

**On Babies and Bath Water:
Why Factor Four and Natural Capitalism Deserve a Careful Critique**

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The publishing of *Factor Four* and *Natural Capitalism* would seem to add weight to the notion that important shifts are currently occurring in the environmental debate. Informed by a central premise that 'if resource productivity was increased by a factor of four, the world would enjoy twice the wealth that is currently available, whilst simultaneously halving the stress placed on our natural environment' [vonWeizsäcker, 1998 et al., p. xv], *Factor Four* makes a bold case for the argument that technological innovation, better living and ecological concerns are perfectly compatible partners. Expanding on this theme in *Natural Capitalism*, it is a broader agenda still, of energy and resource efficiency, waste elimination, the development of a 'service and flows economy' and the restoration of 'natural capital' that is seen as laying the basis for nothing less than a 'new industrial revolution'.

For those used to engaging in the political end of green discourses, these texts make for interesting but disconcerting reading. In contrast to the problem-oriented and technologically pessimist tone that has dominated much environmentalist thinking over the last four decades, *Factor Four* and *Natural Capitalism* are relentlessly upbeat. In comparison to accounts of green futures which have made a virtue out of austerity or 'abandoning affluence' [Trainer 1985], this project boldly declares 'efficiency does not mean curtailment, discomfort or privatisation' [vonWeizsäcker, 1998 et al.p. xxii]. Unashamedly co-opting the language of Enlightenment optimism, it is argued that progress can be redefined in ecologically more benign ways. Indeed, rather than finishing off capitalism, a transition to an ecological society is seen as potentially making a profit for business.

Is this project either credible or desirable though? The message that you can have 'something for nothing' many well be the elixir of our current age. Such a message, moreover, may well be irresistible to business magazines and the politicians of the 'third way'¹. Yet, can it be seriously applied to the environment debate?

This paper argues that at an immediate level significant problems and even real dangers surface in this project. *Factor Four* and *Natural Capitalism* are hampered by moments of implausible optimism, managerialist ideologies and technologically reductionist assumptions. There is a failure to fully deal with the simplicities of the limits to growth analysis. Moreover, this sanitised repackaging of the alternative technology agenda ensures that much of the social and political edge contained in the original literature is lost. However, it is also maintained in this paper that too hasty a dismissal of this project - particularly if premised on Malthusian, eco-armageddonist or techno-phobic premises - is equally mistaken.

In a situation where the environmental debate is increasingly characterised by high degrees of disputation and science-politics manoeuvring, it is suggested there are distinct virtues in the manner in which this project seek to side-steps such disputes through an 'ecological

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modernist' discourse and a developed 'reconstructive-utopian' vision. The insistence that an ecological project does not entail a rejection of technology, development or affluence but indeed could open up new paths for environmental innovation, clean industrial development and better living for all is an agenda which deserves careful scrutiny. *Factor Four* and *Natural Capitalism* are correct in seeking to save the gains of *modernity* from undifferentiated eco-critique. What needs further scrutiny is the desire of this project to do the same for *capitalism*.

While the dominant current of this project is framed around a discourse of corporate environmental management, it is argued a second subordinate discourse can also be unearthed which is much more adequately described as 'green social democracy'. Questions are asked in this paper though as to whether either of these discourses fully examine the political, economic, cultural and social factors which could retard an ecological restructuring of the productive base. The extent to which this literature fully grapples with the potential *ecological irrationalities* of the new global political economy of contemporary capitalism is considered. Finally though, worries are raised as to whether this project fully considers the regressive potential of a corporate-lead eco-technological transition. To draw from the critical social theory of Dryzek, Plumwood and Leff, it is the extent to which a *Natural Capitalist* future might simply ensure that ecological rationality is achieved *at the expense* of democratic rationality and social equity that is raised as a chief concern.

Old, New, Borrowed and Green

There is no doubt that *Factor Four* and *Natural Capitalism* present us with an interesting barrage of ideas. Drawing from Amory Lovins' own pioneering work in eco-technologies [Lovins, 1977], lean-thinking managerial strategies [Womack and Jones, 1996] more long standing themes of ecological economics [Hawkin, 1993; Daly. and Cobb, 1989; Daly, 1994] and recent innovations that have occurred in environmentally friendly design, engineering and architecture [Wines, 2000], the end result is a stimulating but odd synthesis. Clearly inspired by the utopian spirit of the 1960's and 1970's radical technology discussion [see Bookchin 1965,1975,1976; Illich, 1973; Dickson, 1974; Boyle and Harper,1976] these texts are nevertheless spring-cleaned of reference to Mumford or Marcuse and fused instead with the buttoned-down probity of 1980 and 1990's green business discourses. Despite the evident desire to craft a discourse which appeals to elite policy makers, corporate managers and investors, one can still draw out interesting critical material from these texts.

Firstly, whether we are considering the huge amount of energy wastage that occurs in Western societies, the fact that 80% of products are discarded after a signal use or that 99% of the original materials used in the production of goods made in the USA become waste after six week of sales [vonWeizsäcker, 1998 et al., p.xx] *Factor Four* and *Natural Capitalism* offer a powerful critique of existing arrangements. Having read these texts, it is very difficult to avoid having a sense of the absurd social and ecological *irrationalities* that presently mark contemporary societies. From a materials and energy perspective, it is convincingly argued that current production processes in advanced capitalist societies are 'massively inefficient' [Hawken et al, 1999:8].

Working through the huge array of innovations available for significantly improving energy, materials and transport productivity, an equally strong case is made that much waste, pollution, environmental degradation and risk generation currently produced is simply unnecessary. Displaying how far alternative technology has come since the 1960's, it is persuasively demonstrated that resource productivity technologies, intelligent architecture and eco-design, plus productive and sustainable farming and forestry could offer massive opportunities for reducing environmental impacts. Biomimicry - where industrial systems are redesigned so that the waste of one process becomes either the input for another or is returned to the environment as a nutrient rather than a hazard - would seem to offer an intelligent way

of reorganising production processes. The range of further suggestions one can find in these texts that define the contours of 'the new industrialism' - from extending the durability of the service life of products - to making manufacturers responsible for the disposal of products would seem imminently ecologically rational

Further elements also stand out in these text though. For example, the assertion that many of these ideas are not just bright ideas on the drawing board but viable and indeed being partially implemented by US and European companies is interesting. It does add further evidence (albeit anecdotal) to the notion that the corporate world is at the very least hedging its bets and toying with alternative energy and renewables. If this claim is substantiated by further research it would add weight to the claims of ecological modernisation theorists [*see Weale, 1992; Hajer, 1995; Spaargaren 1997, 2000*] that a certain degree of institutional transformation orientated towards the sustainability agenda is now taking place in the OECD countries.

Perhaps the most striking aspect of this discussion though (if frustratingly undeveloped) is found in the suggestion that real opportunities exist for transforming current 'zero-sum' views of the relationship between environment protection and development. Demonstrating a sensitivity to the extent to which aspects of the UNCED Rio agreement in 1992 were seen by many in the South as a Northern attempt to both frame the global environmental agenda and possibly put a 'cap' on Southern development [*Agarwal and Narain, 1991; Redclift, 2000*] the *Factor Four/Natural Capitalism* agenda is presented as offering a new way forward. Eco-tech innovation coupled with institutional and productive reorganisation could ensure that 'even the gravest world-wide distribution problems can be solved without any part of the world having to accept significant sacrifices in well being'. [*vonWeizsäcker, 1998 et al.,:268*]. Indeed, partially coinciding to the long stand analysis of the ecological left, that a lack of prosperity is one of the South's principle environmental problems rather than population growth per se [*Bookchin, 1990; Harvey 1996*], it is argued that a principle ecological duty of the North should be to not only embark on a Factor Four transition as soon as possible but to do all it can 'to facilitate both increase prosperity and the efficiency revolution in the South' [*vonWeizsäcker, 1998 et al.,:266*].

These texts then are clearly full of highly ambitious claims and assertions that scandalise traditional ecological positions. Moreover, there is also a distinct attempt to 'turn the tables' on traditional framings of the environmental debate since it is now the green side of the argument that is rapped itself in the cloth of technological optimism. Do these arguments and manoeuvres actually stand up to sustained critical scrutiny?

The Critics Assemble

While these texts have attracted an overwhelming array of plaudits, a number of criticism of this broad agenda can be identified. For deep green critics such as Wolfgang Sachs [*1987, 1999*] a basic problem with this project is that it is still seems inadequate for dealing with the current scale of 'the global survival crisis' for which evidence is indeed 'incontestable' [*Sach, 1999:47*]. The type of changes this project advocates, it is argued, will simply be eaten up by more fundamental exponential rises in pollution, resources use etc. Moreover, this project is seen as not only problematic for trying to transcend 'natural limits' but also for its potential to further stoke the misleading agenda of corporate greenwash. From this perspective then, it is an agenda of 'sufficiency', 'self limitation' and a sense of 'enoughness' that needs to triumph over demands for eco-efficiency and resource productivity.

Alternatively, contrarian voices such as James Heartfield [*1998*] and John Gilliott [*1999*] have been keen to assert that this project is merely a new Malthusianism dealing with environmental problems which are largely fictitious or overstated in any case. The idea that we need to increase resource productivity is based 'on a false sense of limits'. Moreover, it is

maintained that the manner in which this project counterpoises labour productivity against resource productivity is mistaken. Increasing labour productivity should remain 'a key goal of human progress' [Gilliot 1999:139]. *Factor Four* is thus a project which is against progress and ultimately a fairly conservative attempt to downscale production. [Heartfield, 1998].

One might well muse here: so far, so predictable. More recently though other voices have joined the debate. For figures such as Vaclav Smil, [1999, 2000] and Horace Herring [2000] it is the sweeping nature of this project with its 'grand prescriptions for paradisiacal futures' and its supremely rational utopianism that is its ultimate undoing. Thus, Smil argues this project demonstrates no recognition for the unintended consequences it could generate or the extreme difficulties that could arise in implementing such proposals. For Smil then it is the gradual workings of 'evolutionary change' which need to be defended over 'facile' calls for sweeping revolution.

Perhaps the central and most extended academic debate that these works and the broader 'factor x' discussion have provoked so far though has centred around the question of whether the pursuit of eco-efficiency and resource productivity will actually deliver the gains that are claimed for it. Energy analysts [Sachs 1999; Inhaber and Saunders 1994; Herring 1998, 2000] have suggested that it remains very unclear that gains in eco-efficiency at the *micro level* will actually add up to an improved situation at the macro level. For Sachs, the basic fallacy of the eco-efficiency programme is its failure to deal with three central effects: rebound, volume and growth. Rebound effects are seen to arise when efficiency gains stimulate new expansion e.g. a more fuel efficient economy might simply encourage more people to use more heat etc. A volume effect arises from expanded demand for an eco-efficient product e.g. cars are more eco-efficient than years ago however, the increasing number of car, their size & power swallows up the efficiency saving. Finally, growth emerges from the expansionary tendencies of the economy as a whole. Thus, it is suggested, independent of per unit efficiency, if the dynamics of the economy are expansionary at the macro level this is again going to eat up eco-efficiency measures [Sachs, 1999].

The Evident Weaknesses of *Factor Four* and *Natural Capitalism*

Standing accused then, of being simultaneously too revolutionary and too conservative, excessively rationalistic and not rationalistic enough, it would appear that this project has had to negotiate difficult rapids. What would seem to emerge as evident failings of the *Factor Four/Natural Capitalism* agenda?

There is no doubt that there *are* good reasons to hold distinct reservations about this project. Firstly, it is certainly the case that this project suffers from excessive hyperbole. The Lovinses and their collaborators do write in a fashion so unrelentingly optimistic and up-beat, that these texts are often exhausting to read. So keen to please, convince and avoid 'negativity' at times *Factor Four* and *Natural Capitalism* end up reading like a Californian self-help manual.

It is also disappointing that these texts never quite achieve the spring-cleaning of Malthusian myths from the environmental debate with the degree of thoroughness that is clearly needed. For example, questions could indeed be raised with the whole manner in which this project frames the 'environmental problematique'. It is at least recognised that the original *Limits to Growth* report on the population/resources issue underestimated the significance of technological innovations and the effects of substitutes to ameliorate such problems. Reasonably enough, it is argued attention now needs to be given to the very real series of worries that surround the issue of ecological simplification (the filling up of sinks and the deterioration of ecosystems and biodiversity). However, these reports are still dependent on the highly problematic *Beyond the Limits* study². Thus, despite all the talk of 'modernisation', it could be noted that a whole series of highly ideological concepts such as 'carrying capacity', 'overshoot', and problematic undifferentiated exponential projections of environmental

degradation slip into this analysis drawn straight from sixties and seventies popular ecology. There is a distinct failure here to engage with the more complex social ecological analysis that has emerged out of geography, critical social theory and environmental sociology over recent years which has sought to transcend the simplistic and unproductive framing of the environmental debate in terms of the catastrophe/cornucopia discussion. There is no attention given to the growing literature that has sought to understand environmental degradation as a product of the complex interplay between economic and political institutions, social practises ideologies and eco-systems rather than people and their appetites [see amongst others Benton 1994; Bookchin, 1980, 1990; Braun and Castree 1998; Dryzek 1987; Haila and Levins 1992; Harvey 1996; Leach and Mearns 1996; Philips and Mighall 2000; O'Connor 1998, 2000; Taylor, Halfon and Edwards 1997].

More serious and disturbing though is the manner in which *Factor Four* and *Natural Capitalism* bolster reductionist currents in the environmental debate. One need not share the suspicion of science and technology apparent in certain deep ecological quarters to recognise how *scientism* and a narrow focused technological reductionism can have the effect of systematically *detracting* attention from the social and political roots of social and ecological problems [Habermas 1971; Benton, 1994]. The wild claims that currently abound, for example, that biotechnology will 'cure' world hunger, stands as a case in point where excessive attention to 'technological fixes' has almost entirely sidelined well grounded research demonstrating the social and political roots of famines [see Sen 1981; Lappe and Bailey 1999]. Excessive claims made in *Factor Four* that energy efficiency might contribute to world peace or poverty alleviation generate the same dangers. Reductionism occurs at two further levels in this discussion though.

Firstly, re-enforcing recent moves in World Bank , OECD and corporate discourses to see sustainable development as a capital exchange process, a high degree of objectification enters into this discussion. In *Factor Four* and *Natural Capitalism* 'nature' is reduced to a resource 'out there' to be managed as 'natural capital' and the human subject becomes simply 'human capital'. As Eamonn Molloy has noted, the ethical and moral implications of conceptualising individuals and social relations as 'stock' or 'capital' that can simply be produced, consumed and re-evaluated are simply elided as is the rhetorical resonance this language has with the discourse of eighteenth century slave traders [Molloy:2001]. Hawken, Lovins, Lovins and vonWeizsäcker demonstrate very little recognition that the use of this language

'open[s] up the possibility of regarding the entire non-human world, genes, bodies, species as instrumentally there for exploitation, appropriation, and accumulation...now social relations and culture, indeed subjectivity itself can be owned, traded, consumed, turned into waste and thoughtlessly discarded' [Molloy, 2001]

Secondly, and somewhat unsurprisingly, the politics that emerge from this project have distinctly managerialist overtones. As Hawken, Lovins and Lovins brazenly state in *Natural Capitalism* as a broad prescriptive vision:

'Communities and whole societies need to be managed with the same appreciation for integral design as buildings, the same frugally simple engineering as lean factories, and the same entrepreneurial drives as great companies.' [Hawken et al,1999:286]

Indeed, in a revealing passage following a discussion of the ecomodernist virtues of the Brazilian City, Curitiba, it is argued that one of the great virtues of the mayors who have run this city is that:

'Five of the six were architects, engineers, or planners who treated the city and its political leadership as design problems' [Hawken et al, 1999: 290]

When one is reading these statements one does wonder why the Lovinses and their co-workers don't simply go all out and call for the return of Plato's Guardians as a solution to our ills! Part of the basic problem here, of course, is that not only does this analysis reiterate the classic mistake of static and a-historical utopianism (the idea that politics can be replaced by rational design) but little awareness is demonstrated of the extent to which there is a long, and now well documented, history of public and environmental health being used as regulatory strategies of social control [Darier, 1999]. Little attention is given to the growing concerns that have been raised against the manner in which domestic and global environmental agendas are increasingly being subverted and rearticulated by state, NGO, corporate and international bodies giving rise to technocratic strategies of social control and Foucaultian projects of 'green governmentality' [see Bookchin 1990; Sachs 1993; Gorz, 1993; Haila and Levins 1992; Luke 1999; Darier, 1999].

Beyond these issues though, what can we make of the broader array of objections that have been pressed against this project? Is it the case that the *Factor Four/Natural Capitalism* project needs to be rejected for the manner in which it contains too many 'facile affirmations' [Smil 2000] or because it ultimately possesses 'zero political appeal' [Herring 2000]?

On Babies and Bathwater....

While this project clearly has its problems, there are grounds for feeling that some of the criticisms that have been launched against it equally deserve careful scrutiny.

If we turn firstly to the principle technical objection to this project, the manner in which energy efficiency programmes can give rise to 'the rebound effect' is clearly an important issue. There is no doubt that the well grounded research of Brookes [2000]; Sach [1999], Herring [1998; 2000a]; Rudin [2000], Owens [2000], and Moezzi [2000] amongst many others suggests that serious questions could be pressed against the idea that pursuing energy efficiency *in itself* offers an easy solution to current problems. It seems evident though that within this literature, and elsewhere, critical questions remain concerning how much, how rapidly, in which sectors and with what manifestations such rebounds occur [Schipper 2000].

For example, different institutional and political settings would seem to affect the success of energy efficiency programmes [Owens, 2000] as would the length of time over which such energy programmes are measured. Summarising the conclusions of a recent series of research papers on this issue, Lee Schipper has suggested that the broad consensus emerging in the field is that: 'rebounds are significant but do not threaten to rob society of most of the benefits of energy efficiency improvements' [[Schipper, 2000:353], *but also see see Schipper and Brookes 2000; Greening, Green and Difiglio 2000, Haas and Biermayr 2000, Berkhout, Muskens and Velthuijsen*].

These conclusions are of course provisional and subject to ongoing debate. At the very least though such research suggests that some of the more sweeping dismissals of the *Factor Four/Natural Capitalism* project based on the 'efficiency does not work' premise can be questioned. It does also need to be recognised, moreover, that neither *Factor Four* nor *Natural Capitalism* are as innocent of this issue as some critics have inferred. For example, as Hawken, Lovins and Lovins explicitly state:

'Without a fundamental rethink of the structure and the reward system of commerce, narrowly focused eco-efficiency could be a disaster for the environment overwhelming resource savings with even larger growth in the production of the wrong products, produced by the wrong processes, at the wrong scale and delivered using the wrong business models' [Hawken et al 1999 p.x]

In some respects then, there is perhaps less distance between the Lovinses and their critics here. Both are in agreement that a narrowly conceived efficiency agenda on its own is not going to stand as any kind of viable panacea to current problems.

Moving on to the deep green critique of this project, problems clearly emerge here. A central problem with Wolfgang Sachs's position is that it is premised on a rather undifferentiated view of the environmental debate. Few serious commentators would now maintain that the environmental transformations currently underway are anything but 'larger scale, riskier and more far reaching and complex in their implications...than ever before in human history' [Harvey, 1998]. However, it equally needs to be recognised, in the detail of specific environmental questions, there is still considerable scientific debate. For example, as Peter.J.Taylor has observed 'after an initial honeymoon period, global climate modelling, estimates of biodiversity loss and other studies on the implications of environmental change have become subject since the early 1990's to scientific and consequent political dispute' [Taylor, 1997:149]. Sachs starting point for a critique of the Factor X debate does seem inadequate in firstly failing to appreciate the extent to which the environmental debate more broadly is clearly marked by high degrees of contestation

Deeper failings are also evident in this line of thought. Notably, there is a further failure here to recognise what could be call the diminishing returns of over-generalised ecological armageddonism. Generalised armadeddonist positions may well have served some purpose in the 1960's and 1970's in getting environmental questions onto the political table³. However, as a range of thinkers sympathetic to the ecological agenda have increasingly argued of late [see Katz, 1993; Gorz, 1994; Harvey, 1996; Boucher, 1995] questions really could be asked about the continued usefulness of this means of framing the environmental discussion. Concerns have been raised for example as to whether overgeneralised crisis naratives can merely simplify complex issues [Leach and Mearns, 1996]. Moreover, it remains increasingly unclear whether such approaches actually spur action or in fact generate their own pathologies such as fatalism or disempowerment by excessive risk anxiety etc. [Katz, 1993; Gorz, 1994; Harvey, 1996].

It could be argued then, that despite all their problems, in certain senses here the Lovinses and their co workers actually offer a much more sophisticated reading of the current state of the environment debate than their deep green critics. There is a much greater recognition in both *Factor Four* and *Natural Capitalism* of the extent to which the environmental debate is increasingly characterised by high levels of complexity, uncertainty and huge degrees of science-politics manoeuvring and that devoid of a powerful, credible and attractive alternative vision this in turn simply gives rise to institutional and political sclerosis. Whatever the other failing of this project then, it could be observed that there is at least an attempt here to pose the question: how can ecological positions move forward in a political environment which seems less spurred to action by eco-crisis narratives but more likely to be paralysed, in a manner that their green critics have scarcely caught up with?

Similarly problems could be raised with the whole notion that a politics of 'self limitation' and 'sufficiency' offers a viable alternative to the *Factor Four/Natural Capitalism* agenda. There are of course many virtues to Green arguments that have sought to challenge the new secular religion of consumption. The basic insistence that there could be modes of being, pleasures, sensations and experience (individual and inter-subjective) beyond that offered by societies driven by relentless commodification, consumption, privatisation and egotism are vitally important issues. This thinking draws from a rich intellectual genealogy from Marx's critique of commodity fetishism to Aristotle's reflections on the nature of the good life as the balanced life. Problems emerge here though when these legitimate issues are reframed into the demand for a generalised 'politics of 'enough'. It needs to be remembered firstly that voluntary simplicity is not a particularly attractive aspiration for those who live in involuntary poverty. Moreover, surely the Lovinses are correct here to argue that the point of an ecological project

should be about 'improving the quality of life for all' rather than 'redistributing scarcity' [Hawkins *et al* 1999:158]. Demystify consumption by all means but surely not to make a virtue out of self denial.

To move from one extreme position to the other what can be made of the contrarian critique of *Factor Four*? Questions could indeed be asked about the rather sharp juxtaposition that can be found in both *Factor Four* and *Natural Capitalism* between the desirability of resource productivity and what is viewed as a less desirable aspiration to achieve labour productivity. The emphasis the Lovinses place on the manner in which certain paths to an ecological transition might well be labour generating clearly needs to be counterbalanced by the long standing theme of left-ecological theorists such as Bookchin [1971], Gorz [1976] and Soper [1990; 1998] that an ecological society should ultimately aim- wherever possible - to open the possibilities for better living rather than tightening the work ethic, for expanding the 'realm of freedom' rather than the 'realm of necessity'. Of course, there is nothing inherently progressive about the pursuit of labour productivity in and of itself (contra Heartfield and Gilliot's rather reductionist assertion that increasing the productivity of labour 'should remain a key goal of human progress'). More productive labour can simply be attained by making work more repetitive, exploitative, dehumanising and alienating and ensuring that society at large is further colonised by instrumental rationality. Surely, the ultimate aim of an emancipated society should not be simply to make labour more productive but to make it more meaningful.

A deeper problem with this contrarian argument though is that not only is it based on a questionable grasp of environmental science⁴ but that it does seem to be premised on some quite shaky theoretical assumptions of its own. Notably, one could seriously question the implicit assumption in these arguments that it is the *scale* of productive processes and the *net throughput of materials* that should be regarded as a mark of progress. Based on this reasoning, the industrial installations of the high industrial revolution must surely be judged more 'progressive' than anything the information age has to offer?

More generally, it could well be asked, is a project which aims to achieve higher energy efficiency, lower environmental impacts and more considerate and productive farming, that aspires to reduce waste, congestion and noise, produce higher quality goods and allow people to travel more comfortably in ultra-light hybrids cars backward looking? (Following this logic presumably profligacy and waste generation are forward looking?) More troubling still, is it seriously going to be maintained by contrarians that the only choice open to the developing world is simply to accept existing arrangements or embrace a Victorian phase of dirty industrial development with all its Dickensian misery. No possibilities open then for the people of the South to have the option of 'leap-frog' eco-technologies which facilitate as fast as is possible a clean transition to a ecological modernity and the information age -*should this be their want?*⁵

Finally, what can be made of the claim that *Factor Four* and *Natural Capitalism* are marked by techno-hubris and utopian overstatement? As we have established, technological fixes of course are not going to provide any kind of long term solution to current problems. However, it would also seem increasingly evident - as Bookchin [1995], Gorz [1994], Harvey [1996], and Feenberg [1999] have insisted over recent years - that Luddite, technophobic and romantic green currents can be as *environmentally problematic* as 'gung ho' technological determinism.

For example, if we accept André Gorz observation, that a credible ecological project needs to stake its hopes 'not on a return to the past but on the capacity of modern societies to transcend themselves and enter on a *different mode of development* from the one which has shaped them up to now' [Gorz, 1994:7], then it would seem evident that there is no feasible way that this is going to occur without fully sifting through and considering the potential advantages (as well as judiciously weighing the drawbacks) of advanced technology. Simply *understanding* and

mapping current environmental change at present involves using advanced computational models of the highest order. Moreover, *adapting* our increasingly complex, dense and hyper-mobile societies [Castells, 1996; Urry, 2000] to future socio-ecological changes (let alone *ameliorating* undesirable change where this is still possible) is simply going to be impossible without availing of advanced technologies.

Secondly, it could also be argued that the Lovinses possibly *underplay* potential environmental benefits that could possibly emerge from new technologies if they were placed in the appropriate context. Speculations considering possible technological futures of course are exactly that - speculations. They invariably involve a degree of sooth-saying, and, in this regard we would do well to heed Smil and Herring's words of caution about being carried away on a bubble of techno-optimism [Smil, 2000, Herring 2000]. Yes, it is now the 21st century and no, we do not have jet packs or hover cars, nor are we taking Martian holidays or lunar city breaks - contra the expectations of some past pundits. It also needs to be recognised though that influential currents of opinion are now arguing that we are living through a period of extraordinary scientific and technological advances [see Castells, 2000; Hutton and Giddens 2000]. Whether we consider 'Moore's Law' (the notion that current microchip capacities are doubling in performance every 18 months) or Castells' observation that digitisation has opened up possibilities for unprecedented interfaces between technological fields and cumulative 'feedback loops' [Castells, 2000], current advances in micro electronics, computers, telecommunications and the biological sciences would seem nothing short of extraordinary.

The nature of these developments and their current directions are clearly not without problems. The development of science and technology clearly does not occur external to society (contra the assertions of some technological determinists). The decline of the public sphere as a whole in the West, public funded science and disinterested inquiry has increasingly insured that the research agenda of the natural sciences have become more and more integrated into the technical and marketing requirements of corporate interests [Benton, 1994]. Well grounded work in the sociology of science has drawn attention to the extent that '[p]olitical, economic, and military interests shape by way of the organisation and funding of research, the research priorities and the formulation of problems for investigation on behalf of the scientific community' [Benton, 1994:35].⁶This, in turn, has given rise to many *legitimate* concerns about the current nature of technological development.

It would seem a great mistake though, for ecologically minded people, to simply close down debate and careful consideration of real social and environmental gains that could perhaps open for re-appropriating current technologies developments or shifting their path in different directions. (The internet after all was initially developed by the US defence department - as Castells (2000:59) notes, but has subsequently been reappropriated in any number of alternative ways). In this respect, it could be observed that *Factor Four* and *Natural Capitalism* scarcely scratch the surface of possible gains that could be opened for example by nanotechnology, the information technology revolution [see Jokinen, Malaska, and Kaivo-oja 1998; Ehrlich, Wolff, Daily; Hughes; Daily; Dalton; Goulder 1999; Romm, Rosenfeld, Hermann 1999] or even biotechnology in a different institutional context.

Indeed, even on the issue of utopianism, a certain care needs to be taken here when it is simply assumed that such a mode of thinking is inherently absurd. *Factor Four* and *Natural Capitalism* are marked by a rather *static* utopian sensibility. However, it would seem grievously misjudged to move from this to dismissing the value of utopian speculation in its entirety. As David Harvey has observed:

The rejection in recent times of utopianism rests in part on an acute awareness of its inner connection to authoritarianism and totalitarianism...But rejection of utopianism

on such grounds has also had the unfortunate effect of curbing the free play of imagination in the search for alternatives' [Harvey:2000 163].

And, it could be observed almost the last thing we need at the present time is more calls for the closing down of our political horizons!

Developing A Progressive Critique of Factor Four and Natural Capitalism

It could be argued then that part of the basic problem with many of the existing criticism of the *Factor Four/Natural Capitalism* project is that many of these lines of thought tend to draw inspiration -whether intentionally or not - from the various and multiple forms that philosophical conservatism can take. One can see the spirit of Edmund Burke hovering over Sachs' demands for a politics of 'self limitation'. It is the thinking of Michael Oakeshott that informs the anti-rationalism and anti-utopianism which runs through Smil's scepticism. Alternatively, it is Ayn Rand and Julian Simon's belief in the omnipotent and inherently environmentally benign qualities of the free market that would seem to inform the contrarian arguments of Heartfield and Gilliott. How then might one move this discussion in a different direction?⁷

Two issues would seem to provide useful orientating points for thinking about how to develop a progressive critique of *Factor Four* and *Natural Capitalism*. Firstly, if this project is technically possible (even in part) and viewed as desirable, it would seem evident that a *progressive* critique should perhaps start to explore the political, economic, cultural and social factors might hold back such a development? To focus this question, it could well be asked to what extent is it credible to believe that an ecological restructuring of the productive process is viable relying simply on corporate good will, rational self interest of business, and market mechanisms? Secondly, and to do justice to the legitimate reservations that do exist around the technological fix, it clearly needs to be ask if ecological rationality [Dryzek, 1987; Plumwood, 1995] is possible within the context of the given system, to what extent might this be achieved at the expense of democratic or communicative rationality and social equity?

Natural Capitalism or Natural Social Democracy?

' Critics on the left may argue that business people pursue only short term self-interest unless guided by legislation in the public interest. However, we believe the world stands on the threshold of basic changes in the conditions of business. Companies that ignore the message of natural capitalism do so at their peril'

[Hawkins et al, 1999:xiii]

In both *Factor Four* and *Natural Capitalism* a dominant, 'business friendly' discourse provides the public framing of these texts. Full of rhetoric that emphasises the importance of 'harnessing the talents of business to solve the world's deepest environmental problems' [Hawkins et al: xiii], constant attempts are made in this discourse to establish the market friendly credentials of this project. Drawing from a neo-classical view of technological change that essentially seems to assume that firms will choose the technique of production that offers the maximum possible rate of profit, it is maintained that the eco-technological and other changes advocated will occur quite simply because if companies do not introduce this produce they will lose competitive advantage [Von Weizäcker et al,1998 :xix; Hawkins et al 1999: xiii]. Something of an inevitabilist thesis is cultivated and a smooth compatibility assured between this project and the interests of corporate CEO's. Thus, at certain points in comforting third way-new Democrat tones, we are informed that this project is 'neither conservative nor liberal in its ideology' [Hawken et al, 1999:20]. Indeed, even lurching at times towards Gingrich-sounding New Right rhetoric, we are assured that much of this project 'can be implemented largely in the marketplace, driven by individual choice and

business competition, rather than requiring governments to tell everyone how to live' [Von Weizäcker et al, 1998: xxiii]. A number of questions are clearly left hanging in the air though concerning how this vision of 'responsible corporate- lead greenery' is going to come to pass.

For example, at numerous points we are assured extensive profits are possible through pursuing *Factor Four/Natural Capitalist* measures and examples are provided of individual firms who have achieved this. It remains very unclear though just how *representative* these companies are. Questions also hang in the air as to as to how industry-lead ecological restructuring might actually work at a broader sectoral level. One could reason that certain sectors of national economies have deep interests in pursuing the range of activities advocated by *Factor Four* and *Natural Capitalism* (such as emerging sustainable technologies companies, renewable energy companies etc). Matters remain much more uncertain though with the far larger and more powerful industrial sectors of the old economy (notably oil, chemical and automobile sectors). One could wonder here - are such companies going to simply write off possibly billions of dollars of fixed investments because a production process has been deemed ecologically redundant?

The Lovinses do point out that key US corporations have in fact been at the forefront of developing and exploring recent eco technological innovations (e.g: the automobile sector committing over \$5 billion between 1993-1998 to developing the 'green' or 'hypercar', Dow Chemicals developing 'organic solvents' and announcing a \$1 billion, 10 year environmental investment programme, DuPont experimenting with 'closed loop' production processes etc.). What is not established though is the actual percentage of the overall company turnover that is actually being diverted into such ventures. *BP* may have based their new image on *Die Gruenen's* sunflower, gone 'beyond petroleum' and their chief executive may well have give a Reith lecture on sustainable development this year. However, *Greenpeace's* recent comment that *BP* spent more on this image change in 2000 than they did on their whole renewable energy programme in 1999 needs to born in mind here⁸.

What is interesting about these texts though is that underneath the glossy and reassuring surface, a rather different second narrative starts to emerge. Notably, after all the various protestations of 'market purity', our valiant *Natural Capitalists* slowly begin to hint that there might be rather more problems between contemporary capitalism (particularly in its current 'red in tooth and claw' neo-liberal mode) and the environment than their corporate readership might want to hear.

Thus, after endless celebrating of 'win-win' scenarios and new eco-businesses opportunities, it is conceded a central failing of 'industrial' (i.e: contemporary) capitalism is that it neglects to assign any value to the largest stock of capital that it depends on - notably the ecosystem. Consequently, there is the slight problem that the market does not adequately account for its own externalities [*Hawkins et al, 1999:5*]. Moreover, it also noted that existing capitalism relies on accounting systems and incentive structures which *actively encourages* the liquidation of 'natural capital'. Indeed, before you know it, these *Natural Capitalists* start to suggest that a whole range of structural deficiencies: from the chronic short term-ism that governs the movement of investment capital to the 'destructive potential of free trade' [*Von Weizäcker et al,1998:282*]; from the whole tax and incentive structure to the irrational use of urban space, gives rise to ecologically irrational outcomes. Indeed, (and in direct contrast to other corporate friendly statements) concerns are even raised with 'the massive interests some capital owners have in preserving existing structures' [*Von Weizäcker et al,1998: xxvi*].

What solutions exist then for dealing with these dilemmas? When the discussion turns in this direction, both *Factor Four* and *Natural Capitalism* begin to suggest a range of much deeper changes are necessary for a functioning green market economy. Thus, drawing from standard themes of ecological economics, it is maintained markets need to be reconfigured so that prices reflect the true price of goods (factoring in their environmental impacts), GDP needs to

be changed to an index which would reflect to a much greater degree quality of life issues, and indeed it is argued the whole tax and incentive structure needs to be revised. It is maintained that we need a whole rethinking of urban policy and urban planning to encourage 'smarter land use' 'stronger neighbourhoods' and compact convivial cities [Hawken et al, 1999:47] to replace anomic and ecologically irrational urban sprawl. Indeed, shading rather dangerously closely to the 'red-green' end of the spectrum at one point it is even suggested that we could perhaps see a moment where a progressive and active trade union movement took the lead in demanding 'just transitions' for the workers and communities reliant on unsustainable production processes [Hawkins et al, 1999:1].

What is interesting about this turn in the discussion (and somewhat at variance with the first discourse) is that the sum total of these changes suggest that free-market capitalism needs to be transformed rather more than the surface self image of this project admits⁹. Indeed, creating the conditions for a viable ecological modernist project would appear to crucially depend on a re-legitimised public realm that pursues an interventionist economic policy, a credible industrial policy and intelligent urban planning. If we ignore here some rather daft ideas about taxation that are floated in *Natural Capitalism*¹⁰, it could be argued that the actual project the Lovinses and their co-workers end up with by and large would be more accurately entitled *Natural Social Democracy*.

Some Problems with 'Natural Social Democracy'

Natural Social Democracy certainly does seem rather more credible than its *Natural Capitalist* rival and when the discussion turns in this direction it is certainly the case that a series of reforms are advocated which would be highly desirable. Further question though clearly hang in the air concerning the longer term feasibility of even this project. For example, it remains very unclear whether even this version of the *Factor Four/Natural Capitalism* project fully grapples with certain central challenges that could stand in the way of its implementation. Two broad areas stand out as requiring further scrutiny here. Firstly, a series of issues could be clumped together under the general heading of 'cultural pathologies of hyper-consumer societies'. Secondly, a further series of questions arise in relation to the fact that contemporary capitalism is clearly in a new phase of globalisation.

If we turn firstly to the whole issue of consumption, one of the on going doubts that have been raised about the greening of capitalism has revolved around the 'treadmill of production' thesis [Schnaiberg, 1980]. Thus, it has been maintained a central anti-ecological tendency of capitalism is that the very dynamics of the production process ensure it has a distinct tendency to generate endless quantities of products with built in physical obsolescence. The Lovinses and their co-workers are certainly aware of this problem. Rather than adopt the 'politics of enough' approach they make the imminently sane argument that an ecologically rational society would seek to make products that are long lasting, durable and upgradable. It is thus argues for the virtues of moving towards a 'service and flows' economy. The basic idea here being that product durability could be improved by manufacturers becoming less sellers of products but providing leasing and renting arrangements for services. Mechanisms and incentive structures are created so that it is manufacturers that are responsible for serving, upgrading and disposing of products.

This idea perhaps should not be immediately dismissed. A service and flows economy for example might well have some relevance in business to business ventures given that rental of accommodation, appliances and equipment is already a well established part of business culture. As a broader strategy to make domestic consumption more sustainable though, it would seem to ignore the social and cultural dynamics of consumption in free market societies and the extent to which it does run up against the ideology of consumption. For example, it would seem evident that the a desire for *ownership* of property, goods and resources in contemporary society is intimately and understandably tied to a desire to gain

security and control over one's life for many. Purchasing items on hire purchase in contrast is invariably viewed as a necessary evil at best. The extent to which a goods and service mentality could significantly penetrate the domestic sphere at present thus does seem slight. The extent to which the often manic nature of consumption patterns in contemporary societies is linked to the preserve and legitimisation of 'distinction' [Bourdieu], conspicuous consumption [Veblen] and coping with status anxiety also needs to be carefully considered. Credible advocacy of a 'service and flows' economy would also need to deal with the fact that it is not just built in physical obsolescence that can give rise to ecologically irrational outcomes but built in cultural obsolescence. As James O'Connor argues 'If it is impossible to build forced obsolescence into commodities...capital tries to market old products in new packages which require more natural resources and also generates more waste and pollution' [O'Connor 1990:12].

Any credible socio-ecological project seeking to rethink or rechannel consumerism clearly needs to grapple with the ideology of consumerism and the manner in which its mistaken and ideologically linked conflation with 'freedom', 'autonomy' and 'choice' has reached the status of a secular religion in the affluent world. As Bookchin has argued, perhaps one of the central social and ecological irrationalities of contemporary capitalist societies is the manner in which it is characterised by 'consumption for the sake of consumption'. For Bookchin, contemporary free market societies are characterised by a collective social pathology of 'buy or die' where, as Bookchin notes:

'...just as the production of commodities is no longer related to their function as *use-values*, as objects of real utility, so wants are no longer related to humanity's sense of its real needs. Both commodities and needs acquire a blind life of their own; they assume a fetishised form, an irrational dimension, that seems to determine the destiny of the people who produce and consume them. Marx's famous notion of the "fetishisation of commodities" finds its parallels in a "fetishisation of needs". Production and consumption in effect, acquire superhuman qualities that are no longer related to technological development and the subject's rational control of the conditions of existence' [Bookchin, 1982:68]

The consumption machine does produce a 'social hypothesisation of need' as Bookchin notes. It is very difficult to see that *Natural Capitalism* would in any way ameliorate this effect.

The second issue that clearly needs to be pressed here concerns the viability of 'green social democracy' in an age of neo-liberal globalisation. There are good reasons to believe that the geo-politics of global capitalism and the massive inequalities that currently mark the world system do give rise to significant further problems in projects seeking to attain a more ecologically rational society. One central issue that needs to be addressed here is the spatial shift of ecological degradation in the light of globalisation.

There are good reasons to believe that a defining feature of contemporary globalisation is the manner in which it has given rise to various mobilities as John Urry [2000] and Manuel Castells [2000] have argued. An aspect of this has been the much noted growing mobilities of people, ideas, images, objects. More germane for this discussion though has been greater liquidity and mobility of capital and concurrently the growing capacities for *spatially shifting* ecological degradation. Following this, as Dryzek [1987, 1997] has long argued, questions clearly need to be asked concerning the extent to which the affluent countries embarking on ecological modernisation projects will simply achieve these ends by transferring their environmental externalities to poor countries? While much is made by contrarian thinkers about environment improvements occurring in advance nations across certain selectively chosen single indicators, the question of environmental displacement is rarely mentioned. Is the United States currently cleaning up though by simply transferring more of its 'dirty' industrial production processes to 'pollution havens' across the Rio Grande or by exporting

waste to the 'under-polluted' third world (to use World Bank official Lawrence Summer's notorious phrase)? Evidence would seem to increasingly point this way. For example, as David Swatterthwaite has remarked in his review of the economic geography of environmental displacement:

'...the fact [is] that businesses and consumers in wealthy cities can maintain high levels of environmental quality in and around the city (and the nation in which it is located) by importing all the goods whose fabrication implies high environmental costs. Thus, goods that involve high levels of energy, water and other resource use and generally involve dirty industrial processes with high volumes of waste (including hazardous waste) and hazardous conditions for the workforce, are imported.' [Swatterthwaite:1997:223; but also see Faber at al 1998].

Natural Capitalism though appears to be hardly cognisant of this development.

A further consequence of neo-liberal globalisation at present is that it has given rise to a new period of heightened international competitiveness between nation states. Such heightened competition coupled with combined and uneven nature of global development (Harvey 1996) this does raise questions about the viability of ecological modernisation as a global project. For example, given that the affluent world has hardly responded with profound generosity at the present in helping the South deal with chronic but entirely resolvable problems that resulting from a lack of clean water, basic sanitation, vaccinations and debt relief, can one seriously see broader clean and eco-technology transfers occurring? Michael Redclift [2000] has indeed maintained that the very structuring of the current world economy ensures that *disincentives* are currently at work giving rise to such outcomes. As he notes:

'...the transition to cleaner technology in the South is not encouraged by most major economic agencies of the Northern, industrialised economies, whose efforts (in so far as they are geared to 'ecological modernisation') are focused on gaining for themselves the market advantages conferred by higher environmental standards in tradable products. They have an interest in not transferring advanced, cleaner, more energy efficient technologies to the South. Acting in the global environmental interest is secondary for most transnational companies, to their pursuit of profit, until such time as profits reflect the internalisation of environmental values' [Redclift, 2000: 158].

Moreover, as Redclift notes, it is the uneven nature of development which ensures that for most developing countries the incentives to pursue lower energy intensities are negligible compared to the potential economic benefits of providing dirty (and frequently unsafe and unhealthy) employment. From the perspective of many of the developing nations of the South then, it would seem increasingly clear that

'It is by no means clear that sustainable development should be given president over achieving increased economic growth ...Posed as a conflict between intra-generational equity , and inter-generational equity, most developing countries are more likely to chose to reduce the inequalities in the present global economic system, rather than make sacrifices to achieve gains for future affluent generations (in the North).' [Redclift,: 200, 159]

It should be noted here once again that the Lovinses, Hawkins and Von Weizsäcker are not innocent of this problem. Concerns are raised at numerous points with the general direction the international architecture being developed around GATT, etc. It is never clear though how this recognition of the dangers of 'actual existing capitalism gone global' is reconciled with the mythical project of *Natural Capitalism*.

The Problem with Corporate Eco-Technology.

Beyond the viability or otherwise of the political economy of this project though, a final series of questions could be raised in relation to the understanding of technology that is demonstrated in this project.

There is a tendency in both *Factor Four* and *Natural Capitalism* to view technological development as a processes which is autonomous from politics. As we have seen, these texts essentially embrace something of a determinist and 'whig' view of technological innovation. Consequently, the *Factor Four* revolution is presented as inevitable and this is so because it is reasoned that the best technologies (that is, the most efficient and profitable) will win out. A basic problem with this claim though is that it would seem at odds with a range of research that has emerged out of the sociology and philosophy of technology of late [see *Bijker, Hughes and Pinch 1987; Winner, 1986; Feenberg 1995; 1999*]. Such research would seem to suggest that technological diffusion and development is not simply a matter of unilinear progression but a multi-centred affair where dominant social groups (political, corporate, military elite) and institutional actors (stock markets, shareholders, states, international institutional bodies) have significant capacities to veto changes they do not like and push technological developments in direction that they do like. Thus, the point one could make here is that even if all the above doubts about the viability of green capitalism are incorrect- *if there are not forces to make things differently* the eco-technological and institutional changes underpinning green capitalism might simply serve and reinforce the patterns of interest of these groups.

The radical tradition of eco-technology that existed in the 1960s and 1970's was concerned not simply with making technology more ecologically benign but also to increase people's autonomy and capacity for democratic control over their own lives [see *Bookchin 1965; Illich, 1973; Dickson, 1974; Boyle and Harper 1976*]. A problem with *Natural Capitalism* though is that in abandoning the social insights of this literature the project is blind and rudderless. There is a naive lack of awareness that such a project could give rise to eco-technologies that are perfectly compatible with extending social control, military power, worker surveillance and the broader repressive capacities of dominant groups and institutions. One could indeed muse could green capitalism simply ensure that employers have 'smart' buildings which not only give energy back to the national grid but allow for new 'solar powered' employee surveillance technologies. Could the clean air of the gated communities of the US middle class simply be attained by simply ensuring that a mass of wind farms are shifted downhill to the poorer neighbourhoods. What of a sustainable military-industrial complex that uses green warfare technologies that kill human beings without destroying ecosystems? After all, if we have to kill Iraqis, is it really necessary to destroy their beautiful building, cities and eco-systems as well?

The above Orwellian scenarios of course are not postulated as a determinist thesis, the word *tendency* was used and needs to be stressed. Technology is 'socially shaped' not socially determined. Opportunities do arise at critical conjectural moments to reshape the direction of technologies and critically re appropriate technologies for different uses. The Lovinses and their co-workers equally need to be reminded though that what often emerges from projects significantly dependent on technological change is not always what is intended.

CONCLUSION

'Today...the feeling of most people towards technological innovation could be described as schizoid, divided into a gnawing fear of nuclear extinction on the one hand, and a yearning for material abundance, leisure and security on the other...It is not surprising that the tension between promise and threat is being resolved in favour of threat by a blanket rejection of technology. To an ever-growing extent technology

is viewed as a demon, imbued with a sinister life of its own, that is likely to mechanise man if it fails to exterminate him. The deep pessimism this view produces is often as simplistic as the optimism that prevailed in earlier decades. There is a very real danger that we will lose our perspective towards technology, that we will neglect its liberatory tendencies, and worse, submit fatalistically to its use for destructive ends. If we are not to be paralysed by this new form of social fatalism a balance must be struck'

[Murray Bookchin, *Towards a Liberatory Technology 1965* :85-86]

'the fear that the ecology movement will be side-tracked into technocratic thinking is a real worry. [However], I am also concerned about no growth policies, anti - technology ideologies, regression to magic or pre-modern medicine, and the general mood of high minded nothingness about computers and technical advance that we've all encountered in certain quarters'

[Andrew Feenberg, *quoted in O'Connor 1990*]

'...the critical left often spends more time debating and lamenting the effects of western technoculture in other countries than it devotes to creating technological countercultures in the West'

Constance Penley and Andrew Ross *Technoculture 1999*

This paper has argued that many significant problems linger around the *Factor Four/Natural Capitalism* project. Questions have been raised as to whether these texts provide an adequate conceptualisation of the environmental problematique. Persistent worries have been raised against the technocratic and managerial tendencies evident in this project. More specifically, the market idealism and political naiveté that pervades this project have been extensively critiqued. It has also been argued though that a move from this critique to a generalised dismissal of this project - particularly if premised on technophobic or Malthusian grounds is thoroughly mistaken.

In an age of convulsive technological developments, both dangerous and exciting, it would seem increasingly evident that techno-pessimism provides a unsatisfactory basis demonstrates all the potential of collapsing into a form of ecological conservatism. is neither intellectual coherent nor does it provide

Whatever failings can be found in *Factor Four* and *Natural Capitalism*, it also needs to be recognised that the ever inventive Amory Lovins and his co-workers have developed an intelligent and a project with far too much liberatory potential to be. In contrast to the claim that luddite reaction is at the core of green thinking, this project clearly demonstrates that ecological awareness and an embrace of human creativity and innovation are not only compatible but in many respects, a prerequisite of attaining an social and ecologically rational society. In contrast to the claim that an ecological realignment of contemporary society constitutes a regressive backward step, this project demonstrates such a project could lead to a *qualitative improvements* in our lives. Finally, in contrast to the widely held idea that an ecological project constitutes a renouncement of modernity, we are presented with a powerful reconstructive-utopian vision which suggests that possibilities exist for alternative modernities.

Dangers clearly abound. It needs to be noted though that there is nothing inevitable about the rise of technocracy in this development. If the aspiration for ecological rationality is combined with a humanist project to develop institutions which encourage and express 'self critical rationality' [Plumwood 1995] - in short what some have referred to as a project for

ecological democracy - [Dryzek, 1987; Plumwood, 1995; Mason, 1999] - there is no intrinsic reason why progressive forces could not simply reappropriate much of this project for democratic, communal and fraternal ends.

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¹ The very fact that this intellectual project has attracted the attention of figures such as President Clinton and Geoff Mulgan - former Demos guru and now one of Tony Blair's key advisors (see the dust jackets of Factor Four and Natural Capitalism) and gained plaudits from the usually eco-sceptic *Economist* magazine to the (leftish) *Nation* magazine suggests the need for a closer, critical look at this project.

² See Porter (1993) for a useful critique of the *Beyond the Limits* study.

³ Although, even here we would have to carefully differentiate between different currents of 'early warning' green literature. Rachel Carson's *Silent Spring* and Lewis Herber's (pseudonym for Murray Bookchin) *Our Synthetic Environment* certainly constituted intelligent and humane interventions into the public realm correctly flagging alarming environmental developments. On the other hand Paul Ehrlich's *Population Bomb* simplistic understanding of the population/environment relationship no end of damage to the whole environmental movement and to a fair proportion of people in the South who had to bear the burden of population policies.

⁴ For example, John Gilliot states 'there are many good reasons for developing excellent public transport systems, but an inherent problem of poisonous exhaust products is not one of them' (Gilliot 1999:138). Beyond the fact that this assertion seems to ignore the fact that exhaust products from vehicles are estimated (on average) to contribute around 25% of greenhouse gases, this claim would seem to simply ignore the evidence which suggests poisonous exhaust products from car vehicles do indeed have a very detrimental effect on human health. Recent estimates by the UK Department of Health for example put deaths by air pollution (generally) in Britain at 10,000 a year. More specifically, recent research sponsored by the World Health Organisation and published in the *Lancet* (see S.J. London and I Romieu Traffic Costs Due to Outdoor Air Pollution' *The Lancet* Vol.356, No. 9232) has argued that nearly 6% of all deaths in France, Austria and Switzerland (around 40,000 a year) stem from air pollution, and around of this is due to particles found in vehicle exhausts. Indeed, health costs of air pollution from traffic across the three countries was estimated to amount to 1.7% of gross domestic product. It is interesting here that the commentary on this article even suggests that this estimate might even 'prove conservative' (S.J. London 'Commentary' *The Lancet* Vol.356, No. 9232) given new data that has challenged the belief that air pollution exacerbates but does not cause asthma. As London notes, traffic related air pollution was associated with asthma prevalence in a recent study

of 331,686 children in Taiwan (Guo YL, et al 'Climate, traffic related air pollutants, and asthma prevalence in middle school children in Taiwan' *Environment Health Perspect* 1999:107. James Heartfield, alternatively, seems to confuse global warming with ozone depletion when he talks of 'growing concern over the depletion of the ozone layer as a consequence of CO2 emissions'.

⁵ While, there is not the space here to elaborate, the further claim made by Heartfield and Gilliott that the resource productivity agenda is based on a 'false sense of limits' is equally dubious. Fred Buttel observation is apt here when he states 'one does not necessarily have to advance an a-historical or universal notion of 'limits' to recognise the fact that social life should be permanently monitored and reorganised with regard to its consequences for the 'environmental utilisation space' that is available for us and coming generation'. (Buttel 2000).

⁶ To recognise the social shaping of science however, is not to endorse some of the more extreme idealist and relativist positions that some advocates of the 'strong programme in the sociology of science' slide towards. Current 'defenders' of science (more accurately *scientism*) such as Gross and Levitt (1994) would seem to miss the point here that it is perfectly compatible to be committed to philosophical realism in relation to science (recognising that science seeks to explore and describe objects, entities, causal powers and processes which exist independent of mind) while still recognising vital insights that emerge from the social construction of science (that this activity itself is never a-social, a-historical or disinterested). As a critical realist such as Benton notes here 'While it is true that a great deal of scientific research is funded with a view to its possible application in marketable or usable technologies, science cannot be justifiably be *reduced* to this motivation.' (Benton, 1994:34)

⁷ Limits of space insure that I am simply assuming the superiority of the progressive tradition of political thought over the conservative tradition rather than arguing the point. For a solid critique of conservatism though, which this paper would be much in sympathy with see Honderich (1990).

⁸ See <http://www.greenpeace.org.uk> for further information on this.>

⁹ It is interesting in this respect that one can find persistent contradictions in this project between rhetoric and reality. Thus in relation to the spread of the green 'hyper-car', we are told at one point that this 'is gaining its momentum not from regulatory mandates, taxes, or subsidies but rather from new unleashed forces of advanced technology, consumer demands, competition and entrepreneurship' (Hawken et al:20). The rest of this chapter is then spent arguing that a range of government guided interventions in the market would be necessary to shape a viable context for the cars emergence.

¹⁰ Hawken, Lovins and Lovins suggest that taxation should be shifted away from labour and income and towards taxing resources use with the end goal to achieve 'zero' taxation on employees. Beyond the fact though that such a proposal would be profoundly regressive, it does seem increasingly evident that it simply would not work. The fuel tax rebellion which swept Europe recently does suggest there are currently upper political limits to flat rate indirect consumption taxes.