

A Quadruple Bottom Line of Sustainability

Analysis of Ecofitting Design Concept

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Abstract - This paper presents a Quadruple Bottom Line Analysis of Sustainable Design Directions for Ecofitting, a sustainable solution for the large UK fleet of internal combustion engine cars that will soon be rendered non-compliant with fast approaching initiatives for Ultra Low Emission Vehicles. Ecofitting circular economy strategy goes beyond just electrification, opening an opportunity for new approaches to automotive design, and to cater for generational shifts in desirability. The need to understand subjective aspects related to aesthetic experience, aesthetic properties, values, worldviews, and tastes, initiated the development of an extended view on sustainability include these issues. The paper presents the analysis made with an expanded and revised Sustainable Design-Orienting tool [1]. The analysis pointed out that Ecofitting can have a significant impact in the automotive industry. At the same time, this study reveals the importance of the quadruple bottom line to develop tangible and intangible aspects of design.

Keywords—Sustainable design; sustainability; retrofitting; electric conversion; electric cars; circular economy.

I. INTRODUCTION

Ecofitting is a new concept that explores the development of novel design directions to expand the trends of converting internal combustion engine (ICE) cars into electric vehicles (EV) as an additional strategy towards zero-emission mobility. Opposed to current industry strategies based on the creation of new products, Ecofitting avoids the massive impact of end-of-life and disposal. At the same time, re-using vehicles will require updating in usability, safety, and aesthetic to make them attractive to consumers. This involves not just electrification but, importantly, the customisation and personalisation of these vehicles to create desirability,

promote behavioural change, and long-term ownership. Therefore, to develop Ecofitting it is necessary to consider not only the environmental, economic, and socio-ethic aspects of sustainability. It is also necessary to explore personal and aesthetic experiences related these vehicles, extending the understanding of sustainability from a triple to a quadruple bottom line, and adding Subjective Sustainability.

On this research, the strategy and products of Ecofitting were compared to current EV and ICE alternatives using a Sustainable Design-Orienting (SDO) toolkit expanded to a quadruple bottom line. The analysis highlighted Ecofitting's relative benefits compared to the EV and ICE alternatives and which were plotted in radar charts (figures 1 to 4). The tool is used to analyse the current models and orientate the following automotive design experimentation.

The Sustainable Design Orienting toolkit analysis highlighted Ecofitting's benefits are mainly 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.

II. EXPANDING THE SUSTAINABLE DESIGN-ORIENTING TOOLKIT FOR DESIGN RESEARCH

Aiming to develop a holistic analysis of sustainability to the Ecofitting concept and inform the design research process, we use the Sustainability Design-Orienting toolkit (SDO) [1], developed at the Politecnico di Milano by Dr Carlo Vezzoli, with Ursula Tischner and others, and its user guide created by Hussain Indorewala and Daniel Metclafe [2]. The original SDO looks into the Environmental, Economic and Socio-ethical dimensions of sustainability, questioning a series of issues related to product and service design, and respective externalities, relating to a triple bottom line for sustainability.

Following Stuart Walker [3] suggestion to amplify the concept to a quadruple bottom line for sustainability, also including the Personal Meaning, the SDO toolkit was reviewed to include a fourth dimension. Applying the same structure as the Environmental, Economic and Socio-Ethical dimensions, we have added a Subjective Dimension. As in the original toolkit 3 dimensions, six criteria were defined under the Subjective Dimension with references to the aspects discussed by Walker [3, 4], Faude-Luke [5], Papanek [6], Manzini [7], Sovacool [8], Hassenzahl [9] and others. A checklist was added to each one of the six criteria. Additionally, a review was made in the original questions of the toolkit to align to automotive

design research and referencing the UN Sustainability Goals [10].

For designers and design researchers, the SDO presents the advantage of being manageable in qualitative research or to compare concepts during their creations. According to the authors the objective of the SDO is:

“The objective of this tool is to orient the design process towards sustainable system solutions. This happens thanks to the different functions of the tool, which is able to support designers in: setting sustainability priorities; analysing best practices; using sustainable design-orienting guidelines; and checking and visualising the potential improvements in relation to an existing reference system.”[11]

III. THE ANALYSIS

In this Quadruple Bottom Line Analysis, the toolkit is used to compare ICE-based automotive industry and products, with EV-automotive industry and products and Ecofitting circular economy and products, which is a new concept proposed in this research [12]. The objective is to observe how Ecofitting, as a design concept in the context of circular economy, can differentiate from the current strategies of automotive industry and to help to identify its high and lows points, design implications, and inform its feasibility [13].

The study is dived in four dimensions, according to the updated toolkit. All four dimensions have six criteria, which are investigated using the checklist questions. The checklists are answered to inform the comparison between the three, above mentioned, industry and products concepts. The answers are given as present and short-term context, or long-term, when specified. Following the checklist, a review is written, and it is signalised a scale of improvement for the specific criterium. The level zero of the scale of improvement is the current state of the automotive industry and products, which is predominantly ICE-based. Therefore, on most of the criteria, ICE will have no improvement, and receive an equal signal (=). In the case of long-term questions, ICE can improve or worsen. Improvements can be medium or high, receiving one or two plus signals (+) respectively. Worsening receives the minus sign (-). Then, the grade signs are transferred to a Radar Chart per each criterion. There are 4 Radar Charts, one per each of the sustainability dimensions analysed in the project. The following section describe the 4 dimensions, list the checklist questions for each criterium, and summarizes the results.

1. Environmental Sustainability Dimension

Definition

Environmental Sustainability looks at issues related to the materiality, efficiency of systems and products, and externalities that affect the environment and life. In this analysis, Environmental issues are considered often functional, tangible, and quantifiable. Nevertheless, because this study is mostly a conceptual analysis, it will not deliver data like a life Cycle Analysis, but a qualitative comparison between ICE, EVs and Ecofitting.

This dimension of sustainability is considered here as practical issues and related to Stuart Walker's idea of Practical Meaning. "Practical Meaning is characterized by: that is sense based and provable; instrumental thinking; intellect and reasoning; quantitative methods; evidence-based methods; analytical thinking; logic and efficiency" [14]. It relates to physical sciences, mathematics, engineering, technology, innovation. The checklist questions used on the analysis are shown on table 1.

Summary of results for Environmental Sustainability

In the Environmental Sustainability analysis, Ecofitting has showed better results than mainstream EVs and ICEs, in every criterium. The results of the analysis can be seen in the following radar chart (figure 1).

Ecofitting's better results included criteria which are significantly difficult for EVs today: Resource Reduction and Transportation and Distribution Reduction. Looking at the perspective of the replacement of the ICE for electric cars, it is strategic to put in place alternatives to reduce the impact of transportation and use of resources. Ecofitting shall also make a more significant use of biomaterials, to increase the biocompatibility of the system.

A considerable improvement of Ecofitting is on minimisation of waste and on the optimisation of the product and system. Although now the conversion of cars is mainly happening on small scale, the objective of Ecofitting is to expand this activity, therefore the environmental impact of electrification of private mobility will be reduced.

The Environmental Sustainability analysis indicates that Ecofitting Circular Economy concept is a worthwhile strategy towards zero-emissions and environmental sustainability.

Checklist Questions for Environmental Sustainability

Biocompatibility and Conservation:

- A. *Is all energy produced from fossil fuels? Is all the energy produced from renewable sources?*
- B. *Does the system use mainly depleting and/or non-renewable material for the production processes? Does it use biomaterials?*
- C. *Does the system use locally grown materials?*
- D. *Is the product and system prepared to respond to changes and disturbances in natural and manmade contexts?*

Resource reduction:

- A. *Is the system consuming high quantities of natural resources? Is the system absorbing high quantities of consumables?*
- B. *Is the system consuming high quantities of energy?*
- C. *Are the extension of life of the products and system facilitate?*
- D. *Is the extension of life of materials promoted in the system?*

Transportation and distribution reduction

- A. *Are there any excessive transportation of goods, semi-finished products, or by-products?*
- B. *Are the transportation means in services fully used or shared?*
- C. *Is there any excessive transportation of materials and resources to run the system or product?*
- D. *Are maintenance and upgrade developed locally or highly dependent of long-distance transport?*

Product and System life optimisation:

- A. *Do parts of the system and products tend to be technological or culturally/aesthetically obsolete?*
- B. *Is the system individually used, when it could be shared in some of its parts?*
- C. *Do some parts of the system/product tend to wear out more easily (than others)?*
- D. *Does the system favour maintaining and upgrading services?*

Pollution and Toxicity reduction:

- A. *Are the processed resources toxic or potentially toxic during production and distribution?*
- B. *Are the processed resources toxic or potentially toxic for people?*
- C. *Are the processed resources toxic, polluting or damaging to the environment in the long term?*
- D. *Are the products, subproducts, packing or infrastructure toxic or potentially toxic during after service time?*

Waste minimization:

- A. *Do the production, packing and support products produce big quantities of landfill waste?*
- B. *Does the system produce high quantities of landfill waste at the end of service-life of products and parts?*
- C. *Does the system facilitate dismantling and disassembly?*
- D. *Does the system use biodegradable materials?*

Table 1. Checklist questions for Environmental Sustainability

ENVIRONMENTAL SUSTAINABILITY

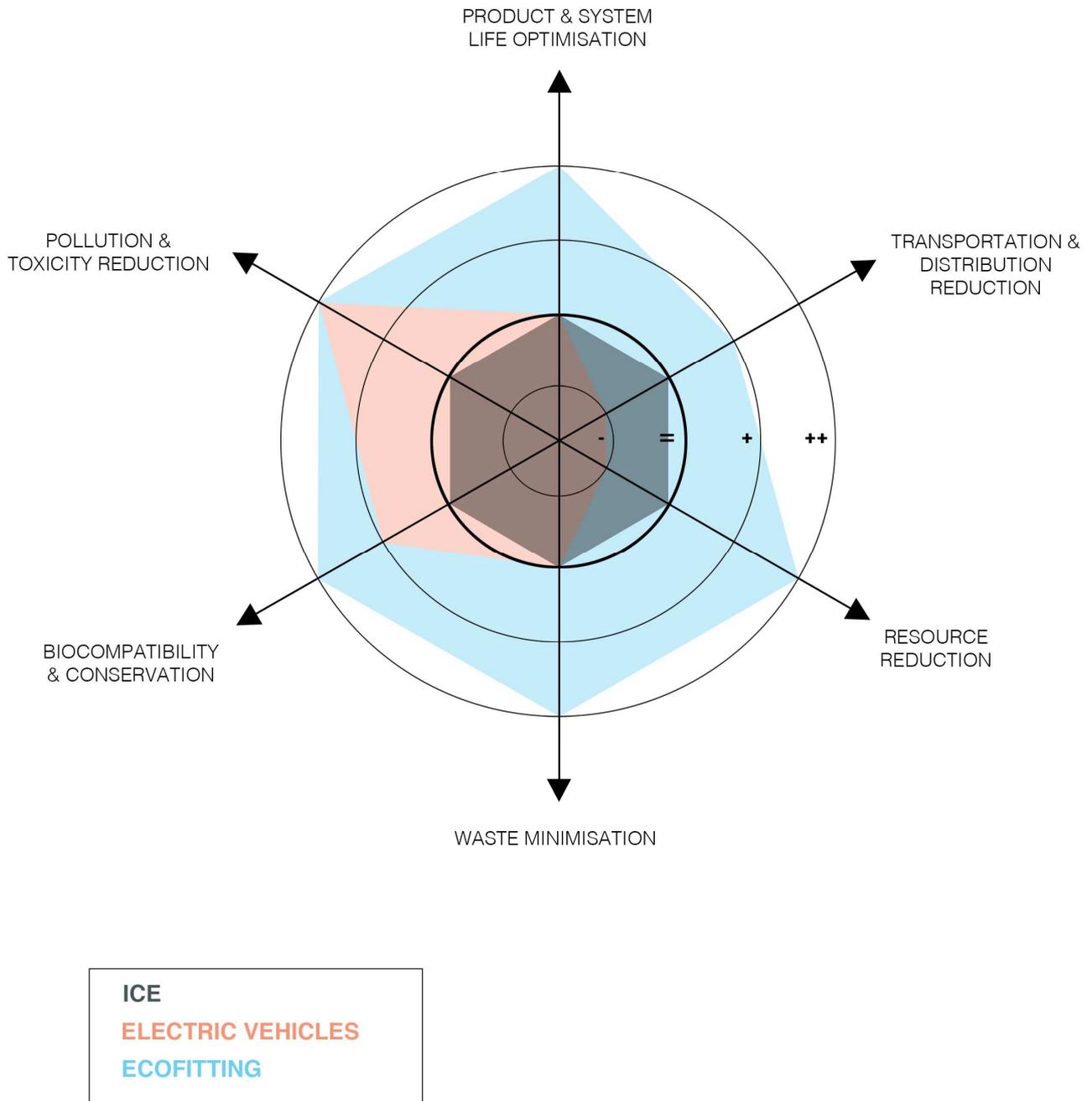


Figure 1. Environmental Sustainability Radar Chart

2. Economic Sustainability Dimension

Definition

Economic Sustainability also looks at issues related to the materiality, efficiency of systems and products, but through a financial perspective. More importantly, in this study, the wider consequences of the economic activity, how it includes people, how benefits are shared, and how inequalities are reduced, are prioritised in the economic model. In this analysis, Economic issues are considered then more functional and tangible than just a monetary quantity. This study will not deliver data on profit or expending. It considers this dimension of sustainability practical issues, or means to something, and is related to Economic Means [15].

Economic Means are characterized by: financial viability, but not as an end in itself. The focus is on inclusion and sustainable development. It is sense based and provable; but should be observed holistically to promote sustainable development. It relates to physical and social sciences, mathematics, economics engineering, technology. The checklist questions used on the analysis are shown on table 2.

Summary of results for Economic Sustainability

In the Economic Sustainability analysis, Ecofitting has showed better results than mainstream EVs and ICEs, in most of the criteria. The results of the analysis can be seen in the following radar chart (figure 2).

It is expected that Ecofitting will have a better result on profitability and added value for companies, that is significantly difficult for EVs now. While supporting long-term ownership, Ecofitting improves customer fidelity and deliver services more continuously. Additionally, the circular economy concept supports partnerships and creates a positive macroeconomic effect, while creating jobs and reducing the financial cost of environmental damage.

A challenge for Ecofitting is to match the added value for customers. Theoretically, purposely designed EVs will perform better than adapted cars and have the support of the mainstream automotive industry strategies for marketing, maintenance, and benefit from government incentives.

The Economic Sustainability analysis indicates that Ecofitting Circular Economy concept is a worthwhile strategy towards a new sustainable economy model.

Checklist Questions for Economic Sustainability

Market position and competitiveness:

- A. *Are the products of the system in a weak or strong market position?*
- B. *Are there possibilities to improve market position? Are there possible threats to market position?*
- C. *Is there an intense competition in the market for products of the system?*
- D. *Are there lower cost offers for delivering the same service or function?*

Profitability and added value for companies:

- A. *Is the profitability of the system low or high for companies and partners?*
- B. *Are there opportunities to create more value in the whole system or value chain?*
- C. *Does the system allow long-term fidelity of costumers?*
- D. *Are there possibilities of lowering costs through reduction of processes, use energy or material?*

Added value for customers:

- A. *Do the products of the system perform efficiently their functions?*
- B. *Is the cost benefit good for costumer and final user of the system?*
- C. *Does the system offer long-term tangible savings for the costumer?*
- D. *Are the products of the system keeping the value invested by the costumer?*

Long term business development:

- A. *Is the acceptability of the offer of the system secure for the long term?*
- B. *Are there any major risks to the business from external sources?*
- C. *Are the products of the system threatened by technological or fashion changes?*
- D. *Is the system financial background strong, stable, and self-sustainable?*

Partnerships support:

- A. *Are strategic partnership and cooperation possible in the system?*
- B. *Does the system make use of existing manufacturing and marketing capacities?*
- C. *Does the system encourage sharing of products?*
- D. *Do the system favour partnerships to end-of-life management, closed-loops recycling, remanufacture, re-use or retrofit?*

Macroeconomic effect:

- A. *Are there problems on a macroeconomic level, monopolistic structures or rebound effects or encourage the development of fair trade?*
- B. *Does the system create shared economic benefits to the development of communities or concentrates financial gain?*
- C. *Does the system create costs of environmental impact?*
- D. *Does the system support job opportunities and inclusion of people on sustainable economic development?*

Table 2. Checklist questions for Economic Sustainability.

ECONOMIC SUSTAINABILITY

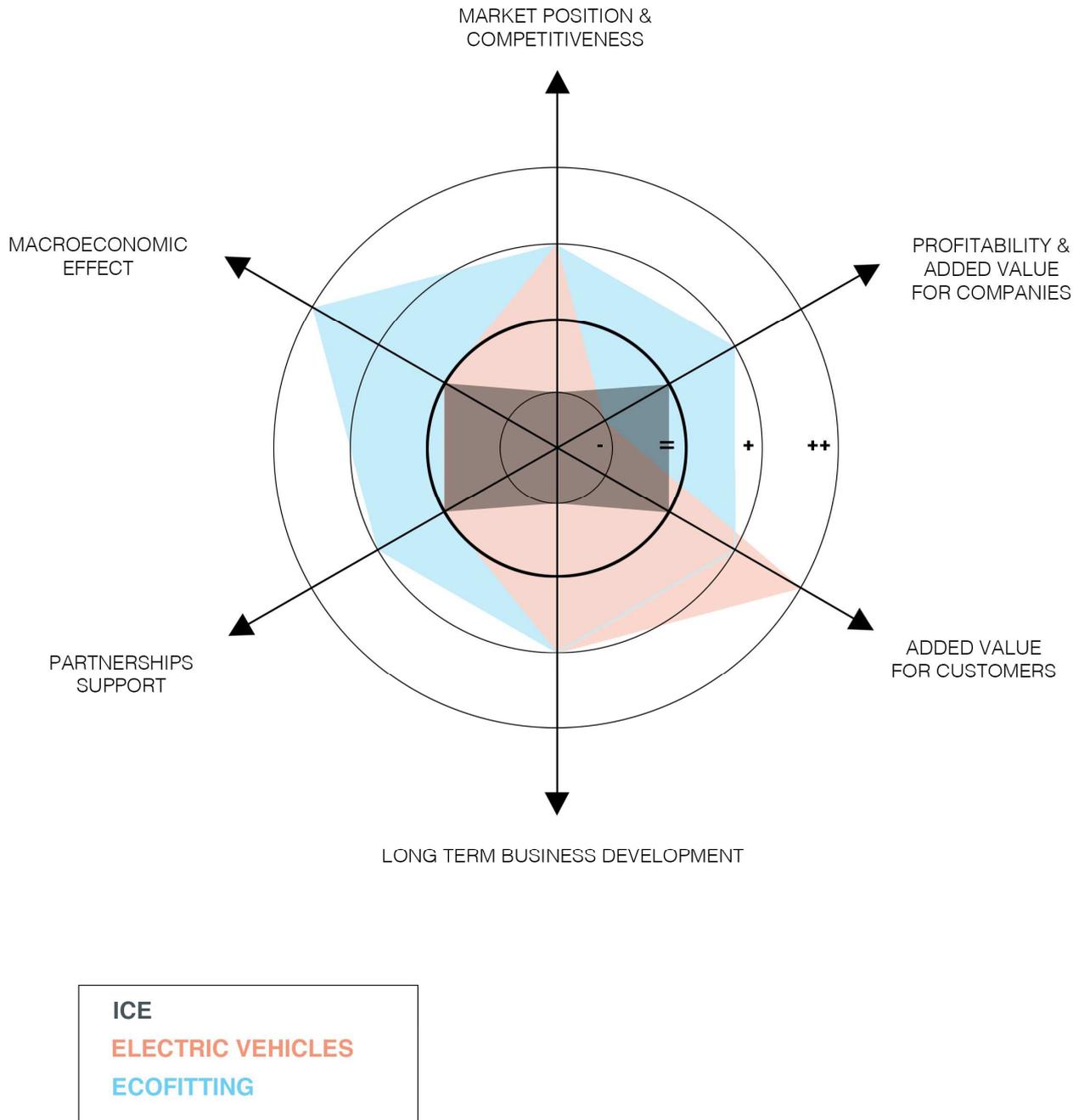


Figure 2. Economic Sustainability Radar Chart

3. Socio-Ethical Sustainability Dimension

Definition

Socio-ethical Sustainability looks at issues related to communities, society, and people, considering the collective and shared contexts. It investigates ethical issues and the relationship to work and the externalities of consumption habits. The Socio-ethical dimension deals with qualitative issues and it is related to Social Meaning.

Social Meaning is characterized by: “concerns of justice, peace, charity, compassion, and the moral compass that informs our social relationships” [14]. It is represented by disciplines such as social sciences, politics, law philosophy, economics, as well as the applied arts such as design and fashion. The checklist questions used on the analysis are shown on table 3.

Summary of results for Socio-Ethical Sustainability

In the Socio-Ethic Sustainability analysis, Ecofitting has showed better results than mainstream EVs and ICEs, on all criteria. The results of the analysis can be seen in the following radar chart (figure 3). While EVs industry and product show improvements on sustainable consumption, reciprocity, social integration, externalities, and valorisation of cities, when compared to ICE’s, Ecofitting can bring even more improvements. Ecofitting advantages lies on the long-term ownership, respect for local culture and the integration of people in the system. Therefore, Ecofitting shall focus on developing the design related to place.

Ecofitting Circular Economy also enables improvement in issues EVs will not promote change, like social cohesion, promotion of equity between stakeholders, improvement of work opportunities and social mobility. The Socio-Ethic Sustainability analysis indicates that Ecofitting Circular Economy concept is a worthwhile strategy towards a more respectful and egalitarian society.

Checklist Questions for Socio-Ethical Sustainability

Valorisation of cities, communities, and culture

- A. *Does the system improve the quality of public and private spaces of the city?*
- B. *Does the system have a positive impact on social well-being of the local community?*
- C. *Does the system respect or support local cultural values and identities?*
- D. *Does the system favour the long-term building of culture and community?*

Improvement of Social cohesion

- A. *Is the production system creating or favouring any form of intragender, intra-cultural, intra-generational exclusion or discrimination?*
- B. *Do the system and product offer inclusive access to all, regardless of income, gender or background?*
- C. *Is the system creating opportunities to people to participate on sustainable initiatives?*
- D. *Is the system creating opportunities to people to support each other?*

Promotion of equity and justice between stakeholders

- A. *Are there critical (geographic, political, social) implications on the suppling system?*
- B. *Are there any unjust unethical relations with suppliers, subcontractors, sub-suppliers and between the partnerships?*
- C. *Is the equity of benefits and sustainability promoted or safeguard in the relationship between stakeholders and governments?*
- D. *Is there knowledge exchange to develop partnerships to climate action or environmental good?*

Improvement of work, opportunities, and social mobility

- A. *Are there any problems with health and safety?*
- B. *Is there social mobility in the system?*
- C. *Are there any problems with workload, inadequate wages, or profit distribution?*
- D. *Does the system favour the development of new sustainable industry?*

Enabling responsible and sustainable consumption

- A. *Are the system and products delivering relevant benefits for society that justifies itself?*
- B. *Are there options of products and service delivering the benefits in a sustainable way?*
- C. *Is the client/final user able to acknowledge clearly and easily the social sustainability along the whole product chain? Is the client/final user able to understand the responsible/ behaviour by the supply chain?*
- D. *Is the system creating distracting elements to entice the consumption?*
- E. *Is the system promoting the extension of life of the products?*

Reciprocity, social integration, levelling, and externalities

- A. *Does the system support levelling of benefits in the community?*
- B. *Does the system propose solutions to people with weaker social status or lower income?*
- C. *Are there opportunities to develop new skills and knowledge to work sustainably?*
- D. *Does the system promote conscious actions towards the environment?*

Table 3. Checklist questions for Socio-Ethic Sustainability

SOCIO-ETHICAL SUSTAINABILITY

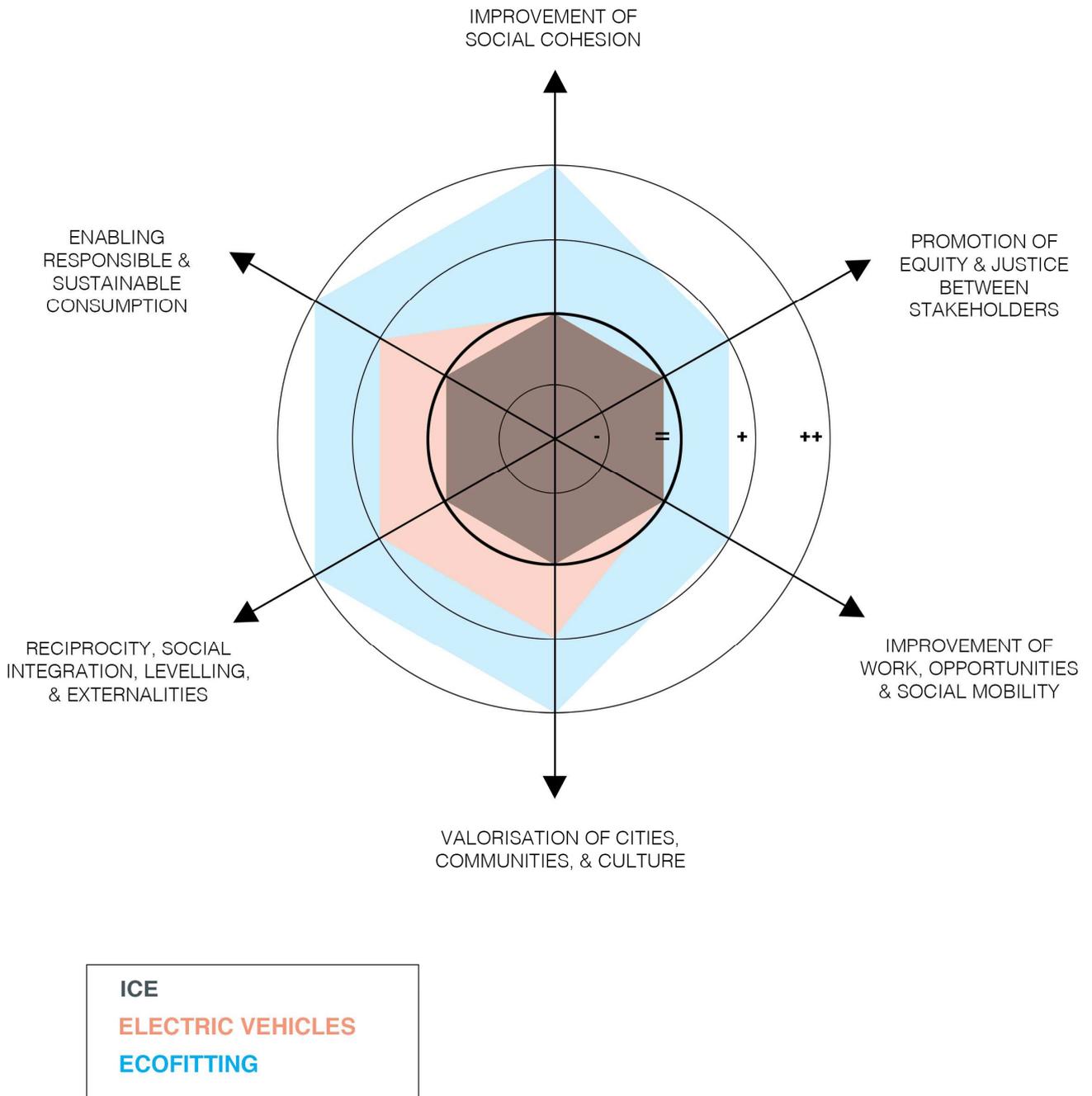


Figure 3. Socio-Ethic Sustainability Radar Chart

4. Subjective Sustainability Dimension

Definition

Subjective Sustainability looks at issues related to aesthetics, meanings, personal experiences with products, values, and wellbeing. It deals with symbolic and intangible aspects of design, which are essential for its conceptualisation. In this analysis, Subjective issues are considered qualitative and related to context. The analysis provides a comparison between ICE, EVs and Ecofitting, and helps to position the aesthetic principles of Ecofitting.

The envisaged concept will share the principle of extending the lifecycle of the object, therefore some of the original object will be kept as a base platform. In addition, Ecofitting research [13] investigates design directions which are more adequate for sustainability, reflecting its values and then aligning to the expectation of the user. While a Ecofitting design will have to perform in usability and practicality it will also need to attract consumers, create satisfaction and personal fulfilment. Don Norman [16] argues that “the emotional side of design may be more critical to a product’s success than its practical elements”.

Subjective Sustainability is the proposed fourth pillar added to the original SDO, and it relates to Personal Meaning, described by Stuart Walker. Personal Meaning characterized by: “the interior life and addressing perennial questions about being itself, life’s purpose and ultimate value cannot be pursued through rationalization or proved via empirical methods” [14]. It is represented by disciplines such as arts, poetry, music, and literature.

The checklist questions used on the analysis are shown on table 4. The Subjective Sustainability analysis follows the findings on previous research [17,18] regarding the value of aesthetics to sustainability. It is a new contribution to advanced design research methods to mobility, developed as a tool to evaluate Ecofitting, and can be applied to other design research.

Checklist Questions for Subjective Sustainability

System alignment with basis of values, and subjective worldviews:

- A. *Does the system connect to an essence for existing and a search for deeper values?*
- B. *Does the system encourage imagination or spiritual experiences?*
- C. *Does the system promote principles of rightness, truth, and goodness?*
- D. *Does the system adhere to principles of empathy and reciprocity?*

System backing of culture and education

- A. *Does the system promote development of knowledge?*
- B. *Does the system encourage reflection and questioning of habits?*
- C. *Does the system consider local culture and heritage?*
- D. *Does the system help to build a sense of belonging and permanency?*

Products aesthetic properties adequacy

- A. *Do the products of the system have moderate aesthetic properties?*
- B. *Do the products of the system have elegant aesthetic properties?*
- C. *Are the aesthetics of the product of the system congruent with its sustainable meaning?*
- D. *Does the aesthetic of the products of the system facilitate the understanding of its utility?*
- E. *Are the aesthetic properties of the product of the system long-lasting or not ephemeral or transient?*

Personal and societal aesthetic expression

- A. *Does the system promote personal image congruent with sustainable behaviour?*
- B. *Does the system promote personal identity expression?*
- C. *Does the system aesthetic encourage empathy?*
- D. *Does the system promote humble personal expression and societal status?*

Personal aesthetic experience with products

- A. *Does the experience with the products promote subjective well-being for the user?*
- B. *Does the experience with products stimulate one’s interaction with a natural or physical dimension?*
- C. *Does the experience with the products stimulate one’s spiritual dimension and imagination?*
- D. *Does the experience with the products stimulate one’s ethical consciousness and sustainable behaviour?*

Personal Fulfilment

- A. *Do the system and products add to one’s sense of reality, life purpose and achievement?*
- B. *Do the system and products collaborate to inner development and transformation?*
- C. *Do the system and products collaborate to build a sense of belonging and harmony in ourselves in our dealings with others and nature?*
- D. *Are the system and products relevant for life in long term?*

Table 4. Checklist Questions for Subjective Sustainability

SUBJECTIVE SUSTAINABILITY

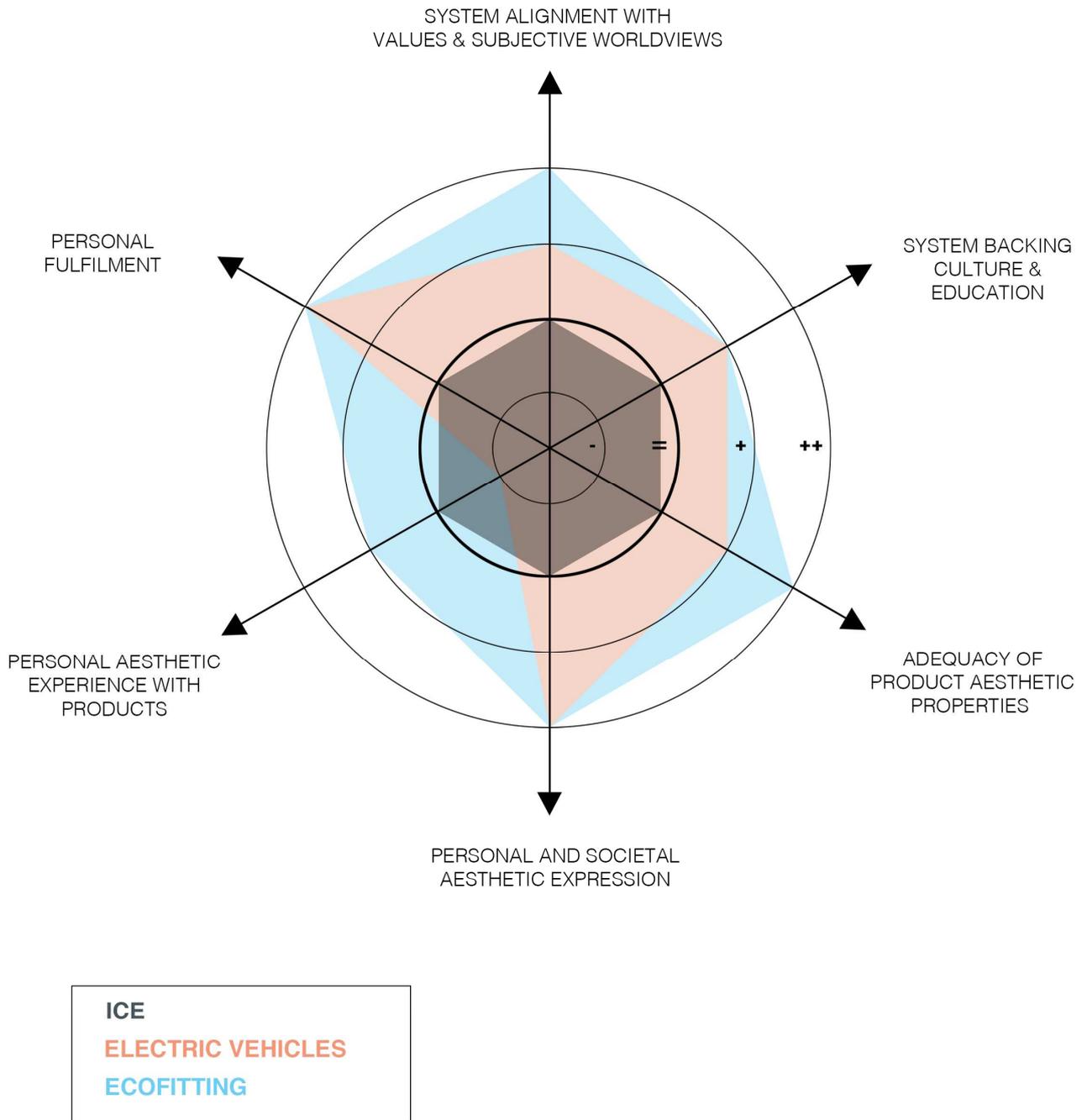


Figure 4. Subjective Sustainability Radar Chart

Summary of results for Subjective Sustainability

In the Subjective Sustainability analysis, Ecofitting has showed better results than mainstream EVs and ICEs on most of the criteria. EVs has matched Ecofitting on three criteria. The results of the analysis can be seen in the following radar chart (figure 4).

While based on existing cars, Ecofitting can respond better to the personal aesthetic experience with products, which has been a historic challenge for EVs. In the other hand, Ecofitting can focus on developing a more radical aesthetic for sustainability, and highly personalised products, using factors less explored by mainstream industry to create desirability. The Subjective Sustainability analysis helps to indicate to which directions Ecofitting shall be developed to be an alternative strategy towards a more sustainable consumption.

An analysis of the automobile, as a system, must also consider in addition to designing, producing and regular use, the activities related to car culture: motorsport, car clubs, touring, those give a different dimension of the subjective worldviews about the automobile as a system. Our relationship to the system, not only to the car as an object, is emotionally driven and related to images of freedom and pleasure. While electrification changes the focus a bit towards rightness and goodness, Ecofitting should be as system based on principles of empathy and reciprocity, more than individuality and lust.

Ecofitting circular economy concept creates a different level of backing culture and education, while decentralising the production and opportunities. This is a space to explore both in technology and aesthetics areas. Ecofitting envisages the insertion of local craftsmanship in the development of electrification.

While Ecofitting is based on the existing ICE fleet, it is expected that those selected to be donor vehicles have an aesthetic value, or an emotional connection with the owner. There is an opportunity to develop an aesthetic which is less mainstream and more aligned to principles of sustainability.

The same diversity which can be identified on EV or ICE cars is expected to Ecofitting. Additionally, Ecofitting can create an alternative to the Aesthetic of Perfection [13]. Aesthetic properties can incorporate aging, rust, imperfections, re-used materials and elements, and upscale. Ecofitting can also incorporate natural materials and local craftsmanship – something that is seen in premium brands like Bentley, but in an authentic and straightforward version.

Progressively, car became a form of personal expression in society. It is expected that the sustainable car will reflect a change to more empathetic, honest, and humble aesthetic expression, which should change the ways car are used, shared, and discarded. Ecofitting shall regard cars as useful tool and culturally valuable objects, instead of instruments of ensuring power and social oppression.

Our aesthetic experience with the cars has been influenced by its symbolic images, the Myths of Speed, Comfort, and Freedom [17]. Although it has been more visceral than reflective, or profound, the awareness of the climate crises is changing people's perception. The electric car is a conscious option, nevertheless, it has struggle to deliver personal aesthetic experience the same way as the ICE cars used to, because people are still tied to symbols and experiences of the past. As context moves, the reign of ICE loses power to EVs, but until that point, Ecofitting can be a solution which will fit better the expectations of many consumer, and car enthusiasts who feel out of place today. Additionally, Ecofitting is protecting objects – which are adored – from becoming redundant.

In the relationship between people and cars, there are values that can collaborate to personal fulfilment and well-being [19]. The climate crisis created a tension between what you love and what you can have. While there is an urgency to be sustainable there are also aspects of people happiness which needs to be considered. A sustainable car will bring people closer to nature, and reduce the social conflicts surrounding car production and use. EVs can be a solution to many. Ecofitting can be an alternative for those who do not have access to new cars, or simply do not want their vehicles to be scrapped.

IV. CONCLUSION

The current context of the automotive industry was analysed from the perspective of environmental, economic, socio-ethical and subjective sustainability, in order to determine how Ecofitting might fit into the current on-changing landscape and serve to improve it.

Aiming a holistic approach, it was considered both tangible and intangible aspects of design, focusing on the deeper meaning and wider shared benefits, instead of financial gain translated in money or carbon credits. It is important to put on the perspective that the costs and benefits considered for the achievement of sustainable targets are now determined by the unsustainable dominant economic model. On the contrary, this analysis was based on an evolved sustainability mindset.

The Sustainable Design Orienting toolkit analysis highlighted Ecofitting's benefits are mainly 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. The analysis point out that Ecofitting industry and products can be a serious competitor for mainstream EVs and ICE vehicles.

From the Subjective Sustainability Dimension there are many ways in which Ecofitting is relevant, which only became clear using the SDO based on a Quadruple Bottom Line of Sustainability. The research highlighted the importance of creating design development tools considering both the tangible and intangible aspects of design.

V. FUTURE RESEARCH

Following the feasibility study of Ecofitting, focus of 2020's CENTS (UKRI) supported project which included explorations design directions, state-of-the-art research, and the quadruple bottom line analysis, the next stage is the development of a digital platform to facilitate the spread of knowledge and information, to connect industry partners to consumers and researchers on circular economy, and for designers to mediate the process of developing Ecofitting vehicles.

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