IS SUSTAINABLE CAR MAKING POSSIBLE?

ABSTRACT

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Can the car really be made sustainable, or are we wasting our time? I will explore this question in the context of some of the guidelines for sustainability already available, such as those proposed by The Natural Step and those from the German Federal Parliamentary Commission on Protection of Humanity and the Environment. What is lacking is a clear 'roadmap' for the car and its use. We would need to establish the kind of world we want, the kind of cars we want and what motorised mobility needs we will require in this future world. We can then identify the characteristics needed. The next step would involve a careful plan – the roadmap – of how we go from what we have to what we will need at that future point.

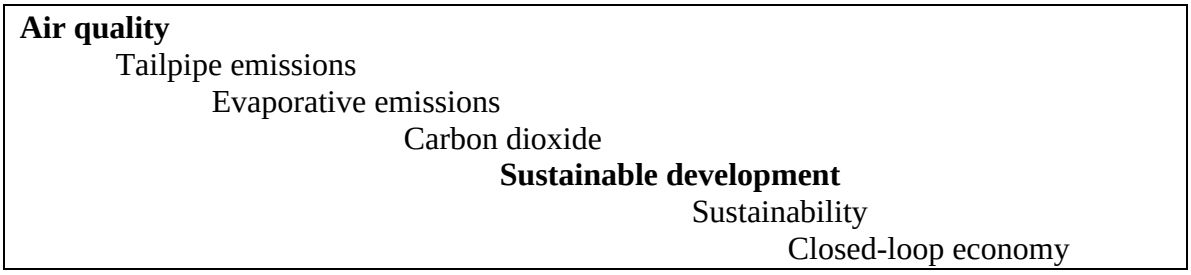
I will explore – briefly - the extent to which the current automobility system could adjust to drastic energy and resource use reduction or to a closed-loop economic system. If we explore the perceived extent of the changes needed and the implications of the changes to cars and car making this implies, we can see that current efforts on the part of the industry appear comparable to rearranging the ashtrays on the Titanic. However among the various actions the industry has been implementing to react to legislation and social pressure are a few gems that are more promising. Identifying and building on these may be more rewarding.

Sustainability and the Car

Looking back over the history of environmental concern surrounding the motor car, we can distinguish some distinct phases. In the early phases air quality was the prime concern, leading to regulation of toxic emissions from cars. Initially, from the 1950s, the technical problem of crank-case blowby was the main concern, rapidly followed by tailpipe emissions during the 1960s and 1970s, and then during the 1980s and early 1990s, evaporative emissions of toxic VOCs. The 1990s were dominated by the CO2 debate, which is still a major concern, and will dominate the agenda of the motor industry over the next ten years at least. However, increasingly, governments have adopted

elements of the sustainability concept. This concept is by no means clearly defined, although some clarity has emerged in recent years.

Fig. 1: History of Primary Environmental Regulatory Concerns



Sustainability is the most fundamental of environmental concepts in that it ultimately defines any practice that we cannot indulge in indefinitely without lasting environmental damage or impact as 'unsustainable'. We will investigate what this means for the automotive sector below. However, practices may also be sustainable for shorter periods. Thus in one sense, oil use is sustainable for the next 10 years, less so for the next 150 years and is unsustainable in a pure sense, in that we cannot continue to use oil indefinitely.

Environmental sustainability is not about the here and now, rather it looks into the future implications of our actions here and now. Our activities may not damage us in our lifetime, but may damage future generations. This makes it difficult for our short-term focussed society and its politicians to handle. It also makes it difficult for conventional economics to handle as the market does not begin to work until a commodity has become too scarce, by which time it is usually too late. Our ability to foresee a crisis and act in a precautionary manner cannot easily be captured by the market without decisive intervention.

But what does sustainability mean in practice? An environmentally sustainable motor industry would not use finite resources and would not cause pollution that could not be easily absorbed by nature. At first this appears an impossible task, however it is actually technically possible to operate in this way. The first requirement, however would be a closed loop economy (see below). Given the secondary materials currently already in the world economies, with judicious recycling a car could be made without extracting additional raw materials, but merely using what has already been extracted in the past and recycling it. Next, energy used in this process would need to be moved onto a sustainable footing. It should not use non-renewable resources nor cause pollution that could not be readily absorbed. This would also apply to the transport of these secondary materials.

Using renewable energy sources would be the answer. Again, the technology exists, but it is just not yet widespread enough to make an impact. It may never in fact meet our current requirements, so a closed loop sustainable system would also imply a dramatic

cut in our energy use, as well as reduced overall consumption levels. Again this is technically possible – and von Weizsäcker and Lovins (1997) have analysed how and given best practice examples – but not yet on the required scale. Despite the apparent fanciful nature of these concepts, they are becoming mainstream among environmentalists and in the longer term will be unavoidable. This means that in any longer term strategy devised at the moment, these concepts need to be kept in mind.

For several years, the new more comprehensive environmental sustainability concept was largely confined to the environmental and academic communities, however an award-winning paper in the Harvard Business Review by Greening of Industry Network member Stuart Hart (1997) brought it to the attention of the wider business community. Hart asserts that sustainability should not be confused with mere pollution prevention or waste reduction, it requires a fundamentally different mind set. He writes that:

"… in meeting our needs, we are destroying the ability of future generations to meet theirs"

Hart foresees the development of completely new technologies and completely new types of businesses developed in order to meet the sustainability needs. He predicts that in the developed economies the demand for virgin materials will decline as reuse and recycling become more common, hence over the next decade or so, Hart believes that sustainable development will become one of the biggest opportunities in the history of commerce. Businesses will have to decide whether they are part of the problem or part of the solution. Hart does not ignore the car sector and states that ***"Although the auto industry has made progress, it falls far short of sustainability".***

Hart extends the responsibility of producers further than ever before, when he asserts that***"Companies can and must change the way customers think by creating preferences for products and services consistent with sustainability".*** He concludes by saying that although changes in policy and consumer behaviour are essential, business can no longer hide behind these 'figleaves'. They must actively work to change consumer behaviour through education.

Currently the concept of 'sustainable development', rather than sustainability is preferred by government and industry. This operates at the intersection between environmental, economic and social considerations and was first defined in the so-called Brundtland Report (World Commission 1987). Gro Harlem Brundtland herself (Sir Peter Scott lecture, Bristol, 8/10/86, as reported in Pearce et al. 1989, 175) emphasised the following four points as defining principles for sustainable development:

1) it requires the elimination of poverty and deprivation.
2) it requires the conservation and enhancement of the resources base which alone can ensure that the elimination of the poverty is permanent.
3) it requires a broadening of the concept of development so that it covers not only economic growth but also social and cultural development.

4) and most important, it requires the unification of economics and ecology in decisionmaking at all levels.

The thinking behind this definition is that moving to a purely environmental sustainability agenda would have unacceptable economic and social consequences in the short term. Therefore a balancing of these three areas of concern may be more realistic. In practice, we now have a situation where business and industry tend to focus on the economic aspects. This is something they understand and can cope with. Nonetheless, environmental thinking on sustainability continues to inform the rolling definitions of sustainability and thus continues to underpin them with the more radical environmental agenda.

Environmental thinking has moved on since these ideas were enshrined in the 1980s. A greater sense of urgency now informs environmental thinking and it is likely that over the next few years less proactive firms throughout industry and business will have a rude awakening, as government and NGOs will increasingly give at least equal weight to the other two elements: social and environmental. Most of conventional industry is ill prepared for this.

Taking our inspiration from The Natural Step (e.g. Nattrass & Altomare 1999) we at the Cardiff Centre for Automotive Industry Research (CAIR) have developed a model for sustainable car making and sustainable automobility, as follows.

Sustainable Car Making: The CAIR Model

1) Use only secondary materials already in the economy – reuse and recycle
2) Energy used in this process for manufacturing and transport would need to be sustainable = renewable
3) Processes cannot cause pollution that cannot readily be absorbed by nature
4) Products have to be designed and built for maximum durability to avoid unnecessary production

Sustainable Car Use: The CAIR Model

1) Cars can only be powered by renewable energy sources
2) In-use disposables would be designed for re-use or recycling
3) Society encourages citizens to choose the optimum mode for each journey

Clearly these simple statements paint a picture that is very far removed from the way things are currently done. However, having established this set of desirable outcomes, a vision of a sustainable automotive future, how would we actually get there?

A Road Map

In recent years, a technique called ‘roadmapping’ or ‘routemapping’ has gained favour with strategists in government and industry (e.g. Kappel 2001). From analysis of existing roadmaps, such as the US aluminium sector example (Energetics, 1999) there appear to be two types. The first type starts with technologies or systems currently under development and assesses when these will reach maturity; it then maps ahead to a future based on these. More useful for our purposes is the opposite approach. In these the process starts with a vision of a desirable future. The roadmap then sets out what is needed to achieve this. A good example of this is the roadmap currently being developed for the UK Foresight Vehicle programme by Cambridge University (Foresight Vehicle 2002, forthcoming).

The CAIR model outlined above also takes the latter approach in that it creates a situation whereby car making and car use are sustainable and then tries to analyse what is needed to get there. The model above set out very basis requirements, but these could be developed in more detail with precise deadlines for each stage along the route. We will discuss some aspects of this below.

A Closed-Loop Economy

In a closed-loop economy, no new raw materials are added, only the existing pool of secondary materials is used, re-used and recycled. Any energy used in re-using and recycling has to come from renewable non-fossil sources. In addition, no net increase in emissions is allowed; i.e. only emissions which can be readily absorbed by for example growing crops, can be tolerated.

In practice we are far removed from a closed loop economy in most of the developed world; many developing countries come much closer. Nonetheless, there are some areas where a move in this direction has been made for economic reasons. As we know, paper and glass already use some recycled material. Similarly, steel bicycle frames, for example tend to be made from recycled steel sourced from minimills, rather than the predominantly ore-derived steel used for car bodies (Ryan & Durning 1997). The incidence of such examples is increasing and in many cases the technology to bring it about is available. It is the economics that are lagging behind. Taxing any raw materials would be a way of moving in the right direction and other such policy measures are being discussed by environmentalists and environmental economists around the world.

If there were any serious moves towards a closed-loop economy, the vehicle recycling sector would have a key role to play in this. Although apparently utopian at present, in the longer term such a move seems inevitable as by most current calculations, many key raw materials are set to run out during the present century.

However there are a number of issues with this approach. Although enough secondary materials exist in the world economy to sustain a – limited – automotive industry on this basis, it does restrict our ability to experiment with new alternative materials, unless we divert these from other uses. On the energy side, availability of renewable energy is still

very limited, although it has been growing rapidly in recent years, particularly in some countries, such as Denmark. This does mean there is still scope for a dramatic increase in this area, whilst a dramatic cut in energy use by increased efficiency would cut our requirements.

Increasing Vehicle Durability

Cars now live longer than in the past. This is a byproduct of various product improvements, rather than a deliberate strategy on the part of manufacturers, however, in the 1970s, there were a number of projects which looked into the possibilities of extending the lifespan of the average car. A project by Porsche (1976) proved that this was at least technically feasible. Such knowledge would have to be shared, as car life expectancy would have to be extended still further to meet the requirements of our model.

The environmental advantages of extending the useful lifespan of cars are clear. If we move towards a useful life of 20 instead of 10 years, the number of times a new car has to be produced and dismantled could be roughly halved. This means a saving in the energy consumed and pollution created during the production and dismantling processes. Besides, the dismantling of natural ELVs is only barely profitable and given the current economic environment, unlikely to become so in the short term.

This will reduce the overall lifecycle impact that a car makes on the environment in the production and dismantling stages, though not in its use. However as the main purpose of a car is in its use, this must be desirable, however small the impact. The figures for the proportion of this impact in relation to that of a car's use vary somewhat as table 6 illustrates. Volvo's (1992) figures are flattered by the fact that they already assume a longer lifespan than other manufacturers. The figures produced by Teufel et al. (1993) are probably the most comprehensive. Only their energy figure is presented in Table 6, although they take a full lifecycle approach starting with the raw materials extraction stage.

Doubling life expectancy could drastically reduce the vehicle element of the waste burden. Experiments with vehicle dismantling lines are - despite the publicity - unlikely to be cost-effective (Ford 1993a, Eisenhammer 1993) and do not solve this problem. Over the past 15 years or so there has been a significant improvement in the quality of cars. This is due to the dual pressures of increasing competition within Europe and the increase in competition from Japan. Especially the Japanese have emphasised product quality. In practice these quality improvements have lead among other things to greater reliability and longer product life as both key mechanical components - such as engine and gearbox - and bodywork last longer. Improved steels and rust preventative measures in production have rendered modern cars far more rust-resistant than their ancestors.

The implications of this in the context of the ELV Directive are also clear. As the manufacturer incurs an additional cost at some stage in the future, it must be attractive to minimise this cost by increasing the car's life expectancy. Another implication is that an

industry geared up primarily and exclusively towards selling new cars may have to devise a way of keeping track of its products throughout their useful life.

In practice, there are a number of environments where cars already routinely exceed the normal life expectancy of around 12-13 years. This is certainly true for third world countries and it was also true for Eastern Europe. However, car life expectancy also varies considerably in the industrialised countries of Western Europe. The first decade in which this became apparent was the 1980s, the decade when most cars currently classed as natural ELVs were built.

Environmental considerations make it increasingly attractive to take action to accelerate this trend. The increasing sophistication of various alternative technologies also make this increasingly realistic. Modern materials such as carbonfibre, metal matrix composites or even aluminium - as introduced for mass producing a complete car bodyshell by Audi and Alcoa on the Audi A8 and A2- could easily be used to build cars whose basic structure would outlast its first owner. GM spokesmen suggested that the long-life technology used on the Impact and EV-1 electric car would allow the car to be ***"passed on from generation to generation"*** (GM 'Impact' press release 1992) .

The latest powertrain items and other new technologies could be fitted at various points during the car's life. A modular system would make such an approach more feasible. However, retrofitting of certain items such as catalytic converters and airbags is already possible. Many new technological innovations can thus be fitted to existing vehicles without the need to scrap the vehicle.

In the UK, the Morris Minor Centre in Bath has shown that extending the life expectancy of an existing, even obsolete car is cheap and viable, especially if it is updated in the process. Its founder, Charles Ware sets out the basic philosophy of the venture in a book (Ware 1982). He argues that new car depreciation wastes consumers' money and leads to premature scrapping of many cars when the value of the car renders repair uneconomical. Instead, Ware argues that like houses, cars should be seen as a long term investment, rather than a short-term consumer "durable". Experience in Sweden shows that - quite apart from the environmental advantages - a long life car regime can save car buyers significant amounts of money. The Swedish vehicle testing agency, AB Svensk Bilprovning (1992,14), estimated that Swedish consumers have saved between SEK 3200-4000 million per year in new cars they have not had to buy (£1 = SEK 10, approximately).

The need for manufacturers to keep track of their products throughout their useful life can be used to the manufacturers' advantage. However this will require a significant shift in culture. At present, the industry is still geared up to selling new cars. Issues affecting the parc, or vehicles in use, are of little interest. There is already a clear correlation between car purchase price and life expectancy. If new car sales decline, but cars last longer, used car sales take on much greater importance. With the higher new price used cars sales could also become more profitable. Under such a 'product stewardship' regime, aftersales in terms of parts, accessories and service would also become more important and vehicle

dismantlers could benefit from such a trend. Retrofitting of new technologies to cars that last for decades could develop into a new industry. Again, vehicle dismantlers could play a major role in this in that they would manage the salvage of usable parts and modules for re-use in the durable basic vehicle structure.

MFR

A major new research project initiated and managed by CAIR under the aegis of the Cardiff ESRC Centre for Business Responsibility, Accountability, Sustainability and Society (BRASS) will look into these issues over the next few years. The research programme runs from 2002 until 2006 and will focus on the CAIR concept of 'micro-factory retailing' or MFR (e.g. Wells & Nieuwenhuis 2000). This concept combines car assembly with the aftermarket functions of retailing, service, repair, aftersales, modular reconfiguring for re-use and end-of-life vehicle take-back, dismantling and recycling. It would address the motor industry's and motor retail sector's economic problems of chronic lack of profitability, but would also address wider economic and social issues of relocalising of economic activity and job creation, reduction of transport miles, reintroduction of economic diversity etc. Preliminary work by CAIR suggests such a model could be more cost effective and more flexible and responsive to markets than the existing car making system. The current system is characterized by large centralized factories drawing in supplies form global supply networks and sending finished goods over long distances for distribution via a global network of largely SME-type businesses. The research programme will assess the feasibility of MFR in terms of technology, cost, social and political considerations.

Current sustainability efforts on the part of the automotive sector focus largely on alternative fuels and powertrain optimization. However, if we are serious about sustainability, a much more radical approach is needed. This should not only tackle car use, but also car manufacturing with its problems of over-production and waste. If current assessments of environmental degradation are correct, then present efforts are largely pointless and akin to "rearranging the ashtrays on the Titanic". A more radical approach does however need some clear future options to be developed. One or more of these could then be chosen and a roadmap could then be developed of how the sector could progress in this desired direction. This important new project should be seen as a major contribution to this process.

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