. This paper is one of a trilogy that focus on the 'sustainable development' of cities and that, by the end, spells out a rather specific scenario of collapse as a consequence of energy starvation that we will, in all likelihood, be seeing unfold over the coming decades. Here we take a distanced view of the whole 'sustainable development' and 'sustainable cities' discourse, concluding that it has become diffused and lost in a welter of fragmented analyses, hopes and small projects that, prima facie, is failing to address deteriorating environmental conditions. The point, however, is that the real source of unsustainability of our civilisation lies in its extreme and increasing reliance on fossil fuels which, in the coming decades will be declining in availability. This paper makes a preliminary assessment of the relationship between 'development' and its demand for energy, noting the consistent avoidance of any meaningful assessment of this or what should be done in an effective way to avoid an emerging crisis. This will surely reveal itself with the progressive difficulty, and thence impossibility, of satisfying our energy demands in a situation where the widely held belief in the imminent rapid growth of alternative sources of energy proves to be without foundation. The next paper in the trilogy looks at the reasons why our society is so blind to the tragedy ahead and the third sketches the probable trajectory of the collapse of our civilisation and the consequence of this for the future of cities both in the north and the south.

Introduction

The idea that our way of life and beyond this the fixation on 'economic growth' with a particular structure is 'unsustainable' is repeated everywhere, as a kind of incantation. And yet, what this actually means and what it actually would take to overcome this in concrete terms has been lost altogether in a cloud of diminutive, vacuous hopes and actions. Genuinely meaningful action is

clearly absent, as evidenced in the empirical indicators of deteriorating environmental conditions and profligate squandering of resources.¹ The evident disregard which our civilisation has for its own future in the face of the increasing certainty that it will collapse in the coming decades is, to the say the least, quite astonishing!

Over the past two decades *City* and its predecessor, *Regenerating Cities*, have looked critically at unfolding urbanisation processes and the changing feelings, social relations and

in certain respects incoherences (splintering, fragmenting) which characterise these. In most media and academic representations of urban changes, the problematic nature of these changes is in large measure obscured. In part this is via the bland academic and professional language of researchers and development institutions that depicts social division and poverty as technical rather than moral issues and fails abjectly to analyse the causes and who or what is to blame. A further dimension is the almost bellicose self-congratulation of capital with its competition to produce iconographic statements.

A certain reading of contributions to *City*—Bob Catterall's ongoing debating piece in the journal, 'Is it All Coming Together?' providing a general thread to this—if read systematically, gives a sense of foreboding and distinct pieces of evidence concerning a dark future as yet incompletely defined, not yet recognised as a crisis but having all the ingredients of imminent collapse.² A further dimension of this crisis, less distinctly represented in the pages of *City*, that can be seen as perhaps the final push of current urbanisation dynamics over the cliff-edge, is the issue of 'environmental sustainability': the ability of the global economy and resource base to continue to support the kind of urbanisation we are witnessing and to protect the cities from sudden environmental catastrophe (viz. New Orleans).

My own contributions to the debates in *City*,³ concluding that urbanisation all around the globe is 'out of control', have looked mainly at the ideological and economic/structural driving forces of the processes. This had an eye towards the probable non-sustainability of the processes in the sense of running up against eventually insuperable environmental and resources problems. These, I argued, continue to be incorrigibly screened out of the political decision-making process in any more than rhetoric and vague hopes that everything will work out OK. Over the past 2 years I have been carrying out research into what 'unsustainability' might mean in detail and in this

paper focus on what seem to me to be the limiting factors. It may have reached the attention of many readers that I am by no means alone in focusing stronger attention on the looming denouement ahead and reference will be made to this rapidly growing literature later in this and subsequent papers.

Here I focus attention particularly on two matters. In the first instance the paper addresses the 30-year long discourse on 'sustainable development' with a view to assessing its impacts on the development process. In so far as it can be deemed to have failed in its own terms, the main reasons for this are presented. The paper then sets this discourse aside to focus attention on what seems to me to be the fundamental problem of the unsustainability of our way of life. This is the great reliance of our civilisation on vast throughputs of energy which at present are provided predominantly by fossil fuels—that is, resources that are finite, that one day will be exhausted.

The second half of the paper thus presents the results of my research over the past 2 years into possible energy futures. This concerns the probable trajectory of depletion and eventual exhaustion of fossil fuels and then the alternative resources that it is generally hoped will fill the increasing energy supply gap as fossil fuel availability declines. The conclusion is that we can see now in relatively sharp focus from such an analysis that the world is almost certain to experience an accelerating decline in available energy in the coming decades. This clearly has extremely serious implications for the sustainability of much of what we consider to be the 'natural' conditions of modern life. Simply put, our whole civilisation comes deeply into question under circumstances of significantly reduced energy availability: it simply is not sustainable.

My further researches, beyond what is presented here, have been looking deeper into the reasons for the blindness of our society to the importance and at the same time unsustainability of the use of vast inputs of energy needed to sustain our civilisation. A

start has been made—notably in Jared Diamond's recent book *Collapse*⁴—to analysing how and why civilisations in the past have collapsed, suggesting reasons for the blindness of our society to its own future. My own researches have surveyed this literature, leading on to studies of what Diamond refers to as 'core values' of our civilisation tending to lie beyond the boundaries of rational debate. These focus on the suburban lifestyle and closely related but even more problematic obsession with mobility of our civilisation, with the automobile at its epicentre. Discussion of the wisdom, in terms of the sustainability of this lifestyle, is being intellectually screened out or at best emaciated to a point of incoherence with any effective discussion of sustainability.

With this firmly in mind, it becomes possible to formulate scenarios of the stages in the collapse of our civilisation that we can expect as a consequence of energy-starvation. The crucial issue will be: when might we expect our society to come to terms with the reality of declining energy and thus what kind of living arrangements and lifestyles are supportable under these circumstances? I conclude that there are philosophical/moral issues to be considered here even before it is possible to think of physical (planning) solutions. Furthermore, the legacies of environmental abuse of our civilisation—in particular global warming—are liable to exacerbate the problems faced by future generations in rebuilding civilisations that can be expected to function sustainably.

The discourse on sustainable development and sustainability

I asserted above that the current concern with 'sustainability' has 'altogether lost focus'. Let me say what I mean by this. The term 'sustainable development' originated in a report published by the International Conservation Union (IUCN) in 1980. The intention was to respond to the *Limits to Growth* study that had predicted the collapse

of our civilisation some time around the middle of the 21st century if appropriate steps are not taken to reduce our exponential demand for resources and the exponential production of pollutants into the atmosphere by suggesting how the environment should be protected against deterioration evident at that time. The term became common currency in the first instance used by the international environmental (subsequently Green) movement to address problems of environmental depletion, picked up in the mid-1980s by the UN Commission on Environment and Development as the key term of their widely circulated report *Our Common Future*.⁵ It was this report that gave us what is by far the most quoted definition of 'Sustainable Development' which is: *development that meets the needs of the present without compromising the ability of future generations to meet their own need*.

The number of books containing 'sustainable development' in their title probably runs into well over a hundred, appearing possibly in every published language. And books focusing on the general problematic under other titles probably run into very many hundreds. Furthermore, there are many journals and hence thousands of articles ostensibly addressing the subject. The concept of 'sustainable cities' has generated another large offer of books,⁶ journals and other literature. Major research programmes have been established with sustainable development as the core topic⁷ and 'sustainable development' is everywhere cited as one of the aims of countless international projects and programmes.

Furthermore, in the course of the 1990s governments everywhere produced national reports on sustainable development and in some countries more than one when we count national Agenda 21 and related programmes that were produced following the UN Conference on Environment and Development in 1992. 'Local Agenda 21' processes were initiated in over 6000 local authority areas.⁸ It is clearly difficult to summarise the contents of this discourse and to explain why this discourse has, *prima facie*, failed abjectly

to activate, inspire or achieve anything resembling genuinely sustainable development. As I noted above, this is evidenced in escalating unsustainable use of natural resources and continuing environmental deterioration, the spread of urban slums and more generally indicators of poverty in the South. In further work I have carried out on this subject, I have attempted to analyse the deeper cultural reasons for this failure. Here I wish merely to point to some rather obvious reasons for this failure that relate more to the simple structure of the discourse and its place in the political and (increasingly indissolubly) economic decision-making process.

The debate originated in concerns for environmental deterioration that identified the parameters of environmental decline, declaring that this decline should be halted or reversed and then generating institutional initiatives necessary to effectuate this, including the creation of non-government organisations, green political parties, national environmental agencies and ministries. By the mid-1990s as a measure to introduce some kind of rigour into the evaluation of whether sustainability was actually being achieved or not the concept of 'sustainability indicators' gained currency. Again, there is a huge literature on this subject with national reports (e.g. the UK *Indicators of Sustainable Development for the United Kingdom*⁹), results of research programmes and systems designed by and for local authorities¹⁰ and academic texts advising on how such indicators should be put together and used. In practice, such indicators had the effect of fragmenting and dispersing the focus on what might be the main issues and generally became a technical exercise that attempted to assess the state of the environment—and thence economy and society—without reference to what might be better than the present or what practical steps might be made to improve matters even if there *was* some notion concerning which direction was genuinely sustainable and which not.

It was everywhere asserted that sustainability was not just an issue of resources and the

environment but should also involve social and economic processes. Variants of the diagram shown in Figure 1 (one of dozens that can be found floating on the Internet) proliferated in books, reports and papers concerned with sustainable development. Whilst we might be sure that our society would need to reorient itself to a more frugal lifestyle and organise its systems of production and consumption and be sustainable in this sense, what has been overwhelmingly meant in the literature on sustainable development is that a healthier, more congenial—indeed in most cases a wealthier—society would be more sustainable. One might be forgiven for being cynical—but realistic—in asserting that more wealth in the form in which it is expected today is precisely that which is unsustainable and that shanty towns and southern poverty are all too sustainable in the sense that people manage to survive in these conditions. Thus 'sustainable development' became an incantation attaching to almost any proposal as something one wishes and hopes for but where the concept by now entirely lacks any framework to evaluate meaningfully whether the activities promoted by the proposals will actually be available, as apparently a basic principle of sustainable development, to future generations.

The fact is that any return to a realistic focus on what lies at the core of the unsustainability



Figure 1

of our civilisation hits up against the increasing unrealisability of controlling the flow of resources that sustain our lives today. The number of truly, historically self-sufficient (subsistence) communities in inaccessible parts of the globe is today almost down to zero and although subsistence farming is still practised by almost half the population of the world, this has everywhere been ‘contaminated’ by creeping reliance on production chains that stretch right across the globe. Even the simplest of accoutrements of everyday life including clothing (in Africa increasingly pass-me-downs from the North), simple farming implements, building materials and increasingly even food and energy (kerosene stoves even in rural areas of the South) are no longer locally produced but are reliant upon the continued sustainability of the totality of the intricately interdependent global economy.

On the other hand, numbers of ‘intentional communities’ have established themselves in northern countries, many of which are determined to live a self-reliant life.¹¹ However, whilst in the most extreme cases these communities live almost entirely on food and energy sources produced by themselves, with perhaps the exception of those using the debris of modern society such as second-hand utensils, glass and so on, vital ingredients of life nevertheless continue to be supplied by the global economy and hence these communities are also reliant on the sustainability of the totality of the global economy.

It is thus the unsustainability of our civilisation as a consequence of the unsustainability of the integrated global economy that supports it that has inevitably to become the focus of any meaningful assessment of the problematic of sustainable development today. This is a strategic issue, not one that can be broken up into any number of discrete issues and the sustainability of each of these assessed independently—with or without sustainability indicators. Thus a focus on the system as a whole and how to systematically reduce reliance on outside inputs is the only meaningful context within which we might

be able to formulate effective solutions to the sustainability problematic. In fact there has been a debate at the margins of the Green Movement concerned with attaining self-reliance on a (sub)regional basis, under the title of ‘bioregionalism’.¹² This is concerned on the practical side to break the environment up into parts that are manageable in terms both of knowledge of available resources and the impacts of development on the environment, and in terms of exerting responsible political control over these. In fact the bioregions movement initiated already in the 1970s has also been greatly concerned with the development of local cultures that encompass empathy with particular regional environments and a rich cultural expression of life under particular regional conditions (learning from the vernacular).

Let me end this section of the paper by noting where the current debates in the political arena have reached regarding sustainability. The past two G8 meetings (annual meetings of the heads of the eight most powerful states) have focused major attention on ‘global warming’ and its potential consequences and called for relevant actors and institutions to come up with ways to reduce emissions of greenhouse gases. The recent, widely circulated *Atlas of Globalisation* published by Le Monde diplomatique¹³ devotes the first chapter to ‘our threatened environment’ where global warming is the first issue to be presented. Furthermore, the World Bank annual ‘flagship report’ *Global Economic Prospects*¹⁴ for 2007 devotes a chapter to environmental problems—and particularly global warming—that are emerging as a consequence of the current development path indicating an apocalyptic fate for humanity if things don’t change very soon.¹⁵

The main cause of global warming—the use of fossil fuels—however, fails to gain prominence. I think it only sensible to state unequivocally that the simple and logical response to the danger of global warming is, of course: stop using fossil fuels right now! Leave them in the ground! This is apparently an unmentionable idea. Perhaps this is

because this at once throws our whole civilisation into question given that it is structured to an extreme degree on the use of fossil fuels: few wish to raise, let alone discuss, such a momentous issue. However, assuming we do continue to exploit fossil fuels as fast as we can, attempting to continue the current upward trajectory in energy use, these will be all but exhausted (what remains will be inaccessible) well within the lifetime of the present younger generation. So, cutting through the thicket of the voluminous debate on 'sustainable development' we come eventually to the simple truth: our use of energy is unsustainable and when it comes to an end then the whole economic and social (and political) structure of our world falls apart. A sustainable economy, society, etc. presupposes a considerably more modest throughput of energy and one that eschews the use of *any* more fossil fuel. This is the unalloyed kernel of the 'sustainability problematic'.

It will be necessary below for me to disabuse readers of the fantasy that beyond fossil fuels there are endless other energy sources that will appear to fill the gap. The story here is one of a radical decline in the availability of energy and what this is likely to bring in terms of the restructuring of our lives physically, socially and mentally, in the context of an environment that has taken to biting back ...

Understanding the connections: energy and society

By way of introduction I would like to highlight the strange and persistent gap between the *de facto* fundamental importance of energy supply and use to the structure and functioning of particular societies—and particularly ours—and the lack of intellectual or institutional focus on this fact. The social sciences pay scant attention to the development of energy sources and the link between energy use and the structure of social activity. There is occasionally passing reference to the role of energy to particular transitions—such as the

proliferation of water and wind mills in the late Middle Ages and the transition to coal as the industrial revolution got under way. These have been seen, however, overwhelmingly as illustrations of human ingenuity, entirely overlooking the umbilical link between technological progress and the exploitation of increasing amounts of energy. The sudden take-off of the global population towards the end of the 17th century and the phenomenon of urbanisation across the 19th and 20th centuries are generally seen as a function of economic, technological and cultural change but without reference to the way in which this was facilitated by and dependent on increasing use of fossil fuels.

Exceptionally, the anthropologist Leslie White asserted as the basis of his work on cultural development up to Roman times that:

*'culture advances as the amount of energy harnessed per capita per year increases, or as the efficiency or economy of the means of controlling energy is increased, or both.'*¹⁶

A few anthropologists elaborated further on this insight but it had virtually no impact on other disciplines. Amongst economists, Nobel Prize-winner Nicholas Georgescu-Roegen, whilst being highly respected for his consistent linking of economics to 'the entropy law' (the laws of thermodynamics),¹⁷ had no followers and achieves no more than passing reference in economic textbooks. Only in recent years have passably adequate analytical tools been developed to look at the multifarious ways in which energy (today predominantly in the form of non-renewable fossil fuels) provides the foundation of so many of our complex functions from food supply and manufacturing processes through transport and everyday life in city and suburb. These intellectual tools, however, remain 'ghettoised' as technical exercises of little importance to any discipline beyond energy studies and those functionaries in the real world employed to manage energy in public authorities and private enterprises.

Energy plays no significant role in the everyday consciousness of the population. It appears as a rather abstract concept and entity that manifests itself in all sorts of disparate actions that rely on all sorts of sources interwoven into daily life. We turn our lights on and off and use our stoves to cook meals. Our houses are heated in winter and cooled in summer. We go to the petrol station to tank up our cars. Few people, however, have any idea how much energy has been expended to produce our food and bring it to the supermarket, or to produce our car or computer or any other household article. We can afford it, it makes life more convenient, end of story.

Educated people in the North have learned bits and pieces about our use of energy—mainly in the knowledge that we do use a lot of non-renewable energy resources that sooner or later will not be there any longer so something will need to be done. The media help to soothe fears of shortages by reference to growing sources of renewable energy: such ideas as a future hydrogen economy and faith in the sheer inventiveness of our civilisation. Someone, it seems to be believed, will come up with a bright idea that will save the day and once the price of oil rises significantly this will trigger the rapid development of alternatives to fossil fuel!

Nor is there any coherent focus on energy by institutions responsible for development. Whilst it is *de facto* clearly crucial to development—hence the importance for instance of investment in hydroelectric dams in developing countries and generally projects to develop energy resources from coal to gas and local renewable energy sources—national energy ministries and agencies are generally marginal within the spectrum of national government institutions and at the international level there is no UN agency with any remit to focus specifically on energy.¹⁸ This clearly contributes to the fact that there is as yet little attempt to conceptualise where we stand as a basis for seeing what the options are for the future.

It might be speculated that energy supply, being dominated by big economic interests, is too important to be the subject of more public and international scrutiny that might challenge these interests. Certainly over the past decades, generally over a quarter of the companies in the top 20 largest private corporations presented in the annual Fortune Global 500 are energy companies and national energy utilities are also often amongst the most powerful interests in the background of national politics.¹⁹ There is, nevertheless, one important agency with a remit to study the global energy situation. This is the International Energy Agency (IEA), attached to the Office of Economic Cooperation and Development (OECD) which is the organisation that looks after the interests of the rich nations. This hints precisely at the closeness of energy to the interests of economic development amongst the rich countries and this becomes clear in its remit²⁰ which is essentially to watch developments in the energy field such as to ensure future energy security for the OECD members.

It is clear that the first priority grows out of the worry concerning accessibility to sources of oil outside the OECD (predominantly in the Middle East but we might add Venezuela and the ex-Soviet republics to the list). The notion of managing energy such that we will use less in the future is hardly present in this remit and there is certainly no recognition that in the medium and especially longer term the current levels of energy use are unrealistic and that hence it is necessary to start planning now for a future energy-poor world. To the IEA, energy is thus seen narrowly as a strategic resource rather than a foundation of development or more broadly as informing the inner structure of civilisation.

It is really only since the OPEC-engineered raising of oil prices in 1973 and 1979 that information has become organised such as to obtain some perspective on our use of energy. As a result we now know that whilst the average sub-Saharan African consumes

around 0.3 tons of oil equivalent (that is translating all energy use into its equivalent in oil) by contrast, the 'developed' countries of Europe and Asia consume around 4.5 tons of oil equivalent per person per annum.²¹ The colder northern countries use around 6 tons and US citizens, known for their energy-profligate lifestyle have an average annual per capita energy consumption of around 8 tons of oil equivalent.

Whilst the structure of energy sources and energy consumption is very different from one country to another, nevertheless some generalisations can be made. Industrialisation, first in Britain, then in Germany and the USA, was based overwhelmingly on coal and by the early 20th century the coal industry was a major employer and, in turn through unionisation, an important political force. Even until the 1950s coal was the main source of energy in Europe. In the USA this had already changed by the 1920s where auto-mobilisation became a significant dimension of the national lifestyle; meanwhile, however, today US coal consumption is rising rapidly as the energetic basis of electricity production.

The major changes came about in Europe in the 1950s and 1960s where auto-mobilisation took off and with it the substitution in homes and industry of oil for coal. At the same time natural gas pipelines were built across the continent exploiting sources in Holland, the North Sea, Algeria and now predominantly Russia. Some countries had hydroelectric potential which for a while became a significant source of electricity but less significant once the potential was fully exploited but electricity demand continued to rise.²² Nuclear power was seen as the next great potential but in few countries reached a very significant percentage of energy supply and is now in decline.²³ By 2005, Europe as a whole was 85 per cent reliant for its energy needs on fossil fuels and less than 5 per cent was supplied by all renewable sources combined (including hydropower, biomass, wind and solar power); the USA had an almost identical energy supply profile.

'Development' or 'modernity' is thus clearly associated with the sustained throughput of large amounts of fossil fuel. The most dramatic illustration of this is to be seen in the Asian countries recently 'developed' or 'developing'. The per capita energy consumption of South Korea is currently very similar to that of Western Europe. From the beginning of the 1960s to today, per capita energy consumption increased 10 times and the country went from less than 20 per cent to 98 per cent dependent on imported energy. China is now on its way having reached just 1 ton oil equivalent per capita per annum and currently increasing energy consumption at a rate of 15 per cent per annum. The notion that China, with over a quarter of the world's population, will some day reach our level of energy consumption, where as a consequence global consumption is double that of today even without consideration of increasing consumption elsewhere in the world, is clearly absurd in the context of the limited availability of energy resources analysed below. In this light we can see China essentially as leading the charge towards a fundamental global energy crunch where energy demand can no longer be satisfied and in a relatively short time the machinery of modern life slows down and returns to the limits of energy provided by the sun, the winds and the biosphere.

The future availability of energy

And so I come to the issue at hand: how long can things continue like this and what will happen when available energy starts to decline? As I noted at the outset of this paper, whilst most educated people acknowledge glibly the unsustainability of our civilisation, any more specific focus on what this means in concrete terms obtains various obfuscatory responses. In my experience anyone with even passing knowledge of the subject admits that on our current development trajectory there will be virtually no fossil fuels left to exploit within the next 80

years. Thus whilst even the reasonably educated lay public has some sense of this, there is little focus on how the decline might unfold. There is a very widely held belief that non-fossil fuel sources will substitute for fossil fuels and meanwhile the problems are dismissed with the thought that these lie in the comfortably distant future.

I will not take space here to argue in detail the fallacies and fantasies attached to the various options or combination of options for alternatives to fossil fuels. Rather I direct readers who would like a popular interpretation to pick up one or more of the recent books that have begun to analyse more coherently and in detail our energy future.²⁴ For the definitive official view, reference should be made to the IEA Energy Outlook 2006.²⁵ This gives the latest assessment of the probable progress in energy demand and provision, referred to as their 'Reference Scenario', and, given possible relatively radical policy changes that are, however, as yet nowhere to be seen, an 'Alternative Policy Scenario'. These look only as far as the year 2030. The following paragraphs set out the essentials.

Whilst technological development has in the past produced many unexpected surprises and hence changed reality in unforeseen ways, it will take some extraordinary developments in the next two to three decades to avoid an incipient and thence more or less accelerating decline in available energy. The emerging popular literature on the emerging decline in energy resources tries to take into account all the possibilities that are under discussion and being researched, before outlining the profile of energy decline and its possible consequences. As yet these focus entirely on the insuperable difficulties that will be experienced in continuing the American lifestyle in the near future. The IEA also tries to take account of currently realistic options and comes to the following conclusions. Remembering its remit, the issue is not what might happen in terms of decline but rather how can we maintain growth in energy supply.

The IEA 'Reference Scenario' that assumes current aspirations and policies sees fossil fuels as continuing to dominate the global use of energy, albeit with increasing likelihood of disruption and with inexorably rising prices consequent mainly on the increasing inaccessibility of remaining resources. Overall energy demand is seen as increasing by one and a half times between 2004 and 2030 with China playing a major part in this. Fossil fuels are predicted to actually increase their percentage from 80 to 81 per cent of the total with, however, the proportion supplied by oil diminishing. Renewable sources, currently supplying a little over 13 per cent of the total are expected by 2030 to satisfy only slightly more of the demand as a proportion at just under 14 per cent. In the IEA Alternative Policy Scenario world primary energy demand is still assumed to be almost three-quarters again of 2004 demand levels of which 77 per cent will still be supplied by fossil fuels and still only 16 per cent supplied by renewable sources.

The only view the IEA takes beyond 2030 (just 23 years from now) is in the context of an assumption that governments will take radical policy steps to increase energy conservation, nuclear power and energy from renewable sources ('renewables'). They hope that there will be massive increases in R&D which will yield technological breakthroughs that enable us to continue the overall trajectory of global development. No view is taken by the IEA concerning the wisdom of current lifestyles and the possibility that there are structural problems in these that make a policy-driven reform of energy supply on anything like the scale hoped for to actually happen. In fact the major driver of their Alternative Policy Scenario is the demand made by G8 of the IEA that they look for ways to reduce greenhouse gas emissions. Whilst the Reference Scenario sees the rate of greenhouse gas emissions increasing by 55 per cent by 2030, the best efforts of the IEA still see these increasing by 31 per cent making nonsense of the Kyoto Protocol.

Currently there is an increasingly intensive debate surrounding the issue of 'peak oil' that focuses on the moment where oil supply starts to decline. The 'man in the street', whilst generally aware that one day oil and other fossil fuels, being a finite resource, will be exhausted, gives little thought to how this will manifest itself. The 'science' of estimating fossil fuel stocks starts with M. King Hubbert who in the 1940s posited that oil exploitation will follow a bell-shaped curve, increasing to a peak and then declining according to a similar profile. Such a curve could already in the 1940s be seen in the declining discovery of new oil fields in the USA and Hubbert concluded that exploitation would follow this curve some years later. His prediction with regard to the exploitation of oil in the USA was reasonably accurate.

Hubbert then estimated the curve for global production. Global oil discoveries peaked in the 1960s and the rate of global oil extraction today has reached twice that of new discoveries. Hubbert posited that global oil production would peak in the late 1990s. Given the disruptions in production of the 1970s, the peak has been pushed forward and

there is debate as to exactly when during this decade the peak will arrive, with a few, including the IEA, being optimistic that the peak will come later than this. Figure 2 shows a number of estimates of the possible global exploitation curve for oil. Note that the more optimistic curves include exploitation of 'unconventional' sources of oil including 'tar sands' and 'shale oil' that are resources where the oil is embedded in rocks/sands and extracted through mining (with serious environmental consequences).

Of course this is not the peak in fossil fuels as such and it is clear that the peak in gas production lies a little way ahead and the peak in coal production and oil from oil shale and tar sands potentially lies a good deal further into the future. This is on the current trajectory of global energy consumption, however, a matter of decades rather than centuries. The immediate concern revolves around the fact that over 90 per cent of energy used for transport comes in the form of oil, demand for which continues upwards at a more rapid rate than energy as a whole—by 3.6 per cent per annum over the past 30 years steadily increasing as a proportion of

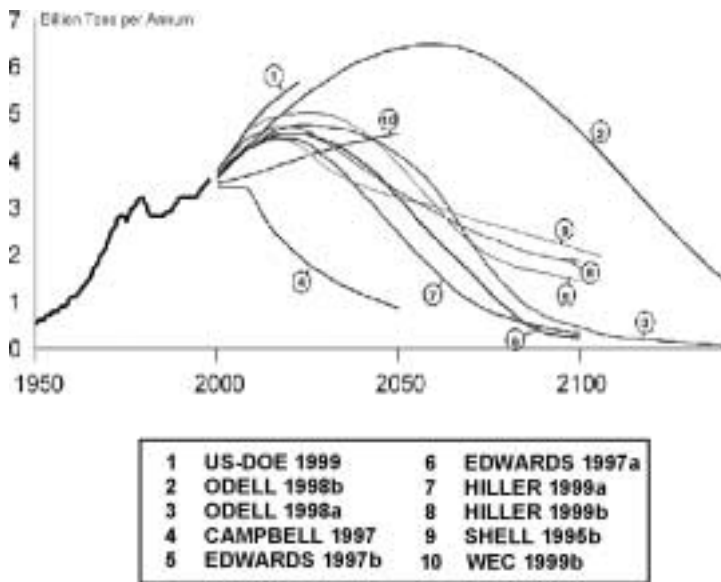


Figure 2 Estimates of the oil peak and depletion curve. Source: Bundesanstalt für Geowissenschaften und Rohstoffe, cited by Georg Erdmann (2004) Lecture: (a) conventional oil wells; (b) including non-conventional sources.

Table 1 Global energy consumption by sector in Mtoe

Sector	1973	2002	% Change
Industry	1693	2242	32
Transport	966	1837	90
Other	1800	2810	56

Source: IEA (2005); reworked to include biofuels in 1973.

the overall energy consumption from a quarter to a third. Half of this is consumed by private cars, 30 per cent by freight and 13 per cent by air travel. This increase in the amount of energy used in transport in contrast to other sectors over the past 30 years can be seen clearly in Table 1. Here we begin to see how central is growing auto-mobilisation—and we should add the suburban lifestyle so closely associated with it—to the problematic of fossil fuel use today. It is this which is the focus of attention of the growing American literature on ‘peak oil’²⁶ and it necessarily became an important focus of the subsequent parts of my own research.

Taking distance from the IEA and remembering their remit, it becomes evident that there is a component of wishful thinking on a heroic scale that becomes more extreme as they look further into the future, ultimately with, in all probability, tragic consequence. This more distanced perspective quickly turns to asking the question as to why there has been and continues to be a studied avoidance of the increasingly obvious need to take stock and to formulate more robust steps towards a future that will work under conditions of diminishing and later in this century radically reduced available energy.

Of course the Green Movement was always aware that the trajectory of our development path is increasingly dangerous and eventually unviable. The *Limits to Growth* study²⁷ and the debate this raised alerted a wide audience to this and the recent revisiting of the *Limits* scenarios by the original authors²⁸ shows all too clearly the failure of the Green Movement that came into being to try to deflect this path and avoid the collapse

foreseen by the *Limits* group should relevant steps not be taken. The collapse trajectory is on track and it is the closeness to this point that I am here discussing, where we are now in a position to see the edge of the precipice more clearly. Had the global political process taken serious account of the Green Movement in the 1970s and 1980s then it might have been possible to plan our way to a sustainable society. Now, however, it is very late in the day ...

Notes

- 1 The best source for this information is the publications of the World Resources Institute (www.wri.org) which include their annual *World Resources* and the regularly updated *Earthtrends* (www.earthtrends.wri.org). For a panoramic view with contributions from over 2000 scientists and other participants, see particularly the Millennium Ecosystems Assessment (www.millenniumassessment.org). On global warming, see the fourth report of the International Panel on Climate Change (www.ipcc.ch).
- 2 Recently most evident in Catterall (2006).
- 3 Atkinson (2004, 2005).
- 4 Diamond (2005).
- 5 WCED (1987).
- 6 Perhaps it is useful to list a few of the more oft-cited offerings: Braheny (1992), Stren *et al.* (1992), Haughton and Hunter (1994), Pugh (1996), Burgess *et al.* (1997), Newman and Kenworthy (1999), Satterthwaite (1999), Allen and You (2002), Portney (2003) and Jenks and Dempsey (2005).
- 7 Throughout the 1990s in the UK the three government research councils collaborated in what was then their largest single research programme under the title of ‘Global Environmental Change’. Germany and the USA had similar government-funded major research programmes.
- 8 UNDESA (2002).
- 9 Department of the Environment (1996).
- 10 The then planning authorities of London as a large and important global city managed to produce a massive report containing 133 sustainability indicators (LPAC, 1996). By contrast Leicester, that won various international prizes as ‘environment city’, generated just 14 key indicators which were intended to be used to steer the city into a path of sustainable development (Leicester Promotions, 1995).
- 11 See the online *Communities Directory* compiled by the Federation of Intentional Communities for brief

- descriptions of over 1500 such communities (<http://directory.ic.org/geo/>). *Diggers and Dreamers* is a UK directory published biennially since the early 1990s with numerous articles on aspects of communal living with a frequent focus on issues of sustainable living (www.diggersanddreamers.org.uk).
- 12 Sale (1985), McGinnis (1999), Theyer (2003) and Carr (2005). My own contribution to this discourse was in the form of a paper delivered to an international conference on sustainable cities in the South (Atkinson, 1992). At the time, the notion of bioregions was dismissed as being too distant from the urgent need to address the spread of urban poverty and slums. My argument was that attempts to address spreading poverty in the South in isolation from the wider issue of bringing resource flows back into a manageable—necessarily (sub)regional—framework could be no more than a holding operation pending the collapse of our whole civilisation along the lines sketched in the *Limits to Growth*. Bioregionalism in this context was presented as a practical framework to stem growing poverty as well as achieving sustainable development.
 - 13 Le Monde diplomatique (2006).
 - 14 World Bank (2006, ch. 5).
 - 15 The World Bank report makes passing reference to the problem of methane hydrates that are trapped in vast quantities in Arctic tundra and the sea bed. In so far as current global warming melts the tundra, these hydrates are likely to be released and with methane being a potent greenhouse gas will start a process of non-anthropogenic increase in greenhouse gas that could eventually result in a reconstitution of the earth's atmosphere that will completely destroy the biosphere. Whilst not being disputed as a possibility, this eventuality is not further discussed in this paper!
 - 16 White (1959, p. 56).
 - 17 Georgescu-Roegen (1971).
 - 18 Following the World Summit on Sustainable Development in 2003, the UN established a small unit entitled UN-Energy that at least provides some overview of what the various UN agencies are doing in terms of energy. A glance in the Internet at their activities and publications confirms the total absence of any strategic focus on future energy availability and problems that might emerge with the decline of fossil fuels.
 - 19 Looked at in terms of assets—disregarding banking and insurance—oil and gas concerns comprised in 2005 eleven of the top twenty largest enterprises globally—and vehicle manufacturers a further five (source: Fortune Global 500 for the listed companies and *Financial Times*, 5 December, p. 11 for non-listed, including state-owned companies).
 - 20 IEA (2006, p. 2).
 - 21 Ranging from Switzerland at 3.72 to Belgium at 5.51 tons of oil equivalent per capita per annum.
 - 22 By 2005 only one European country, Norway, derived more than 20 per cent of its energy from hydropower (WRI, 2005, table 7).
 - 23 Of 35 European countries only 5 derived more than 20 per cent of their energy from nuclear power in 2005 with France (41.3 per cent), Lithuania (37.2 per cent) and Sweden (36.8 per cent) heading the list and more than half having no nuclear capacity at all (WRI, 2005, table 7). Currently in decline, a major revival of nuclear power investment using present technology would lead within a few decades to the exhaustion of global uranium resources.
 - 24 For starters: Heinberg (2003, 2004), Kunstler (2005) and McKillop and Newman (2005).
 - 25 IEA (2006).
 - 26 Heinberg (2003, 2004) and Kunstler (2005); see also the widely circulated video *The End of Suburbia*: www.endofsuburbia.com
 - 27 Meadows *et al.* (1974).
 - 28 Meadows *et al.* (2004).

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