

CENTS: A Research Network
for the Sustainable Transport
Community

Circular Economy Network+ in Transportation Systems



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Physical Sciences
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Title of Feasibility Study:

Ecofitting – whole-life design upgrading cars to zero emissions

Project Team



Dr Artur Grisanti Mausbach | Project Lead

Artur is a Senior Research Fellow, research supervisor and studio leader at IMDC. He is an architect and urban planner committed to sustainability, design and architecture, practice, education, and research. He has worked globally as a consultant for the car industry and has designs built in the UK, Austria, and Brazil. Artur has an MPhil in Environmental Urban Structures and BA and MA in Architecture and Urbanism (University of Sao Paulo Brazil), and a PhD in Vehicle Design (Royal College of Art, London).

Artur worked as consultant for Hyundai and Mahindra, especially on the development of new car aesthetics for emerging markets. Mausbach also delivered trend forecasting to Porsche Consulting, worked on the design of a Fiat racing car, and was a regular contributor to Car Design News. At IMDC he leads the Automotive Transitions Studio exploring paradigm shifts of the car industry, its transition to a focus on autonomous vehicles and sustainability and its connection with car design heritage, material culture and people. He led Ecofitting, Choreography of Mobility and Joyful Journey projects, and research for SAIC and Ford.



Dr Farhana Safa | Research Associate

Farhana is a former eye surgeon who left an established career in medicine to pursue her passion for car design. Upon completing a masters at the Royal College of Art in Vehicle Design, she joined the creative exterior design team at Land Rover, contributing to both automotive design and strategy. She has a wide creative scope also working in fashion, film and as an automotive photographer, and is keen to use her unusual background and skills to make a valuable contribution to the future of automotive design.



Dan Quinlan | Design Associate

Dan Quinlan work as a vehicle designer extends from developing future facing production models to creating abstract concepts. He has worked on the Innovate UK-funded GATEway project, the Future London Taxi and Future Luxury at the Hyundai-KIA lab. Dan is a graduate of the Royal College of Art's Vehicle Design course specialised in ideation, illustrating designs in a digital and physical medium and translating conceptual designs into tangible outputs. Dan also worked as exterior designer at Nissan (2012) on various productions vehicles.

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Executive summary (max 200 words)

Ecofitting project explored the development of novel design directions to expand the trends of converting ICE cars into electric vehicles (EV) as an additional strategy towards zero-emission mobility. The feasibility study identified a stakeholder's landscape and their potential roles and activities; produced a State-of-the-Art of material culture trends in alternative approaches to automotive design, more aligned to the expectations of next generation consumers; classified current trends in conversion of ICE into; compared ICE, EV and Ecofitting strategies through a sustainable design perspective (quadruple bottom line); and produced design provocations to visualise the possibilities of Ecofitting.

The project findings indicate that there are promising opportunities for developing automotive design differently, with designers connecting to users to update their cars, and users reconnecting emotionally to their cars; there are opportunities for alternative suppliers and SME to become part of the automotive ecosystem providing more sustainable solutions; there are opportunities to develop new products to be incorporated as usability and technology updates; there is a need to develop an online platform to facilitate Ecofitting and inform responsible consumer choices on upgrades; there is need to establish policies to certificate and incentivise Ecofitting; finally, Ecofitting is an effective sustainable solution which respects emotional and cultural values of cars, promotes long-term ownership and can change how cars will be designed in the future.

The problem (max 200 words)

Currently, there is no sustainable solution for the large existing fleet of internal combustion engine cars. While these vehicles are being progressively banned from use in places with more strict regulations, that does not guarantee a reduction in global emissions if the destiny of the fleet is not managed properly.

The UK requirements for Ultra Low Emission vehicles will create a fleet of 15 million non-compliant ICE cars in the UK. Complementary to the introduction of new low-emission vehicles from OEMs, it is necessary to extend the life of the current fleet and avoid the impact of the end-of-life of millions of cars, providing an alternative private vehicle offering.

Ecofitting proposes a new circular economy strategy to contribute towards zero-emissions in a sustainable manner by retrofitting the existing fleet of ICE cars. This involves not just electrification but, importantly, customization and personalization of these vehicles to create desirability, promote behavioral change, and long-term ownership.

Converting classic cars to electric is a growing trend in small businesses and OEMs. This project aims to expand this trend beyond classic cars. To investigate the feasibility of Ecofitting as a design concept, the research explores possible designs directions to demonstrate its potential.

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The approach (max 100 words)

The project applied a range of design research methods to investigate responsible ways of managing fleets of non-compliant vehicles and developing alternatives to make people embrace the transition to EVs.

The approach included investigating the state-of-the-art, behaviour changes, and trends in automotive design and material culture related to the concept of Ecofitting. Additionally, the Sustainable Design Orienting toolkit by Carlo Vezzoli was expanded to include personal and aesthetic issues. Using the new toolkit, Ecofitting was compared to ICE and EV strategies, in the perspective of Environmental, Economic, Socio-Ethical, and the novel Subjective Sustainability. Finally, a series of design experimentations were conducted to explore possible applications of Ecofitting and visualise possible future design directions. The outputs were presented and discussed in panel of specialists organised at the RCA.

Novelty (max 100 words)

Ecofitting changes the perspective of electrification and retrofitting beyond classic cars and considers cars from 1980 onwards thereby substantially expanding the potential environmental impact. This project innovates by venturing into alternative approaches to vehicle design, which are well respected and explored in architecture (retrofitting, renovation), more experimental in product design (upcycling) and more meaningful in traditional craft (Kintsukuroi), but far less so in vehicle design. At the same time, opens vehicle design to more sustainable practices.

It proposes understanding vehicles as platforms that can be updated and customised promoting long-term ownership and changing the way new cars will be designed in future.

The Sustainable Design Orienting toolkit was expanded to a quadruple bottom line, including Subjective Sustainability.

Results (max 500 words)

Identifying the fleet

Referring to the UK government targets on clean-air zones and zero-emission vehicle phasing, we identified a timeline and scope within which the context of Ecofitting is most relevant. All cars made from 1980 until the implementation of the current emission standards are worthy candidates for Ecofitting. By looking at data from the Department for Transport (see figure 1), it has been identified that as of 2019, there is a fleet of 15.1 million diesel and petrol cars currently on the road in the UK that are non-compliant with clean air zones. These cars are the main focus of Ecofitting. The remaining 53.5% of the fleet, which are compliant to the ULEZ, can be a part of a second Ecofitting wave, converting them to zero-emission. Currently, only 0.2% of the UK fleet is zero emission.

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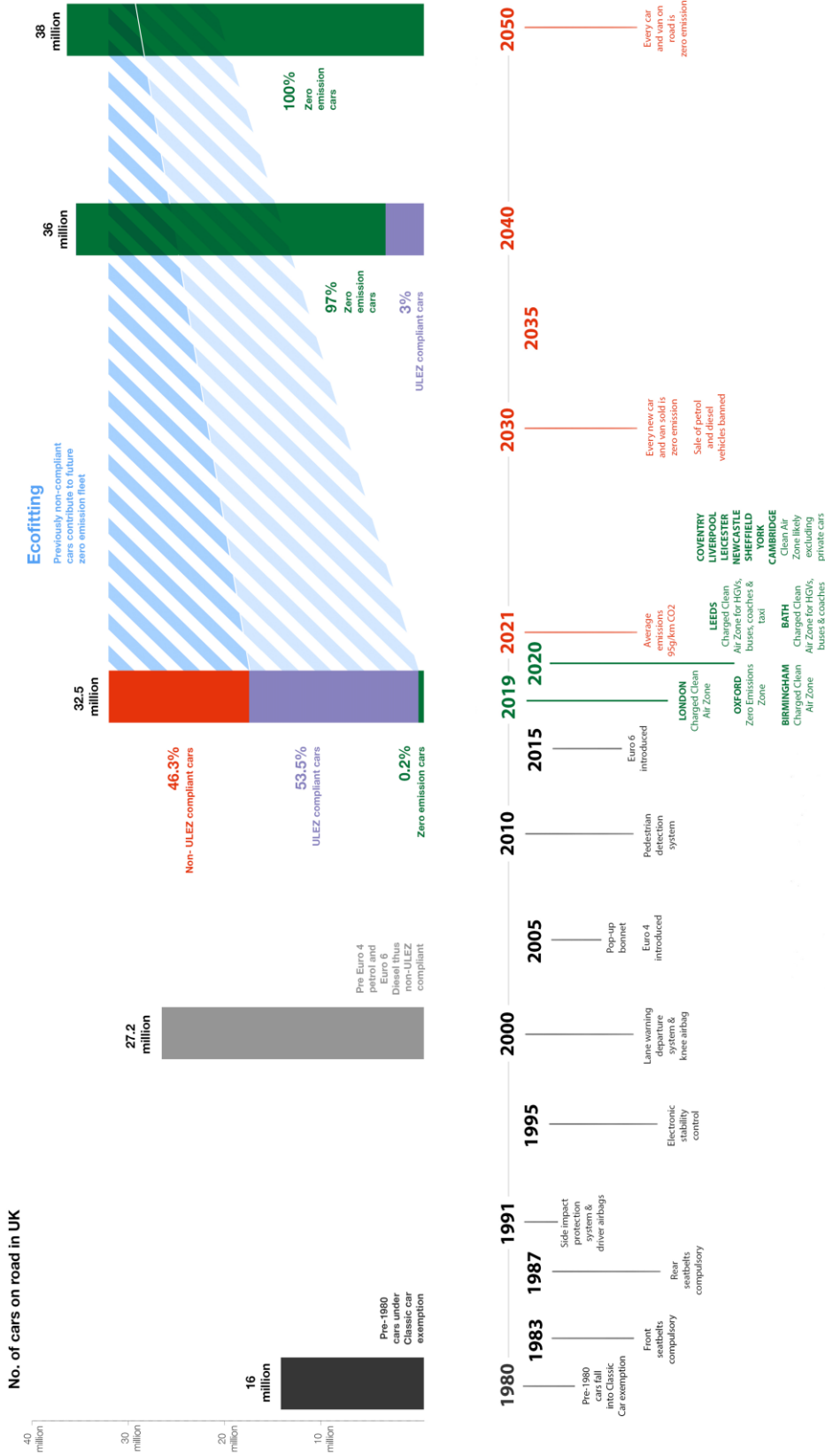
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Figure 1. Ecofitting Timeline

ECOFITTING TIMELINE
CONTRIBUTION TO ZERO EMISSION STRATEGIES



Data on all licensed and registered cars from Department for Transport



Context

Through the taxonomic research we identified trends influencing the current development of car designs. The endurance of the designs referencing the past is a noticeable aspect on the exterior design taxonomy. From an interior car design perspective what stands out is the desire for more personalization and customization, especially coming with the concepts of AV. In general, car design has developed an aesthetic of perfection related to traditional paradigms of perceived quality.

Sustainable Design Analysis of Ecofitting

The strategy and products of Ecofitting were compared to current EV and ICE alternatives using the Sustainable Design Orienting (SDO) toolkit, here expanded from a triple to a quadruple bottom line by including Subjective Sustainability. The analysis highlighted Ecofitting's relative benefits compared to the EV and ICE alternatives and which were plotted in radar charts (fig. 2). The tool is used to analyse the current models and orientate the following design experimentation.

Ecofitting State-of-the-Art

The research identified activities of car conservation - Car Restoration, Car Preservation, and Extension of Life as practices that support the development of Ecofitting. In Car Retrofitting the trends of Full Renovation, Electric Rustoration (rusty EVs), Classic Car Conversion, Budget and Scale, OEM Product Diversion, OEM RE-Manufactured and DIY were classified and positioned in a chart (Fig. 3) to identify opportunities for Ecofitting.

Design Experimentation

Looking at the opportunities to expand Ecofitting, four design briefs were set inspired by the material culture and behaviour trends observed in the research. The designs were produced focusing on delivering efficient, cheaper, more sustainable, and expressive solutions. The Symbiosis, Metamorphosis, Upcycling and Art Car briefs and designs are on figure 4.

Ecofitting concept evaluation panel

Dr Mausbach and Dr Safa presented Ecofitting in an RCA-based design forum to automotive, product and fashion design experts. Key points pointed out by the panel included:

- The Symbiosis approach as interesting to OEMs, especially for the case of cars already with existing EV versions (such as the Symbiosis Fiat 500)
- Explore in more detail the full carbon footprint involved in the different Ecofitting design directions.
- Explore how policies can support Ecofitting.
- The Symbiosis as a design language that is representative of sustainability and can deliver cost-effective solutions.
- Refurbishing of cars to become a practice similar to refurbishing homes as an interesting area for design to evolve towards.

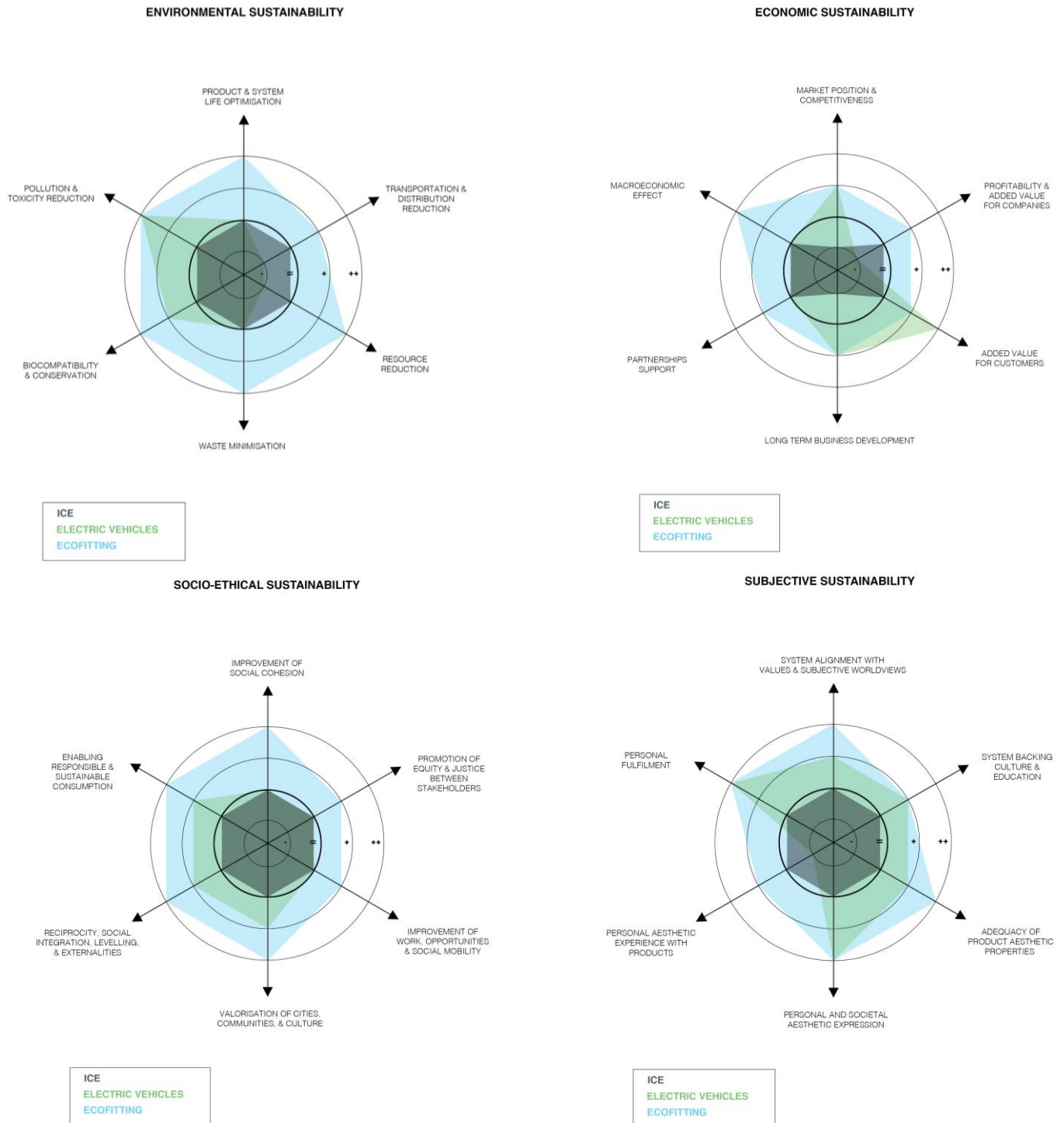
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Figure 2. Radars from the Sustainable Design Analysis of Ecofitting.



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Figure 3 Positioning Map showing current trends of conversion to electric and opportunities to Ecofitting.

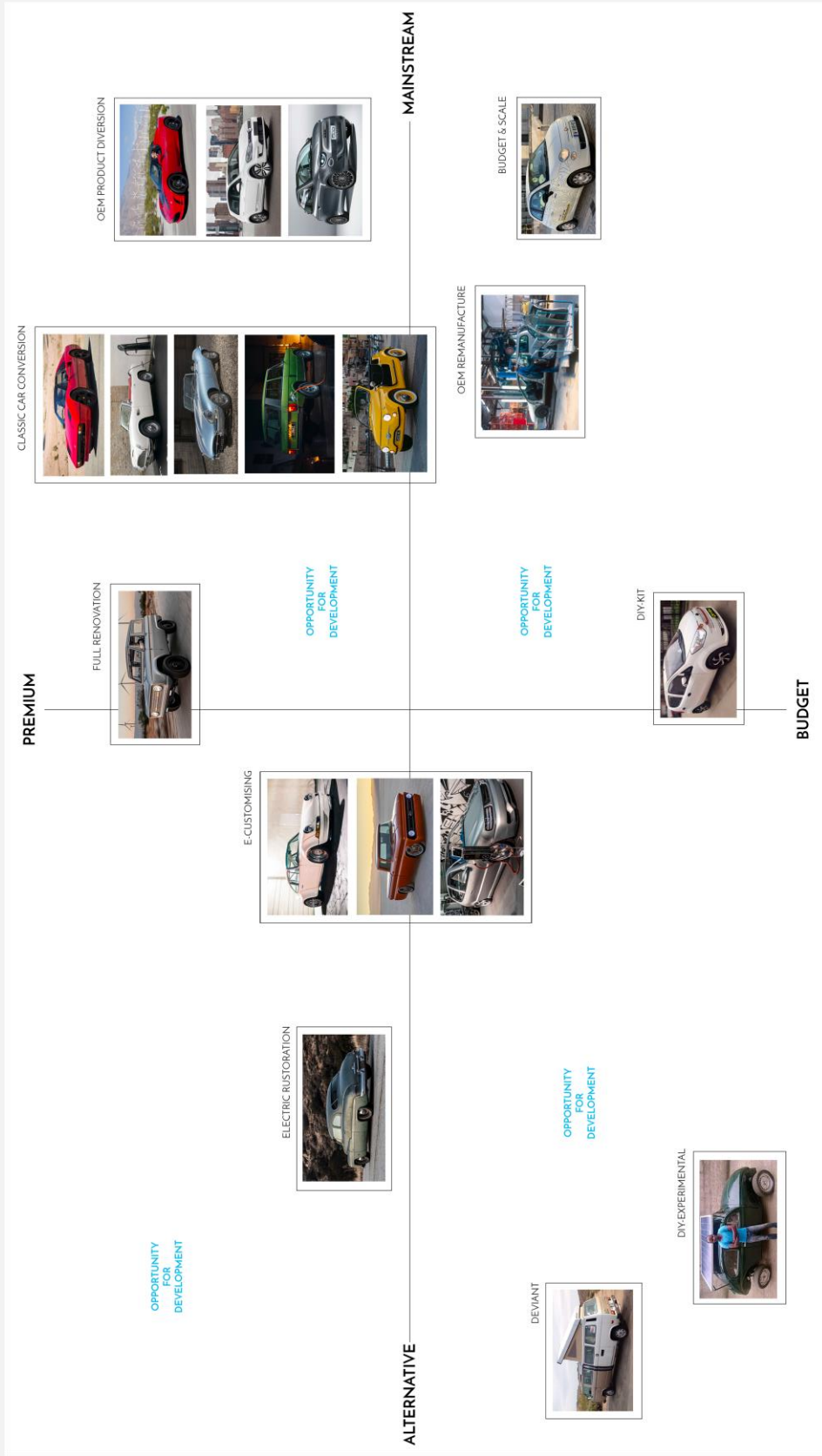


Figure 4. Ecofitting Design Directions.

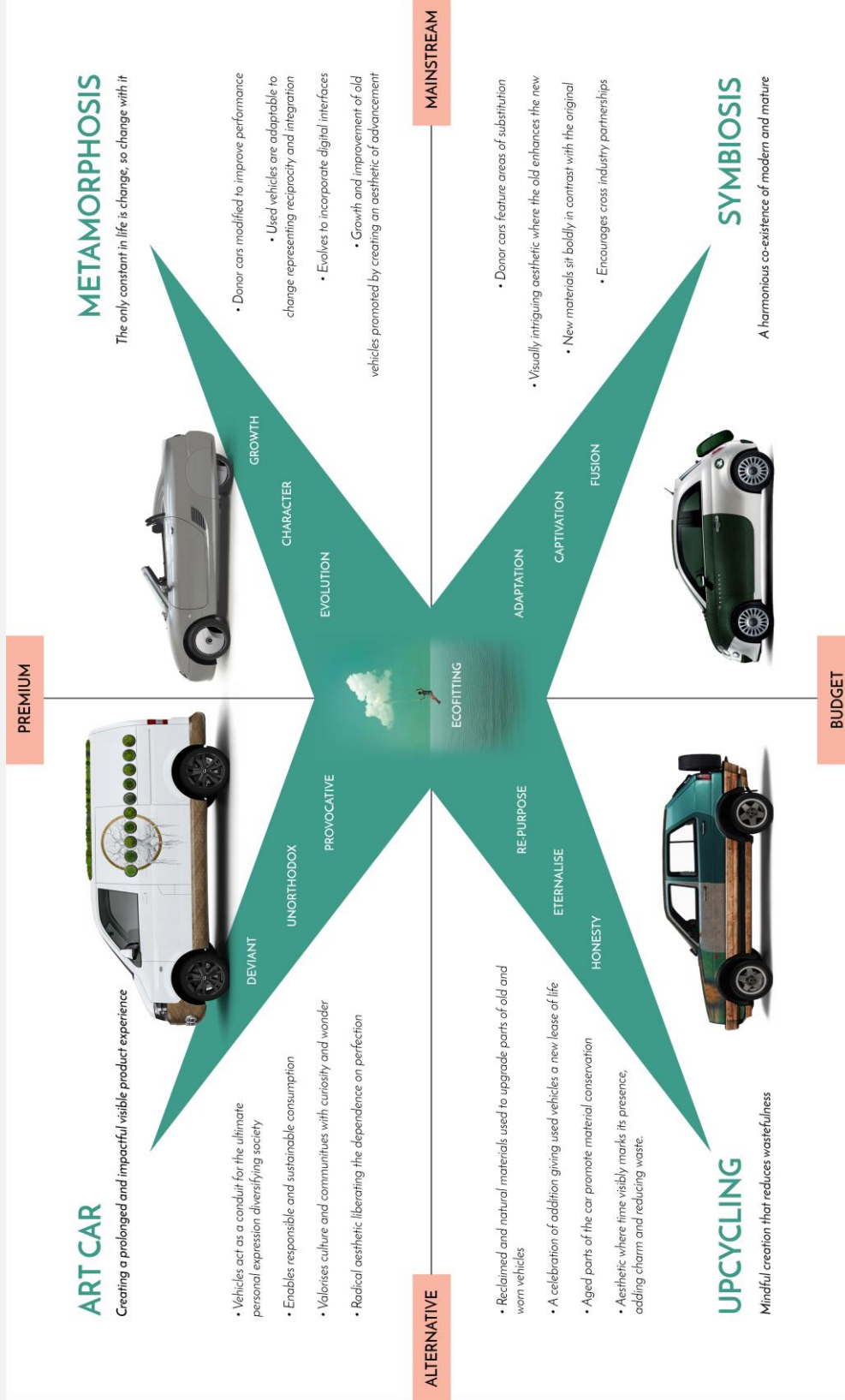
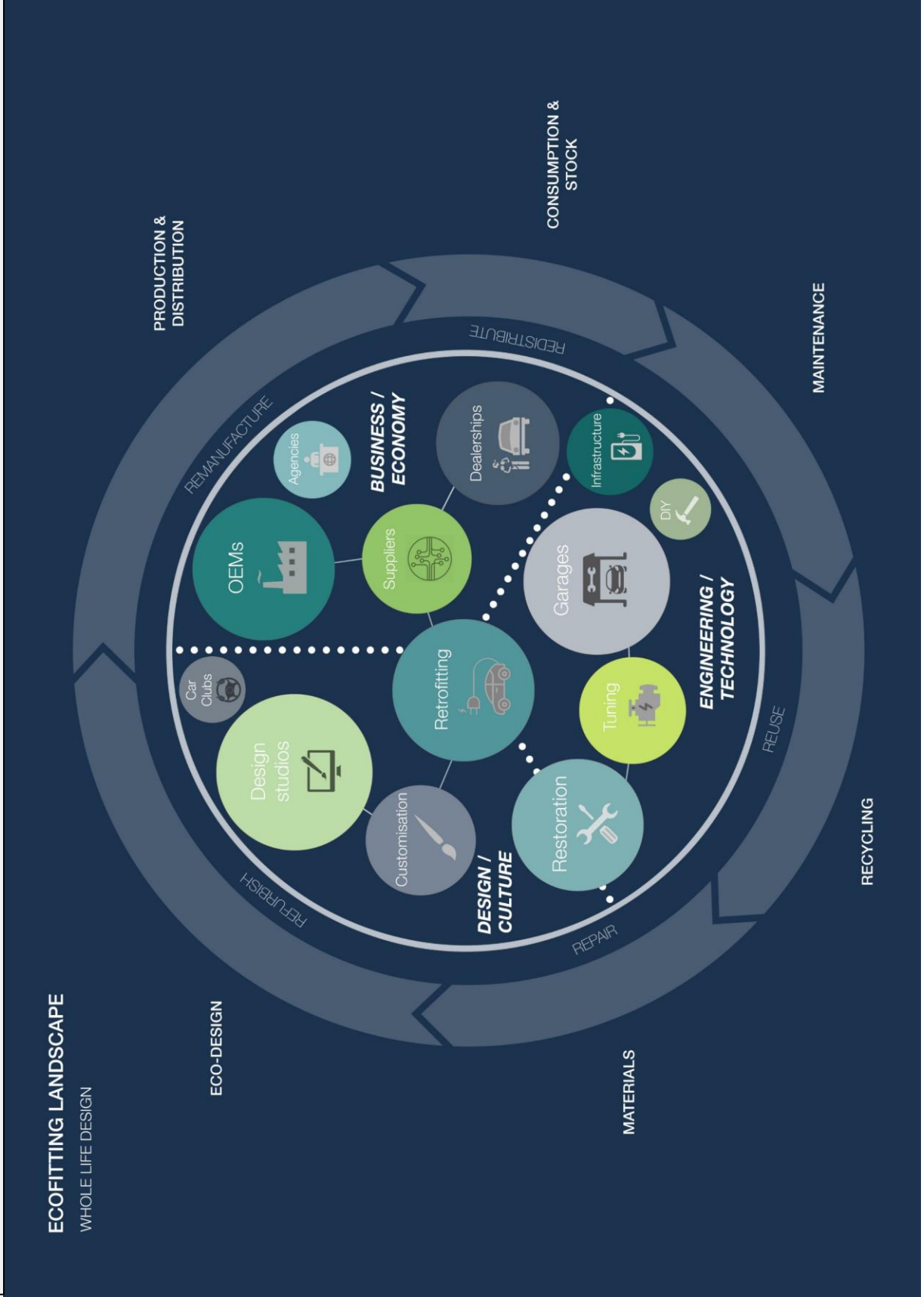




Figure 5. Ecofitting Stakeholders Landscape





Key finding 1 (max 50 words)

Car design has developed an aesthetic of perfection, which is represented by the sleekness of surfaces, thinness of the joint between panels of metal or plastic, the shininess of the chromes, sharpness of edges, or even the noise of closing doors. These are not aligned with the taste of new generations and are too costly to maintain. This creates an opportunity to Ecofitting to develop a more environmentally conscious aesthetic.

Key finding 2 (max 50 words)

The Sustainable Design Orienting toolkit analysis highlighted Ecofitting's benefits related to long-term ownership, waste and resource reduction, local production and wider distribution of opportunities, promotion of local culture, communities and responsible consumption, promotion of an aesthetic of sustainability, valorisation of personal identity and deeper values.

Testimonial from ECR/project team (max 500 words)

Funding and support from CENTS have enabled the IMDC to explore the initial stages of Ecofitting, to uncover the challenges, opportunities, and potential of the project, and ultimately to determine feasibility for this proposal. The project has allowed us to expand our research skills to navigate the possibility of creating a sub industry that involves a much larger scope of players in the journey to a more sustainable future of mobility.

The opportunity to present the project at the 2021 CENTS Conference to an audience of fellow delegates allowed us to gauge the reaction from a wider community, and the following discussion and workshops were useful in addressing both positive and negative reactions to the project. The chance to Table Host gave us an opportunity to directly engage with conference attendees and answer any questions on the project personally.

The design review to a panel of experts as well as a CENTS representative proved to be both a stimulating and useful discussion into the progress and future applications of the project. Following determination of the key findings from the project, we are keen to progress Ecofitting to the next stage with further involvement with CENTS.

Impact (max 200 words)

Ecofitting may not only benefit the individual OEM, but the wider supply chain and ultimately UK plc by developing an entire ecosystem around remanufacturing, redistribution, repair, reuse, and refurbishment. Figure 5 illustrates potential future stakeholders interactions in a circular economy. Beneficiaries are OEMs, expanded supply chain, garages, dealerships, customizers, restores, retrofitters and design Studios.

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There are opportunities for developing automotive design differently, with designers connecting to users to update their cars, and reconnecting emotionally users to their cars. There are opportunities for alternative suppliers to become part of an entirely new automotive industry ecosystem and provide more sustainable solutions. There are opportunities to develop new products to be incorporated as usability and technology updates (interfaces, powertrain, bodywork, upholstery). There is a need to develop an online platform to facilitate Ecofitting and inform responsible consumer choices on upgrades. There is a need to establish a policy to certificate and incentivize Ecofitting.

The outcomes of Ecofitting will support the UK transition towards zero emission mobility.

Outputs include:

- Ecofitting Circular Economy: An alternative approach to market, consumption, and design towards zero emissions – paper presented at EVER2021 (<https://ieeexplore.ieee.org/abstract/document/9242964>)
- Ecofitting – whole-life design upgrading cars to zero emissions – research page at RCA website (<https://www.rca.ac.uk/research-innovation/projects/ecofitting-whole-life-design-upgrading-cars-to-zero-emissions/>)

Next steps (max 200 words)

Ecofitting is focused on the challenge of climate change and protecting the environment. It is aligned with the focus of KTN on sustainability, and specifically, the area of Low Emission Vehicles in the Transport sector.

The next stage of the research will be based on road mapping workshops with stakeholders.

1. Public perception workshop Ecofitting - Hope and Fears will focus on public perception and new consumption patterns. Addressing marketing and design from OEMs and consumers. Aims the development of humanities and design research (AHRC).
2. NPD Workshop Symbiosis and Metamorphosis will look at opportunities for product development and generating new IP triggered by the design provocation. Addressing suppliers and OEMs. Aims the development of consortium, industry funded research, and work with InnovationRCA.
3. Policies and industry strategies Workshop Ecofitting - Nurturing Circularity will focus on policies and strategies to implement circular economy and incentives to business. Addressing multiple stakeholders. Aims the development of consortium and industry and research council research (UKRI, InnovateUK).

The workshops will generate a Ecofitting Roadmap, indicating the unfolded scopes of research to follow. Following stages will include building a physical demonstrator, industry partners projects, developing an Ecofitting Design website, supporting work on the development of incentives to Ecofitting.

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