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Environmental Rating for Vehicles Report

October 2007

CAIR-BRASS/Clifford Thames Environmental Rating system for Vehicles (ERV)

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Introduction

This paper outlines the background to, rationale for, and development of a new environmental rating system for cars. The system utilises publicly available data to assess the environmental impact of cars by considering both their tailpipe emissions and their size and weight. A rating has been established for each model and variant available in the United Kingdom and this allows consumers and legislators to compare vehicles on an objective basis. This rating system is the result of a collaboration between the Centre for Automotive Industry Research (CAIR) and the ESRC Centre for Business Relationships, Accountability, Sustainability & Society (BRASS) at Cardiff University and Clifford Thames Ltd, an international automotive consultancy.

The precursor to the ERV model was first developed in the late 1990s by CAIR's Dr Paul Nieuwenhuis and Dr Peter Wells for a specialist car manufacturer to use specifically for fleet sales. The key requirements were transparency, simplicity and the flexibility to add and remove parameters as and when required. The model was presented at two academic/industry/government conferences and, in addition to the original OEM client, it has subsequently been used by a number of fleet operators. It has also been used to inform the creators of other models, notably at the UK Environment Agency and the provincial government of Quebec.

Context: why another rating system is needed

The current political environmental focus and impending changes in legislation mean that the automotive industry is going through a period of significant change in engine technology, primarily targeting reduction in emissions, specifically CO₂ output. However, the current focus on tailpipe emissions, while a very significant factor, will narrow the focus of any rating to a single issue and make it difficult to compare the real world effect of competing technologies. It also undermines the broader principles of sustainability, which should now inform policy worldwide.

In 2006, VW launched its BlueMotion eco-label and mid-2007, Renault launched their eco² label for cars. Vehicle manufacturers have searched for some time for the right way to package environmental messages to customers, and in particular how to translate policy into product. The approach adopted by Renault is typical in that the company has sought a means to express the whole 'Life Cycle' concept within one relatively simple brand message, and then apply that message to whichever vehicles within the range can meet the criteria. According to Renault, its eco² vehicles will meet three global environmental criteria:

- Be manufactured in an ISO 14001-certified production plant;
- Have carbon dioxide emissions lower or equal to 140g/km or they must be capable of running on E85 ethanol or B30 bio-diesel (equivalent to fuel consumption of 5.3 litres/100km for diesels and 5.9 litres/100km for gasoline engines);
- Are also designed to be 95% reusable by weight at the end of their lives, and constructed with a least 5% of the total mass of plastics being from recycled materials.

Renault claims its Clio III uses about 10% (20kg) of recycled plastic while the New Twingo uses 9% (15kg). Under 'Renault Commitment 2009', the company aims to sell one million vehicles by 2008 that emit less than 140g/km of CO₂, with a third emitting less than 120g/km. Other vehicle manufacturers offer a bewildering array of badges, labels and descriptions to capture and convey the environmental performance of their cars, an example being the Toyota 'Hybrid Synergy Drive' as applied first on the

Prius and then other models in the range. As a range of alternative fuels and technologies become available, so the complexity of the picture increases. This is problematic for corporate or private customers who wish to make informed choices based on all-round sustainability criteria.

Moreover, government agencies and regulatory bodies have not only come to realise that a 'green' car is more than one that meets certain emissions norms, but have also seen the leverage exerted by programmes such as the EuroNCAP safety rating, which both informed consumers and provided objective criteria against which improvements in occupant protection systems could be rated. The overall environmental performance of a car is a prime candidate for similar treatment, if an appropriate means of measurement can be found.

There are essentially four main drivers for the adoption of an environmental rating system:

1. There is a burgeoning array of technologies and fuels being applied to vehicles, and this makes informed choice more difficult;
2. Customers, both individual and corporate, are increasingly wanting to make those informed choices even if there is an underlying awareness that no car can really be totally green;
3. Manufacturers are more interested in promoting their various green credentials, but again substantive claims are difficult to make and support in the absence of a unified system and consistent data;
4. Regulatory authorities are also going to be interested in devising a means to evaluate the total environmental impact of vehicles, perhaps as a precursor to taxation and other measures based on such performance.

The overt 'greening' of the 2007 Frankfurt motor show was commented upon by many, as has been the introduction of the Renault eco2 sub-brand, BMW's EfficientDynamics, along with other vehicle manufacturers' attempts to differentiate their ecologically-informed offerings. In short, an increasingly confusing picture is emerging (Table 1).

Company	Eco-badge
Ford	ECONetic
BMW	EfficientDynamics
VW	BlueMotion
Renault	ECO2

Table 1 – Eco-labelling by car manufacturers (adapted from Franey, 2007)

In this context, it was felt a revised version of our original rating system could form a useful contribution to the debate and re-establish the need for a broader approach to assessing the environmental impact of cars within the context of the sustainability debate. The Cardiff University team were fortunate in being able to link up with Clifford Thames, who also immediately saw the potential of the model and had the database expertise and capability to handle the volume of information required to generate ratings for all new cars.

First however, CAIR's original model needed to be updated and improved to enhance its usability and the revised model, the Environmental Rating system for Vehicles (ERV) has been jointly developed to consider the impact of a wide range of different engine technologies. The model is now capable, for example, of evaluating the impact of particulates for diesels. The key criteria that needed to be met to make the model both usable and credible were that:

- It must be based on sound environmental principles.
- It must be based on readily available data.
- Data must have 'official' status.

- No extra costs should be imposed upon the vehicle manufacturers, regulatory authorities or consumers.
- It must have a clear methodology that results in a simple numerical score.
- It must allow 'good' performance to be identified.
- It must be applicable to cars on the market now.

We believe all these criteria have been addressed in the model, as we will outline below. The key features of the ERV model are:

- Transparency: it is clear all the way along how the final figures are arrived at; in addition:
- Use of only publicly available data is one of the key differentiators of the ERV model.
- New parameters can be added as and when data streams become available and weightings and data can be adjusted to reflect changing social, regulatory or industry priorities. Examples are recycling rates per model/manufacturer, or an indicator of product life expectancy.
- A key element of the model is the use of a 'footprint' calculation of length multiplied by width multiplied by weight. This acts as a proxy for environmental impacts such as raw materials use, paint emissions, end of life impact, as well as infrastructure requirements. Though simplifying the actual impacts in several ways, it avoids the very complex and costly life-cycle analysis (LCA) that would otherwise be required for every single car sold in the UK or EU markets – using directly comparable data.
- The model does allow weights to be allocated to individual parameters in order to reflect changing scientific knowledge as well as changing social and regulatory priorities.
- The model rewards manufacturers for exceeding currently mandated standards.

The data used for the model is created through the official type approval process, notably the emissions test cycle used to ensure that any model complies with emissions and other regulations, together with limited basic information on the dimensions of the car, which is also readily available. This data is therefore available at no extra cost to manufacturers or regulators, it covers all cars in the market, and it has official status. It is important to appreciate the value of information that is seen to be 'fair' in that it treats all vehicle manufacturers' models in the same manner. The regulatory limits and the test cycles used to measure emissions performance are well known, and changes in limits notified well in advance.

The methodology used by the regulatory authorities to collect emissions data can be criticised for being an inaccurate reflection of real-world use, or inappropriate for use in creating an index of environmental performance but our pragmatic response is that these data are the only data readily and publicly available that meet the requirements listed above. Of course, it is still the case that regulatory regimes are different in North America, Europe and Japan. In this respect, another requirement of the approach we show below is that the methodology should be robust enough to be used in all markets and, ideally, any change in regulatory regimes.

Our approach to environmental ratings for cars has two elements: emissions and footprint. The emissions element relates to the emissions from the car as measured in the official test cycle. In the examples shown below we use CO₂, CO, combined Hydrocarbons and Nitrous Oxides (HC + NO_x) and particulates (PM), but, as will be clear, the method is actually able to use more variables (such as noise levels, levels of recycled material) should the data be available or deemed appropriate. For each of these emissions we then calculate, for the car in question, the relative percentage of the standard. As CO₂ is not currently regulated we use the proposed EU 2012 standard of 130 g/km. An overall emissions performance score is then calculated by adding the relative emissions scores using a weighting of 50% for CO₂ and with CO, HC + NO_x and particulates contributing in equal parts to the remaining 50%. These weightings reflect the current EU and UK concerns about the role of CO₂ in global warming but these can be changed if and when appropriate. It is this inherent flexibility that is one of the key features of the model.

To create the final rating, the performance figure is then multiplied by the footprint figure. It could be argued that the footprint is unnecessary, but as noted above it does allow the wider environmental burden of the car to be included and in presentations to industry audiences this aspect was regarded as particularly elegant and effective as a proxy for these wider impacts. The footprint is determined by measuring the length (m), width (m) and weight (t) of the car and is used as a crude proxy for the broader (i.e. non-engine emissions) aspects of the environmental burden of the car. This is a very important consideration, because even a near-zero emissions car has an environmental and indeed sustainability burden. This burden includes the resource consumption required from raw materials; transport and processing of raw materials (with associated environmental and social costs); paint emissions and other manufacturing impacts; contribution to congestion and other road space requirements (parking, for example); the degree of damage caused to people and property in an accident, etc. Again, these data for the footprint are readily available at no extra cost, and are beyond dispute or estimation, although some standardisation of reporting will be required from OEMs in regard of width (with/without mirrors?) and kerb weight (which definition?).

The footprint could be used to group cars within a given size segment, with the performance figure used to rank cars inside the segment. However, for the sake of user-friendliness, with particular consideration for consumers, we have for the time being generally adopted the market segments as used by *What Car?* magazine in the UK although we have split MPVs into small and large sub-categories. Furthermore, the footprint allows the emissions and fuel economy performance of the car to be placed in the context of the size of the car. With this approach, a key advantage is transparency. It allows all users to understand how the figures were obtained and, if so minded, to dispute the weightings attached to data. Using sensitivity analysis, it is clear that for example CO emissions contribute only a very small fraction (1%) of the outcome, whereas vehicle weight and CO₂ emissions together contribute almost 90% towards the rating.

Theoretical Background

The ERV is a very pragmatic approach to the automotive lifecycle problem and the development of an environmental index actually exposes irreconcilable conflicts in attempts to improve environmental performance. We have in the past described the ideal scope and content of an environmental index or rating system for cars (Nieuwenhuis and Wells, 1997a; 1997b; 1998). The approach we espoused adopted all the 'best practice' notions of environmentalism in a concept we termed the 'Environmentally Optimised Vehicle' (EOV). The EOV is not dissimilar to the approach currently developed in Japan. The EOV concept embodied a holistic, life-cycle approach and sought to minimise the total environmental burden of car production, use and disposal. While as environmentalists and academics we seek to develop coherent, comprehensive and meaningful measures of environmental performance alongside a 'vision' of the future we are trying to attain, it is also the case that there is an urgent need for measures now; to be used today. In the less than ideal 'real world' finding a way to measure the environmental performance of cars today imposes huge constraints. This section outlines the problems embedded in what might be termed 'scientific environmentalism'. We then, in contrast to the idealism of the EOV, explain the constraints that have forced upon us a 'pragmatic environmentalism' (Wells and Nieuwenhuis 1999).

Academic theories, and indeed the written papers and books used to present them, are usually highly sanitised. We skirt elegantly around the deep-rooted feelings and beliefs that underpin our artfully constructed explanations of reality. However, in environmentalism our theoretical understanding is confronted daily by the contradictory choices of real life. Much has been made of the effort to develop totalizing empirical accounts of environmental performance. The ideological basis of methodologies such as life-cycle analysis and many models of industrial ecology, though offering useful insights, remains that of the 'techno-fix' (Dobers and Wolff 1999; Tempelman, 1999). Life cycle analysis, or energy balances, or any of the other methodologies deployed to provide empirical content to environmental concepts come cloaked in a swirling mist of scientific rationalisations which serve to conceal our otherwise normative value judgements.

Apart from the relative merits of the theoretical basis of scientific environmentalism, in practical terms the operational deployment of measures such as life-cycle analysis demands considerable knowledge and resources. It is clear that such criticisms apply to our own EOV concept. Most fundamentally, to measure the environmental performance of cars in our EOV concept would require vast quantities of data that do not yet exist in any consistent or coherent manner. Thus, as a small example, one vehicle manufacturer may present data on the performance of their paint processes in terms of emissions per area of car painted, while another may do so in terms of parts per million released into the atmosphere, while a third may not report the information at all. VW tended to report this measure per Golf produced for its Wolfsburg plant – a unit of measurement that cannot be compared to any other in any meaningful way.

In the ERV index we make no claims that this is the ‘best’ approach, or that policy makers should adopt it as a basis for legislation. Of course we hope that our combined expertise and knowledge of the automotive industry at Cardiff University and Clifford Thames is reflected in the index, and we do intend to influence the debate. Indeed, the main purpose here is to show an alternative methodology for understanding environmental impact that is product-centred, and thereby makes the entire debate meaningful for a larger number of people. However, the main distinguishing feature of our approach is that it is entirely pragmatic; we simply seek to do the best with what information is available.

We have already outlined the footprint concept and the thinking behind it in greater detail elsewhere (Nieuwenhuis and Wells, 1998). In brief, the footprint is determined by measuring the length, width and weight of the car and is used as a crude proxy for the broader (i.e. non-engine emissions) aspects of the environmental burden of the car. In an earlier version we also used height, but we found in practice that this either added little in terms of information, or caused undesirable distortions.

For each of the main regulated emissions (note that as there is no regulated standard for CO₂ at time of writing, we have used the proposed 130 g/km limit for 2012) we then calculate for the car in question, emissions as a proportion of the standard. So, if a car has CO emissions, which are only 25% of those allowed under the regulations, the relative CO score would be 0.25. This same principle is applied to other variables (CO₂, combined HC and NO_x, and diesel particulates. Although we use the Euro 4 standards currently in force in the EU market, the proportion approach means that the method can be applied in different markets where different (absolute) standards and test cycles are used. The proportion approach further means that as the stricter Euro 5 emissions standards are introduced, the method will still be valid. Emissions Performance is then calculated as the weighted average of these relative emissions scores. To create the final ERV score, the emissions performance figure is then multiplied by the footprint figure and a 100x reciprocal to create a meaningful range of figures whereby the higher the output number – the ERV – the better the car, at least in environmental terms. It could be argued that the footprint is unnecessary, but as noted above it does allow the wider environmental burden of the car to be included.

Table 2 illustrates the emissions component of the ERV calculation by presenting examples of a current vehicle rated as being amongst the top ten best scoring cars (car X) compared with a vehicle whose score currently places amongst the ten lowest scores (car Y):

Car	CO ₂ (130 g/km)		CO (1.0 g/km)		HC + NO _x (0.18)		PM (0.025)		Emissions Performance
	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative	
X	128	0.98	0.28	0.28	0.05	0.28	0	0	0.58
Y	378	2.91	0.42	0.42	0.10	0.56	0	0	1.62

Table 2: Comparison of components of emissions performance for two real vehicles

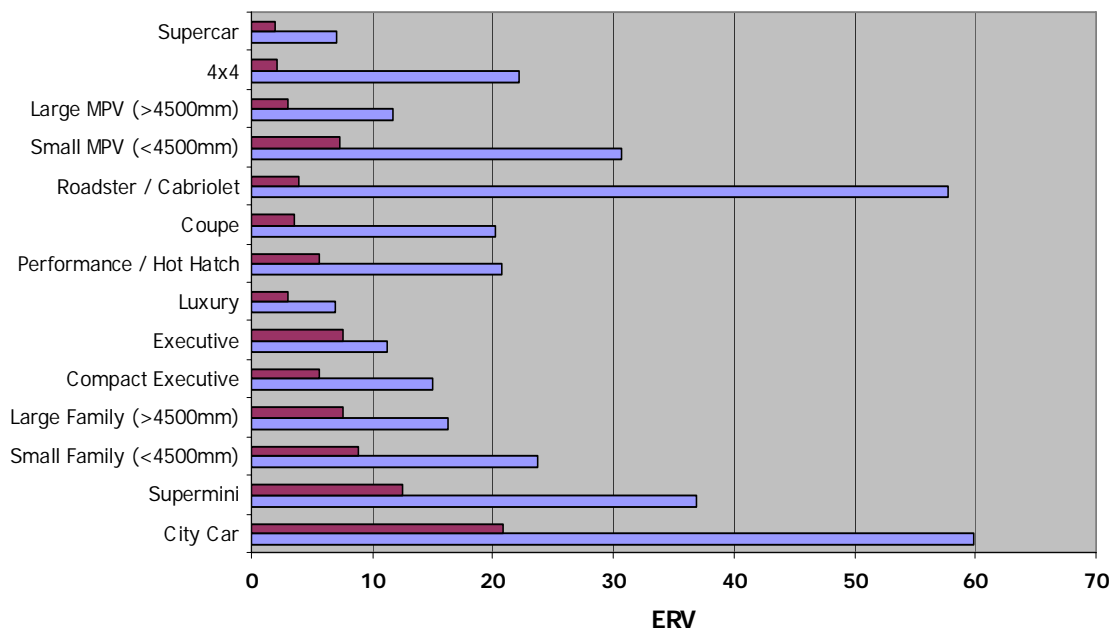
Table 3 shows the corresponding footprint component and the overall ERV score:

Car	Length (mm)	Width (mm)	Weight (kg)	Footprint	ERV
X	3565	1525	884	4.8	36
Y	4786	2216	2355	25.0	3

Table 3: Comparison of components of emissions performance for two real vehicles

Figure 1 shows the best and worst ERV scores across the various vehicle segments. No specific vehicles are named here as firstly the data is provisional, and secondly, as new vehicles are continually coming onto the market this is just a snapshot of the situation as of the publication of this paper.

Figure 1 - Best and Worst Ratings by Class



The above graph shows the wide range of ERV values for vehicles currently on sale in the United Kingdom. As expected, there are large differences between ratings for city cars and supercars, but there are also significant intra-class differences reflecting the wide range of emissions performance and vehicle size within a particular class.

The limits of pragmatism

The ERV system raises some interesting points. First of all, Toyota's Prius still does well in our ERV system; it is still best in class. Lighter cars tend to do better than heavier cars; thus the Lotus Elise is almost on a par with the Prius. Overall, the various Smart models come out on top, including the now phased-out Roadster version. We have included a number of phased out models that show interesting ratings (e.g. Honda Insight). Over time, the database will come to include more and more phased out models and variants. This will make the model more useful for private consumers, who still on the whole tend to buy used, or nearly-new cars, rather than new cars in the UK. Over time, consumers will therefore be able to compare a new Model A, with, say, a three-year-old Model B and get a useful comparison. Few systems currently offer this possibility.

It is clear therefore that the rating system as devised above accentuates the differences in performance between models and may therefore show up differences between them to be greater than they really are. This feature does however aid in clarifying relative performance. The ERV clearly identifies the small, light car as having a lower environmental burden. The Peugeot 106 model, for example, combines good emissions performance with a small footprint and comparatively good fuel economy to produce a low rating. We are aware of the fact that 2-seater cars rate better than 4/5 seaters. It could be argued, for example that a Prius that seats 4 or 5 offers more functionality than a Smart, which only seats 2.

We would counter that most car journeys only involve 1 or 2 people and that this additional functionality is therefore redundant on most journeys, thereby increasing the environmental impact of the larger vehicle. In many cases the user offsets functionality against environmental impact. This is most evident in SUVs, which in addition to carrying a 5-12 people and their luggage are capable of doing this off-road. Our model makes this visible, thereby allowing users to make a more informed choice. In any case, the segmentation system allows potential buyers to compare vehicles with similar functionality.

Furthermore, should a vehicle manufacturer improve the performance of the model by, say, reducing CO₂ emissions through greater fuel efficiency, that improvement will be reflected in the ratings system with a higher total ERV score. Equally, should a manufacturer introduce lighter materials into the car this will be reflected in a smaller footprint and a higher total ERV score.

It is useful to note that in case of some models, the performance in terms of emissions is not only better than the Euro 4 requirements, it may also be better than the forthcoming Euro 5 requirements. The structure of the model allows us to deal with the adoption of more stringent standards in two ways:

1. The new standards can be entered into the model and an updated set of relative emissions scores (and hence ERV) can be calculated). At this time all existing vehicles in the database can be re-evaluated and an updated set of ERV results published.
2. The original standards used in the model are retained and those vehicles meeting the new standards will, by definition, generate better relative emissions performance and hence an improved ERV. The advantage of this would be that once evaluated, a vehicle would retain that ERV score and there would be a stable historical database that would grow with new model introductions.

There are clear weaknesses with the ratings system, which must be acknowledged. Notwithstanding the footprint element of the rating, the system is unable to capture the environmental benefits of alternative power / fuel vehicles that fall outside emissions legislation or CO₂ performance. We cannot compare the battery electric TH!NK (Wells and Nieuwenhuis, 1999) with the Smart diesel taking full well-to-wheel emissions into account. This kind of difference is to some extent subsumed in the model via the footprint element as although the emissions from electricity generation cannot be reflected via the emissions element, they may be considered to be embodied via the battery weight element of the footprint part of the equation. If an electric vehicle is charged entirely from renewable electricity, we cannot capture it. However, should such data become publicly available in a robust, standardised form, it could easily be incorporated. More fundamentally, we cannot compare manufacturing processes or other key variables such as longevity/durability, although again, should such data become available it can easily and quickly be incorporated in the ERV model.

Conclusions

Much of our work has been concerned with transition, with the process of change whereby the current state of affairs in car making and use is transformed into a broadly envisioned, more sustainable future. However, transition consists of many steps along the way. We do indeed have that vision of the future of the automotive industry, in a concept we have termed 'Micro factory retailing' (Wells and Nieuwenhuis,

1999; Nieuwenhuis and Wells 2003). In order to accelerate the process of transition we believe there is considerable merit in constructing measures of environmental performance that are applicable today. This is about educating consumers and others to begin thinking in environmental terms. It is therefore a means of introducing environmental issues into the competitive arena, into the market place ahead of more radical changes in automotive technologies, although these may indeed be encouraged by such a rating system as the ERV

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Brass

Our Approach

The ESRC Centre for Business Relationships, Accountability, Sustainability and Society exists to understand and promote the vital issues of sustainability, accountability and social responsibility, through research into key business relationships. The Centre pursues a research agenda based on academic excellence, relevance to main user groups and accessibility in dissemination. In this way it will seek to contribute:

- **Locally**, through an active involvement in promoting greater levels of sustainability, accountability and social responsibility within regions, with an initial focus on the Welsh economy;
- **Nationally**, by acting as a national centre of excellence in the development of new theoretical perspectives and the pursuit of nationally relevant research; and
- **Globally**, by research aiming to develop sustainability, accountability and social responsibility within industries whose scope is global, and whose structure includes both Trans-national Corporations and small-to-medium sized enterprises.

Key Aims

Through its research work, partnerships with businesses and their stakeholders, and communications activities, BRASS aims to significantly contribute to:

- The development and dissemination of new knowledge and understanding about the significant changes occurring in the relationships among firms and their stakeholders, including their customers and suppliers, investors, communities, employees, government and a range of non-governmental organisations (NGOs);
- The creation of a better understanding of the social responsibility of business including corporate accountability, governance, and business ethics based on an integrative, systems perspective;
- The development and promotion of new tools, models and approaches to business strategy and decision making which will help practitioners, policy makers and researchers to better understand and manage the sustainability impacts and implications of business activity;
- The fostering of a more holistic and inter-disciplinary approach to the understanding to the interaction between businesses and their social and physical environment;
- The development of international research links to enable comparative international research, and the transfer of knowledge between companies, regions and countries;
- The development of the UK's research capacity in relation to business, sustainability and social responsibility.

CAIR

Introduction

The Centre for Automotive Industry Research at Cardiff University was launched in 1991 and has since built a global reputation in the field of economic and strategic aspects of the world automotive sector. 2005 saw the retirement of Professor D G Rhys from full time employment in Cardiff University and also as director of CAIR. This prompted the appointment of Dr Paul Nieuwenhuis and Dr Peter Wells as joint directors of the Centre. CAIR currently has four permanent full time members, half a dozen associate members, and two PhD students.

Much of CAIR's research these days involves issues of sustainable mobility. This is now taken very seriously by many in the automotive industry and takes up a significant amount of vehicle producers' R&D budgets. This research is largely carried out under the BRASS banner, using BRASS resources. This has become such a key element of BRASS research that the two CAIR directors are 50% funded by the ESRC through BRASS.

CAIR has carried out many funded projects, including among its past and present clients the European Commission, DG Environment, ACEA, OECD, UNIDO, DTI/BERR, National Assembly for Wales and several vehicle producers and suppliers.

In 2006, CAIR was integrated into the Logistics and Operations Management section of Cardiff Business School.

Dr Paul Nieuwenhuis AffIMI Co-Director, Centre for Automotive Industry Research, Cardiff University

Paul Nieuwenhuis was born in the Netherlands and studied in Australia, Belgium, Spain and Scotland, where he obtained two degrees from Edinburgh University. A lifelong interest in cars and car making allowed him to get a job with the Motor Industry Research Unit at the University of East Anglia. The unit was later privatised, this moved him into the consultancy world, carrying out projects for most of the world's car and truck makers, while he also became a special advisor on state aid to the automotive industry for the European Commission (DGIV). Since 1990, he has been with the prestigious Centre for Automotive Industry Research (CAIR) at Cardiff University. Here he also developed his special interest in the problems of making personal mobility compatible with the need for sustainability.

Dr Nieuwenhuis has co-authored *The Green Car Guide* (1992), *Motor Vehicles in the Environment* (1997), *The Automotive Industry and the Environment* (2003) and the influential *The Death of Motoring?: Car Making and Automobility in the 21st Century* (1997), among others. He also contributed to the *Beaulieu Encyclopaedia of the Automobile* (2000). Dr Nieuwenhuis is a member of the Society of Automotive Historians, a member of the Guild of Motoring Writers, an Affiliate of the Institute of the Motor Industry and a member of the UK DTI-EPSC Foresight Vehicle Steering Committee. In 2001 he became a founder member of the ESRC-funded Centre for Business Responsibility, Accountability, Sustainability and Society (BRASS) at Cardiff University.

Dr Peter Wells Co-Director, Centre for Automotive Industry Research, Cardiff University

Peter Wells has a degree in Geography from Leeds University, and an MSc in Town Planning from Cardiff University, while his PhD (also from Cardiff University) was on the subject of the socio-economic consequences of military R&D in the UK. He joined the [Centre for Automotive Industry Research](#) at its inception in 1990 and has since specialised on economic, strategic and environmental aspects of the

world automotive industry. He is particularly interested in small scale, decentralised economic organisation as a means to achieve sustainable consumption and production. In 2007 he was awarded a Readership at Cardiff Business School's Logistics and Operations Management section.

Clifford Thames

Research and Consultancy

The company is increasingly moving towards offering specialist research and consulting services to the global automotive industry. The environment is fast becoming one of its core areas of expertise.

Research and advisory capability covering markets/environment/re-cycling

Clifford Thames is rapidly building a name for offering high quality research and advice to OEMs who are either entering markets for the first time or expanding. The service focuses on both the Western and emerging markets and offers solutions as regards dealer density, service practices, best policy as regards profitability and 'through life' ownership financial and environmental costs. The company also examines the merits of more component re-cycling.

The environment

Much is written about carbon emissions when a car is in use. However, far less is discussed about the environmental costs of maintenance and recycling. Clifford Thames fully intends to become an industry authority on this subject. Measuring a car's 'green credentials' simply by looking at its emissions when in use is far being the entire story.

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